# 行列のグレースケール画像を用いた BiCG 法の収束予測

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# 第1章 背景・目的

#### 1.1 研究背景

近年,様々な産業分野において,計算機による数値シミュレーションの重要性が高まっている.例えば,構造解析を援用した自動車や橋げたの設計などの機械・建築分野,流体解析を援 用した飛行機のジェットエンジンの設計など幅広い分野で数値シミュレーションが行われ,開 発期間の短縮,コストの削減,製品の高精度化等に大きく寄与している.このような数値シミュ レーションの世界では,多くの問題が偏微分方程式により記述されている.そして,それらは有 限要素法,境界要素法,有限差分法等を用いて離散化され,最終的に大規模な線形方程式

$$Ax = b$$

が得られる (A は n 次行列, x, b は n 次元ベクトル). 数値シミュレーションでは, この方程式を いかに高速かつ低コストで解くかが最も重要な問題とされている.

線形方程式の解法には、大きく分けて直接法と反復法という手法がある. 直接法は Gauss の 消去法に代表され、式変形により未知数の個数を減らして解を求める方法である. 一方で、反 復法では、適当な初期値から計算を開始し、一定の精度が得られるまで反復を繰り返して近似 解を得る方法である. 係数が大規模疎行列のとき、反復法は直接法に比べて演算量、メモリ量 の点で有利であるとされている [2]. 反復法の中でも、クリロフ部分空間法という方法があり、 係数行列が非対称な場合は主に双共役勾配法(以下, BiCG 法)が使われる.

しかし,係数行列の性質によっては,収束が停滞してしまい解を求めるまでに時間が掛かってしまったり,そもそも収束しないといった場合もある.反復計算を実行する以外に解が得られるか否かを判断することは不可能である.

#### 1.2 研究目的

最近, 畳み込みニューラルネットワーク (以下, CNN)[3] を用いて, 画像認識を試みることが 容易になってきている. 行列を画像へと落とし込めば, CNN への入力とすることも可能である. そこで, 既存の行列データを用いて学習を行い, どのような行列ならば BiCG 法で収束するの かを判断できるようにしたい. CNN は画像内の特徴量を抽出し, 抽出したパターンを学習する ことで, 分類や回帰を行う. もし疎行列が非零要素の大小関係と疎のパターンを反映した画像 へと変換されれば, BiCG 法の収束性を予測できるかもしれない.

また, 行列を画像に置き換えることで, 次数や行列が生成された分野などの性質を見ずに画像の濃度値分布のみから BiCG 法の結果を予測できるのではないかと考えた.

本研究では CNN を用いて非対称行列と BiCG 法の収束の関係を判断するため, CNN による 分類に適した行列画像の生成方法を調べる. そこで, SuiteSparse Matrix Collection[1] に格納さ れている非対称で実数を要素に持つ正方行列のうち, 次数の小さいものから 875 件に対して BiCG 法を実行し, 反復回数や相対残差ノルム等のデータを集めた. その後, 複数の手法で行列 画像を生成し, どのような行列画像が分類の結果, 誤答するのかについて調べた.

# 第2章 関連研究

本章ではハイパフォーマンスコンピューティング分野の問題点に対して機械学習の手法を 用いた関連研究を2つほど紹介し、そこに示されている今後の課題や未着手の部分を挙げて本 研究の着眼点について説明する.

#### 疎行列の格納形式における自動選択

多くのアプリケーションにおいて, 疎行列ベクトル積(以下, SpMV)が計算の中核を成す. しかしながら, 様々な行列に SpMV を実行する際, 計算機環境などのプラットフォームやアルゴリズムなどの違いからそのパフォーマンスも様々に変化する.

そこで, Cui らの研究[14] では計算を実行する前に与えられた行列に対して SpMV における 高いパフォーマンスを示すアルゴリズムを予測した.

手法として、SuiteSparse Matrix Collection の行列 450 件を用いて非零要素の位置情報を反映 した 32×32 pixel のグレースケール画像と最適な SpMV が実行できる環境のラベルから構成 されるデータセットを用いて、CNN による分類を行った. CPU、GPU のいずれの上で実行する かという選択肢と疎行列の格納形式から構成される 5 種類の環境に対する分類の結果、54%の 行列に対して最適実装が選択された. 選択された実装を用いて、SpMV の実行時間を計測した ところ、提案手法を用いずにランダムに選択した場合と比較して、19.9%の短縮につながった.

### CNN を利用した効率的な前処理行列の生成

反復計算において,前処理の効率はループ前の前処理行列を生成する過程と各反復過程にお ける前処理行列を用いた計算,両方の並列性に依存する.しかしながら,前処理行列の生成は 骨の折れる作業とされている.

そこで, Gotz らの研究 [11] では前処理行列として生成する block-Jacobi 行列に必要な係数 行列 A の対角成分を切り出した. 行列 A の次数は n = 128 として生成し, 非零要素は対角を中 心として幅 20 の箇所に 0.5 ~ 0.7, その他の部分に 0~0.5 の範囲でランダムに数値を与え, 縦横 をパディングした  $21 \times 128$  pixel のグレースケール画像を入力とした. 図 2.1 は実際の入力画像 である.

そのようにして生成した 3000 個の行列を用いて, CNN から出力される非零要素の構造に基づいて block-Jacobi 前処理行列を適用したところ,反復計算の約 22%が削減された.



図 2.1: 対角成分から切り出した入力画像

Gotz らの先行研究のように、行列を画像として変換し CNN を用いて前処理行列を推定する 研究のほかに、Support Vector Machine を利用し、反復解法と前処理行列の組み合わせを推定し た Muralidharan らの研究 [12] や、前処理行列と疎行列ベクトル積の実装方法を自動選択する 山田らの研究 [13] など、前処理に関する研究が多いことが分かる. しかし、1 つの解法に対して 反復計算が収束するか否かに関する研究はされておらず、その点は本研究の新規性であると言 える. また、グレースケール画像を用いて非零要素の位置情報と値の大小関係を反映した先行 研究は存在しない点やマシンに依存しない収束特性の分析を扱っている点も新規性がある.

# 第3章 基本原理と基礎技術

本章はまず前半部分において, BiCG 法の基本理論を説明する. その後,後半部分においては 画像認識を行う上で使用する CNN の基礎理論を述べる.

### 3.1 BiCG法

BiCG 法は非対称な係数行列を係数に持つ方程式の反復解法である.本節では BiCG 法のア ルゴリズムや性質を [4], [5], [6] を参考に示す.以下が BiCG 法のアルゴリズムである.

- BiCG 法のアルゴリズム -Select an initial guess  $x_0$ , Compute  $r_0 = b - Ax_0$ , *Choose*  $r^*_0$  *s.t.* $(r^*_0, r_0) \neq 0$ , *Set*  $p_0 = r_0$ , For  $k = 0, 1, ..., until \| \boldsymbol{r}_{k} \|_{2} \le \varepsilon \| \boldsymbol{b} \|_{2}$  do:  $q_k = A p_k$ ,  $\boldsymbol{q^*}_{\boldsymbol{k}} = \boldsymbol{A}^T \boldsymbol{p^*}_{\boldsymbol{k}},$  $\alpha_k = \frac{(\boldsymbol{r_k}, \boldsymbol{r^*_k})}{(\boldsymbol{q_k}, \boldsymbol{p^*_k})},$  $\boldsymbol{x_{k+1}} = \boldsymbol{x_k} + \alpha_k \boldsymbol{p_k},$  $\boldsymbol{r_{k+1}} = \boldsymbol{r_k} - \alpha_k \boldsymbol{q_k},$  $\boldsymbol{r^*}_{\boldsymbol{k+1}} = \boldsymbol{r^*}_{\boldsymbol{k}} - \alpha_{\boldsymbol{k}} \boldsymbol{q^*}_{\boldsymbol{k}},$  $\beta_k = \frac{(r^*_{k+1}, r_{k+1})}{(r^*_{k}, r_{k})},$  $p_{k+1} = r_k + \beta_k p_k,$  $p_{k+1}^* = r_{k+1}^* + \beta_k p_k^*,$ End For

BiCG 法は残差ノルム  $\|b - Ax_k\|_2$  や誤差ノルム  $\|x - x_k\|_2$  を最小化するといった性質を持た ないため、各反復で近似解の精度が改善されないことがある. そのため、残差ノルムや誤差ノ ルムをプロットすると振動することがあり、収束が停滞したり、発散することがある.

#### 3.1.1 BiCG 法の性質

- 定理 2.1.1 —

BiCG 法によって計算されるベクトルは $i \neq j$ のとき、次が成り立つ.

 $(\boldsymbol{r_j}^*, \boldsymbol{r_i}) = 0$ 

$$(\boldsymbol{p_j}^*, A\boldsymbol{p_i}) = 0$$

数学的帰納法によりこれを示す.

まず,  $0 \le i < j$  の時について考える. 変数 j の帰納法として示す. (i) j = 1 のとき i = 0 となるから,

$$\begin{aligned} (r_1^*, r_0) &= (r_0^* - \alpha_0 A^T p_0^*, r_0) \\ &= (r_0^*, r_0) - (r_0, \alpha_0 A^T p_0^*) \\ &= (r_0^*, r_0) - \alpha_0 (r_0, A^T p_0^*) \end{aligned}$$
  
ここで,  $r_0 = p_0$  であるから,  
$$\begin{aligned} &= (r_0^*, r_0) - \frac{(r_0^*, r_0)}{(p_0^*, A p_0)} (p_0^*, A p_0) \\ &= 0 \end{aligned}$$

となって直交することが分かる.また,

$$\begin{aligned} (p_1^*, Ap_0) &= (r_1^* + \beta_0 p_0^*, Ap_0) \\ &= (r_1^*, Ap_0) + \frac{(r_1^*, r_1)}{(r_0^*, r_0)} (p_0^*, Ap_0) \\ &= (r_1^*, Ap_0) + \frac{(r_1^*, r_1)}{\alpha_0} \\ &= \frac{1}{\alpha_0} (r_1^*, \alpha_0 Ap_0) + (r_1^*, r_1) \\ &= \frac{1}{\alpha_0} (r_1^*, r_0) \\ &= 0 \end{aligned}$$

となって j = 1 のとき, 2 式ともに直交条件を満たす. 次に  $j \ge 1$  のとき, 定理 2.1.1 が成立すると仮定する.  $0 \le i < j + 1$  とき,

$$(\mathbf{r_{j+1}}^*, \mathbf{r_i}) = (\mathbf{r_j}^* - \alpha_j A^T \mathbf{p_j}^*, \mathbf{r_i})$$
  

$$= (\mathbf{r_j}^*, \mathbf{r_i}) - \alpha_j (A^T \mathbf{p_j}^*, \mathbf{r_i})$$
  

$$= (\mathbf{r_j}^*, \mathbf{r_i}) - \alpha_j (A^T \mathbf{p_j}^*, \mathbf{p_i} - \beta_{i-1} \mathbf{p_{i-1}})$$
  

$$= (\mathbf{r_j}^*, \mathbf{r_i}) - \alpha_j (\mathbf{p_j}^*, A\mathbf{p_i}) + \alpha_j \beta_{i-1} (\mathbf{p_j}^*, A\mathbf{p_{i-1}})$$
  

$$= (\mathbf{r_j}^*, \mathbf{r_i}) - \alpha_j (\mathbf{p_j}^*, A\mathbf{p_i})$$
  

$$= 0 ( 帰納法の仮定より)$$

また,

$$(p_{j+1}^{*}, Ap_{i}) = (r_{j+1}^{*}, Ap_{i}) + \beta_{j}p_{j}^{*}, Ap_{i})$$
  
=  $-\frac{1}{\alpha_{i}}(r_{j+1}^{*}, -\alpha_{i}Ap_{i}) + \beta_{j}(p_{j}^{*}, Ap_{i})$   
=  $-\frac{1}{\alpha_{i}}(r_{j+1}, r_{i+1}^{*}) - (r_{j+1}^{*}, r_{i}) + \beta_{j}(p_{j}^{*}, Ap_{i})$   
= 0 ( 帰納法の仮定より)

となって、定理 2.1.1 が成立する.  $0 \le j < i$  の時も同様である.

~定理 2.1.2 ——

$$r_i \neq 0, r_i^* \neq 0, i \leq n$$
 であれば,  $r_0^*, r_1^*, ..., r_n^*$ は互いに線形独立である.

(証明)

数学的帰納法より, これを示す. **r**\*<sub>0</sub> と **r**\*<sub>1</sub> について考えると, 定理 2.1.1 より,

$$(\mathbf{r}^*_0, \mathbf{r}_1) = 0$$
  
 $(\mathbf{r}^*_1, \mathbf{r}_1) \neq 0$ 

が成立する. ここで,  $r_{0}^{*} \ge r_{1}^{*}$ が線形独立でないならば, 線形従属であり,  $r_{1}^{*} = \alpha r_{0}^{*}$ を満た すスカラー  $\alpha$  が存在する. よって,  $(r_{1}^{*}, r_{1}) = (\alpha r_{0}^{*}, r_{1}^{*}) = 0 \ge \alpha$ って,  $(r_{1}^{*}, r_{1}) \neq 0$ に矛盾する. したがって,  $r_{0}^{*} \ge r_{1}^{*}$ は線形独立である.

次に,  $s \leq i$ に対して,  $\boldsymbol{r}^*_0$ ,  $\boldsymbol{r}^*_1$ , ... ,  $\boldsymbol{r}^*_{n-1}$  が互いに線形独立であると仮定する. 定理 2.1.1 と 仮定から,

$$(r^{*}_{0}, r_{s}) = 0,$$
  
 $(r^{*}_{1}, r_{s}) = 0,$   
 $\vdots$   
 $(r^{*}_{s-1}, r_{s}) = 0,$   
 $(r^{*}_{s}, r_{s}) \neq 0$ 

が成立する.

ここで、 $r_s^*$ が $r_0, r_1, ..., r_{s-1}^*$ と互いに線形独立でないとすると、 $r_s^* = \alpha_0 r_0^* + \alpha_1 r_1^* + ... + \alpha_{s-1} r_{s-1}^*$ を満たすスカラー  $\alpha_0, \alpha_1, ..., \alpha_{s-1}$ が存在する.よって、 $(r_s^*, r_s) = (\alpha_0 r_0^*, r_s) + (\alpha_1 r_1^*, r_s) + (\alpha_{s-1} r_{s-1}^*, r_s) = 0$ となって、 $(r_s^*, r_s) \neq 0$ に矛盾する.したがって、 $r_0^*, r_1^*, ..., r_s^*$ は互いに線形独立である.

~定理 2.1.3 ——

BiCG 法は高々n 回の反復で収束する

(証明)

(n-1)回目まで収束しないと仮定する. このとき,  $r_i \neq 0, i \leq n$  であるため, 定理 2.1.2 より,  $r^*_0, r^*_1, ..., r^*_s$ はそれぞれ線形独立である. よって, $r^*_0, r^*_1, ..., r^*_s$ は  $\mathbb{R}^n$ の基底を成す. こ こで, n反復目の残差ベクトル $r_n$ を考えると, 定理 2.1.2 より  $(r_n, r_i) = 0, i < n$ となるが、そ のようなベクトルは  $r_n = 0$  しかない. よって, BiCG 法は高々n回の反復で収束することが分 かる.

### 3.2 畳み込みニューラルネットワーク

画像認識を行う際には

- 畳み込み層
- プーリング
- 全結合層
- Dropout

から構成されるネットワークを構築する.本節では上記の項目について説明する[7],[8],[9], [10].

#### 3.2.1 畳み込み層



図 3.1: 畳み込み計算のイメージ

畳み込み層で行う処理はフィルター処理に相当する.フィルタ Fの初期値はランダムに決定する. 注目する画素の座標を (x, y), 入力画像を I, 出力画像を  $\tilde{I}$ , 座標 (x, y) における画素値を I(x, y), フィルタの中心を原点として, フィルタ内の座標 (i, j) を F(i, j), 近傍領域の大きさを  $(2N + 1) \times (2N + 1)$ とすると, 畳み込みの計算は次の通りである.

$$\tilde{I}(x,y) = \sum_{j=-N}^{N} \sum_{i=-N}^{N} F(i,j)I(x-i,y-j)$$

上記の図で $\tilde{I}(x,y)$ は、

$$I(x,y) = az + by + cx + dw + ev + fu + gt + hs + ir$$

で算出される. 畳み込み層ではフィルタ F を使い,入力画像 I のエッジ (色が変化する境目) や ブロブ (局所的に塊のある領域) などの特徴を得る. その特徴からフィルター F の重みを学習 する. フィルター F の重みを学習することで,画像の持つ特徴を学習している. 畳み込み層を 何層も重ねると層が深くなるにつれて,最初は単純なエッジに反応し,続いてテクスチャに反 応し,より複雑で抽象化された情報が抽出される.



3.2.2 プーリング層

図 3.2: コーディングとプーリング

まず、プーリングの説明の前に必要となるコーディングについての説明を行う. コーディングは入力データ *x* に対して、

$$\boldsymbol{x} = (x_1, ..., x_D)^T \longmapsto \boldsymbol{c} = \boldsymbol{g}(\boldsymbol{x}) = (g_1(\boldsymbol{x}), ..., g_{D_c}(\boldsymbol{x}))^T$$

に示すように、分類に有利な  $D_c$  ( $\geq D$ ) 次元の高次元への非線形な写像  $g(\cdot)$  を求め、この写像 を用いて特徴 c を求める過程である. コーディング関数  $g(\cdot)$  は畳み込み演算のフィルタを判別的に学習することで推定する. 画像領域から得た複数のコーディング後のベクトルを、その 領域を代表する 1本のベクトルにまとめる操作をプーリングという.

$$v = \zeta(C)$$

ここで, ζ(•) はプーリング関数, C は対象画像領域に含まれるコーディング後の特徴集合である. プーリング後の特徴の次元は, 一般的にコーディングされた特徴の次元と等しくなる. 畳 み込み演算をして得られた特徴をプーリングすることで, 対象画像領域が持つ強い特徴を抽出 しているのがプーリング層である.

プーリングを行う長所として,主に2点が挙げられる.1点目は画像から得られる局所特徴の数が異なっていても,プーリングを行うことによって,同じ次元の特徴ベクトルを得られる点,2点目はプーリングを行う画像領域内の局所特徴の位置情報を考慮しないため,位置不変な特徴を得られることが挙げられる.プーリングの手法には,対象ベクトルの平均値を計算す

る平均値プーリング (average pooling) やベクトルの各要素の最大値を計算する最大値プーリング (max pooling) などがある.本研究では,最大値プーリングを使用しており,以下のような 関数で記述される.

$$v_k = \max\{c_{1k}, c_{2k}, \dots, c_{ik}, \dots, c_{Nk}\}$$

ここで、Nはプーリングする領域に含まれる特徴の数である.

#### 3.2.3 全結合層

全結合層は、ここまでの畳み込み層とプーリング層の特徴を受けて、それを特徴量として結果に反映する.推論の結果、最も確率の高いクラスの値を取り出し、one-hot vector へと変換し、 収束/非収束を予測する.

#### 3.2.4 Dropout



図 3.3: Dropout の概念図

Dropout は、ノードをランダムに消去しながら学習する手法である. 分類器を安定させる手段として、多くの異なるネットワークの予測結果の平均を用いるという方法がある. しかし、膨大な数のパラメータを持つネットワークを複数学習させると、計算にコストが掛かりすぎてしまう. そこで、パラメータの増加を抑えつつ、過学習を抑制する手法として Dropout が使用される. Dropout では訓練データが提示されるたびに中間層のユニットの出力をpの確率で0にする. つまり、訓練データが提示されるたびに異なるネットワーク構造が選択され、学習されることとなる. ただし、ネットワークの重みは共有している. 図 3.3 は Dropout 適用前後のイメージである. N 個のノードを持つとすると、 $2^N$  個のネットワークが可能となる. テスト時には、全てのノードを有効として結合重みは (1-p) 倍する. これにより、 $2^N$  個のネットワーク出力の平均が最終的な出力となるため、汎化誤差の低減に貢献する. 一般的に Dropout は全結合層に適用される.

# 第4章 フレームワークとデータセット

## 4.1 分類モデル生成に使用したフレームワーク

本研究では、ディープラーニングのフレームワークとして、畳み込みニューラルネットワークを構築するのに TensorFlow[15] を利用している. TensorFlow は計算グラフを利用したオープンソースのライブラリであり、Python だけでなく C / C++からも呼び出すことができる. 図4.1 は本研究で使用した CNN の構成である. 図では 28 × 28 pixel での例を示しているが、画像のサイズを大きくした場合でも同様の構造とした. このネットワーク構造は元々LeNet[16] と呼ばれる画像認識では定番とされているネットワークの構造で、[13]、[14] でも同じ構造を使用している. CNN は 2 組みの畳み込み層と Max プーリング層を通して、2 つの全結合層と出力層から構成される. 1 つ目の全結合層の出力は 128、2 つ目の全結合層の出力は 256 とした. 疎行列画像の入力サイズは、画像認識分野の基礎実験である手書きの数字画像の分類実験で使用されている 28×28 pixel から、56×56、112×112、224×224 pixel までの 4 パターンを生成した.



図 4.1: CNN の構成

学習の過程において、バッチサイズは 16 として Epoch 数は最大で 30 回にした. 誤差関数は クロスエントロピー誤差関数, 最適化手法は Adam とした. その他, 学習率は 1.0 × 10<sup>-3</sup> とし て、 Dropout の確率は 25% ととした.

# 4.2 データセットの紹介

本研究では、SuiteSparse Matrix Collection に格納された疎行列データセットを利用する. SuiteSparse Matrix Collection は実際のアプリケーションにおいて生成された今なお発展を続けている疎行列データセットである.また、それぞれの行列が生成された分野も様々である.本研究では非対称で実数を要素に持つ正方行列 982 個中、次数の小さいものから 875 個を用いた. 表 4.1 に 875 個の行列それぞれの分野 (属性名:field) についてまとめた.

使用分野	個数	使用分野	個数
subsequent	100	circuit	0
circuit simulation problem	102	simulation problem sequence	0
computational fluid dynamics	06	computational fluid dynamics	7
problem	90	problem sequence	
chemical process simulation problem	67	counter-example problem	7
economic problem	62	statistical/mathematical problem	6
directed graph	50	model reduction problem	6
circuit simulation problem	46	semiconductor device problem sequence	5
2D/3D problem	39	2D/3D problem sequence	4
directed weighted graph	39	frequency-domain circuit simulation problem	3
eigenvalue/model reduction problem	35	optimization problem sequence	3
subsequent computational fluid dynamics problem	30	optimization problem	3
power network problem	24	robotics problem	3
electromagnetics problem	22	chemical process simulation problem sequence	2
structural problem	18	structural problem sequence	2
semiconductor device problem	16	directed weighted graph sequence	1
materials problem	14	directed weighted random graph	1
subsequent optimization problem	13	computer graphics/vision problem	1
subsequent semiconductor device problem	13	subsequent power network problem	1
directed multigraph	12	linear programming problem	1
combinatorial problem	11	acoustics problem	1
subsequent 2D/3D problem	10	power network problem sequence	1
thermal problem	10		

表 4.1: (	吏用分野	ごとの	行列の数
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### 4.3 非零要素の数値分布

図 4.2 に, 実験に使用した 875 個の疎行列が持つ非零要素の絶対値を取り, 常用対数を取ったものの数値分布を示す. 横軸に非零要素の値, 縦軸にその要素数を示す. 非零要素の総数は 414,314,792 個となっている. これらの値は平均が-3.24, 中央値が-2 で-324 から 28 までの範囲 に分布していることが分かった. また, 全行列の疎度を調べたところ, 0.000006% から 76%の範囲に分布している.



図 4.2: 非零要素の分布

ここで, CAx = Cb として, 方程式の両辺に対角行列を掛けることをスケーリングと呼ぶ. 以降で, スケーリング行列を C と呼ぶ.

$$c_{ii} = \begin{cases} 1 & (a_{ii} = 0) \\ \\ \frac{1}{|a_{ii}|} & (a_{ii} \neq 0) \end{cases}$$

と設定した. *C* を掛けた後の行列 *CA* の対角成分は-1,0,1 のいずれかとなる. *C* を適用した際 の 875 個の行列の非零要素の分布は図 4.3 となった. *C* を掛けても,非零要素の構造は変わら ないため,非零要素の総数は 414,314,792 個であり,絶対値を取り,常用対数を取った非零要素 の分布は-324 から 302 の範囲に分布している. その平均値は-4.5 であり,中央値は-3 である. *C* を掛けて対角要素を1でスケーリングすることで,スカラー倍された複数の行列を1つの同じ 行列として認識できるメリットがある.



図 4.3: スケーリング後の全非零要素の数値分布

### 4.4 BiCG 法の収束・非収束と各種変数

BiCG 法の設定は以下のようにした. まず, 解ベクトル  $x \in x = [1, -1, 1, -1, ..., (-1)^{(n-1)}]^T$ として右辺ベクトルはb = Axで計算した. 初期ベクトルは $x_0 = [0, 0, 0, ..., 0]^T$ とし,  $r^*_0 = r_0$ とした. また, 収束判定の条件として  $||r||_2 \le 10^{-6} ||b||_2$ に設定した. 最大反復回数は行列の次数回までとした.

この条件の下, データセットに含まれる行列 08blocks, ex1 に対して BiCG 法を実行した. 結 果は表 4.2 のようになった. 図 4.4 は BiCG 法の相対残差 2-ノルム (||*r<sub>k</sub>*||<sub>2</sub>/||*b*||<sub>2</sub>) のふるまいを 示す.

A に対する BiCG 法では, 行列 08blocks の相対残差ノルムは行列の次数以下の反復回数で収 束している. 行列 ex1 は行列の次数 217 の反復を経ても収束していない. 行列 ex1 のように, 相 対残差ノルムの減少に次数回以上の反復を要したり, 行列によっては相対残差ノルムが増大し てしまう場合がある.

しかし, C を掛けることによって, いずれの行列も収束性が改善される. 行列 08blocks では 反復回数が 78 回までループを削減することが出来た. また, 行列 ex1 においては C を掛ける ことにより, 収束するようになった.

行列	次数	係数行列	反復回数	相対残差ノルム		
08blocks	100	A	95	2.2E-09		
UODIOCKS	100	CA	78	1.1E-07		
ov 1	217	A	217	2.7E-05		
exI	217	CA	166	8.0E-07		

表 4.2: 行列 08blocks, ex1 に対する BiCG 法の計算結果



図 4.4: 行列 08blocks, ex1 の相対残差履歴

# 第5章 疎行列画像の生成過程

本研究では行列画像の生成手法として、SuiteSparseの一部を変更した方法である SuiteSparse 法とシグモイド関数を利用した sigmoid 法の2種類を用いた. またその際, 実際の数値がグレースケール値へどのように変換されていくのかを具体例を踏まえて説明する.

## 5.1 SuiteSparse 法による行列画像の生成

SuiteSparse Matrix Collection より配布されているソフトウェア SuiteSparse[17] を利用する ことにより行列画像は生成出来る.しかし,この手法は行列画像を分類することを目的とした ものではなく,非零要素の位置と値の大小関係を可視化するためのものであり,カラー画像を生 成するための手法である.図 5.1 は SuiteSparse を利用し,生成した 28×28 pixel の行列 08blocks のカラー画像である.なお, nnz は行列の非零要素数を示す.

名前	n	nnz	非零要素の分布	使用分野
08blocks	300	592	$1 \le val \le 100$	combinatorial problem

表 5.1: 行列 08blocks の持つ特徴



図 5.1: 行列 08blocks のカラー画像

本研究は収束 / 非収束の 2 値分類であるという点, そして RGB の 3 チャンネルを含んだカ ラー画像と比較して, 1 チャンネルしか持たず分類が容易であるという点から入力にはグレー スケール画像を使用した. そのため SuiteSparse の機能を変えて, 生成される画像をグレース ケール画像にした. 以降, この濃度付与法を SuiteSparse 法と呼ぶ. グレースケール値は 0 が黒 で 255 が白にそれぞれ対応している.

はじめに、SuiteSparse 法による行列を画像へと変換する手順を示す. その後, 各ステップにおける変換過程を説明する.

- SuiteSparse 法の手順 —

- 1. A の非零要素に絶対値をとり, 正値とする.
- 2. 行列の次数 n を生成画像のサイズ d で割り, 切り上げる. 得られた数を s とする.
- 3. 行列を *s* × *s* ブロックに分割し, 各ブロックから最大値を取り出して行列を再構成する. その行列を *A*' とする.
- 4. A'の非零要素に対して常用対数をとる.
- 5. 常用対数をとった非零要素の中央値 Me, 標準偏差 σ を求める.
- 6. A'の要素 a'<sub>i,j</sub> に対して 5. で生成した数を式,

$$grayscale = \begin{cases} 255 & (Me + \sigma < \log_{10}(a'_{i,j})) \\ 128 + \lceil 127 \frac{(\log_{10}(a'_{i,j}) - Me}{\sigma} \rceil & (Me - \sigma \le \log_{10}(a'_{i,j}) \le Me + \sigma) \\ 0 & (Me - \sigma > \log_{10}(a'_{i,j})) \end{cases}$$

を用いてグレースケール値へと変換する.

7.1行あたりのブロック数である  $\left\lceil \frac{n}{s} \right\rceil$  が d に満たない場合, 画像を拡大する.

- 1. 行列 08blocks の持つ非零要素の分布を階級幅 1 のヒストグラムで示すと図 5.2 になる. 行列 08blocks の非零要素は全て自然数であるため, 値の分布は変わらない.
- 行列の次数 n を生成する画像のサイズ d で割り, それを切り上げた整数値を求める. 行列 08blocks の次数は, n = 300 で, 画像のサイズを 28 × 28 pixel とした場合, s = 11 となる.
- 3. Aを2.で設定した11×11のブロック28×28個に分割し、各ブロックから最大値を取り出した行列をA'とする.ブロックを構成する際、28番目のブロックからはみ出した部分は0で埋め合わせて最大値を取り出す.今回の場合、A'の次数は28となり非零要素数は82個となる.図5.3は行列A'の非零要素値の分布を階級幅1,1刻みのヒストグラムで示している.
- A'の非零要素に対し、常用対数を取る. その際の 08blocks の非零要素の数値分布は図 5.4 のようになる. 1 に対数を取った結果、0 になった値を含めている. このヒストグラムの 階級幅は 0.1 刻みで示している.



5. MATLAB の関数にならい, A' の非零要素を nonzeros(A') として表現する. まず, nonzeros(A') に対して常用対数をとった数値の中央値と標準偏差を求める. 行列 08blocks の場合, こ れらの値はそれぞれ

 $Me(\log_{10}(nonzeros(A'))) = 0, \sigma(\log_{10}(nonzeros(A'))) = 0.9759$ 

である.

6. 行列 08blocks の非零要素に対しては,2 番目の条件から,

 $-0.9759 \le \log_{10}(val) \le 0.9759$  **J J**,

$$0.1057 \le val \le 9.460$$

の範囲に対して,1から254までの濃度値を付与する.例えば,1の場合,行列画像08blocksの濃度値として,以下のように128が割り当てられる.

$$128 + \lceil 127 \frac{\log_{10}(1) - Me}{\sigma} \rceil = 128$$

となる. 図 5.3 より,  $0.1057 \le val \le 9.460$  の範囲に存在する非零要素は 1 だけであり, それ以外の要素は 9.460 よりも大きな値であるため, 1 以外の非零要素には濃度 255 が割 り振られる. 行列 08blocks を画像に変換した際の非零要素に対する濃度値分布を図 5.5 に示す.

7. 行列の次数が小さい場合, 画像を拡大する必要がある. 拡大の際に画像の品質が損なわ れないよう bicubic 補間を利用している.



図 5.5: SuiteSparse 法で生成した行列画像の濃度値分布

元々の行列のサイズが n = 300 であったときに, 非零要素の値の種類は全部で 64 種類であったにも関わらず, これらすべての値が 128, 255 へと濃度値が振られており, SuiteSparse 法による濃度の付与方法は行列内での非零要素の大小関係を細かに反映した方法ではないことが分かる. 画像のサイズを大きくして生成した場合でも同様の現象が確認された. この問題を解決すべく, 本研究では sigmoid 法という新たな濃度値付与方法を試みた. 次節では sigmoid 法による濃度の付与方法について説明していく.

# 5.2 sigmoid 法による行列画像の生成

SuiteSparse 法では、非零要素の大小関係を細かくグレースケール値に反映出来ていないことが分かった.この問題を解決すべく、本節では sigmoid 法を導入する. sigmoid 関数

$$sigmoid(x) = \frac{1}{1 + \exp(-x)}$$

は図 5.6の形状をしており, 値を0から1の範囲へ連続的に変換が出来る. そこで, 非零要素を sigmoid 関数で標準化したのち, 255を掛けて非零要素をグレースケール値へと変換する.



図 5.6: sigmoid 関数の概形

なお本研究では, sigmoid 関数の定義域は全ての実数としている. 以下に sigmoid 法における 行列画像の生成過程を示す.

✓ sigmoid 法の手順 —

- 1. Aの持つ負の非零要素に絶対値をとり、正とする.
- 2. 行列の次数 n を生成画像のサイズ d で割り, 切り上げる. 得られた数を s とする.
- 3. 行列を *s* × *s* ブロックに分割し, 各ブロックから最大値を取り出して行列を再構成する. その行列を *A*' とする.
- 4. A'の非零要素に対して常用対数をとる.
- 5. 常用対数を取った非零要素の平均値 μ,標準偏差 σ を算出する.
- 6.  $\boldsymbol{u} = \log_{10}(nonzeros(A'))$ と置いて、

$$u_i = \frac{u_i - \mu}{\sigma}$$

で標準化する.

- 7. 6. で標準化した値を sigmoid 関数を用いて 0 から 1 までの範囲に収め, 255 を掛けた 数値の切り捨てを算出し, グレースケール値へと変換する.
- 8.1行あたりのブロック数  $\lceil \frac{n}{s} \rceil$  が d に満たない場合, 画像を拡大する.

5. までのステップは SuiteSparse 法と同様であるため 6. 以降のステップから説明をする.

6. A'の非零要素をを標準化する. 平均値は  $\mu$ =0.8353, 標準偏差は  $\sigma$ =0.9759 である. u = nonzeros(A') と置いて, 標準化後の A'の非零要素の分布は図 5.7 のようになる. なお図 5.7 では階級幅を 0.1 としている.





図 5.7: 標準化した 08blocks の非零要素 図 5.8: sigmo

図 5.8: sigmoid 法で生成した行列画像の濃 度値分布

例えばこの場合,非零要素の値が1であったら,標準化後の値は

$$u_i = \frac{\log_{10}(1) - 0.8353}{0.9759} = -0.8559 \tag{\sharp}$$

となる.

 7. 6. で標準化した非零要素に対して sigmoid 関数を適用し, 255 を掛けたのちにその切り捨て を求める. その時の値がグレースケール値となる. 図 5.8 は 08blocks をグレースケール 値へと変換したときの非零要素の分布である. (♯) で算出した値を sigmoid 関数へ代入し, 255 を掛けることで, 08blocks の非零要素 1 は

$$floor(255 * \frac{1}{1 + exp(-(-0.8559))}) = 76$$

濃度値 76 へと変換される.

8. 行列の次数が小さく,入力サイズに満たない場合,画像を拡大する. 拡大には bicubic 補間を 利用している.

図 5.9 は SuiteSparse 法, 図 5.10 は sigmoid 法により生成した 28 × 28 pixel の 08blocks の行列画 像となる. 両者を比較しても, 特徴画像に変化はないように見える. しかし, 非零要素に対して 使用される濃度値の種類は SuiteSparse 法では 128 と 255 の 2 種類であったのに対して, 図 5.8 より, sigmoid 法では濃度値 76, 166, 185, 191, 193, 194, 195 の 7 種類まで増加し, SuiteSparse 法と比較しても非零要素の大小関係を保持しつつ, グレースケール値へと変換できていること が分かる.



図 5.9: SuiteSparse 法で生成した 08blocks の行列画像

図 5.10: sigmoid 法で生成した 08blocksの行列画像

図 5.11: 生成方法の違いによる 濃度値差分

図 5.11 は SuiteSparse 法で生成した行列画像から sigmoid 法で生成した行列画像の濃度値の 差分を取ったものである. SuiteSparse 法で生成した 08blocks の対角以外の要素には 255 だけ が割り振られていた.しかし, sigmoid 法で生成した画像と差分をとることで濃度値分布が変 化しており, 濃度値の割り振りが細やかになった.次に 875 個の疎行列の非零要素に割り当て られた濃度値のヒストグラムを示す.



図 5.12: SuiteSparse 法で生成した 28×28 pixel 図 5.13: sigmoid 法で生成した 28×28 pixel の全非零要素の濃度値分布 の全非零要素の濃度値分布

図 5.12, 図 5.13 のヒストグラムは 28×28 pixel の行列画像に対する結果である. 表 5.2 に各画 像サイズ毎の全非零要素の濃度値分布が持つ平均と標準偏差を示す. SuiteSparse 法では平均値 は 136.7,標準偏差は 81.03 となった. 一方で sigmoid 法では平均値は 135.0,標準偏差は 47.73 となった. 図 5.12 より, SuiteSparse 法による濃度付与は 08blocks 以外の行列に対しても 1, 128, 255 周辺の値に濃度値を割り振ることが多い様子が分かる. また,標準偏差も SuiteSparse 法の 方が大きいという点から,非零要素の大小関係を大まかに表現する点が SuiteSparse 法の特徴 だといえる.

一方で, sigmoid 法では濃度値が 50 から 200 の範囲に多く分布しており, この範囲の数値を

使って非零要素の大小関係を表現しているという点から, sigmoid 法は SuiteSparse 法よりも細かくグレースケール値を割り振り,大小関係を綿密に表現している点が特徴だと言える.

Method		28×28	56×56	112×112	224×224
Suite	平均	136.74	144.56	149.18	155.49
Sparse	標準偏差	81.034	79.197	82.553	84.825
sigmoid	平均	134.997	136.627	138.326	140.344
	標準偏差	47.740	45.759	46.958	47.885

表 5.2: 非零要素の濃度分布に対する平均と標準偏差

### 5.3 スケーリング後の行列画像

本節では、行列 *C* を掛けた変化について説明する. 図 5.14 は行列 08blocks に *C* を掛けた後の非零要素の分布である. なお階級幅は 0.01 としている. 図 5.2 より、行列 08blocks の非零要素は  $1 \le val \le 100$  の範囲に分布していた. しかし、*C* を掛けてスケーリングすることで、対角成分は全て 1 となり、数値分布は 0.0220  $\le val \le 1.10$  の範囲になった.



図 5.14: スケーリング後の非零要素の分布

入力画像は図 5.15 のようになる. また図 5.17 は 28×28 pixel におけるヒストグラムである. 非零要素のグレースケール値の分布範囲は 1 から 211 の範囲に分布するようになった. 図 5.5 の結果では 128, 255 の 2 種類の濃度値しか付与されていなかったが, 非零要素をスケーリング した結果, 行列画像に使用される濃度値は計 10 種類まで増加した. このように *C* を掛けるこ とで BiCG 法の収束性を改善できるだけでなく、より鮮明に非零要素の大小をグレースケール 値に反映出来る. 同様に、C によるスケーリングの後に sigmoid 法を用いて生成した 08blocks の行列画像は図 5.16 である. こちらでも濃度付与に使われたグレースケール値の種類は 10 種 類である. 図 5.16 のヒストグラムが図 5.18 である.



図 5.15: SuiteSparse 法で生成した 08blocks

表 5.3: スケーリング後に SuiteSparse 法 表 で生成した行列画像の特徴 で

n	nnz	非零要素の分布
28	82	$1 \leq grayscale \leq 211$



図 5.17: スケーリング後 SuiteSparse 法で 生成した行列画像の濃度値分布



図 5.16: sigmoid 法で生成した 08blocks

表 5.4: スケーリング後に sigmoid 法 で生成した行列画像の特徴

n	nnz	非零要素の分布
28	81	$1 \leq grayscale \leq 172$



図 5.18: スケーリング後 sigmoid 法で 生成した行列画像の濃度値分布

図 5.18 では、非零要素に対する濃度値が  $1 \le val \le 172$  の範囲で SuiteSparse 法で生成した 場合と同様に 10 種類の濃度値が付与されている. しかし、SuiteSparse 法で生成した場合と比 べて、1 つの非零要素 (値:28) が画像に反映されていない. sigmoid 法で濃度値を生成した場合、 sigmoid 関数の出力値と 255 の積を取った後に切り捨てをしているため,0 になった非零要素 がグレースケール値に反映されないことがある.

以上,使用される濃度値の種類から,スケーリングした行列に対して sigmoid 法で濃度を付与しても使用されるグレースケール値の種類に大きな変化が見られなかった.最後に,Cを掛けた場合の 875 個の行列に対するグレースケール値の分布は以下のようになっている.



図 5.19: スケーリング後 SuiteSparse 法で生成 図 5.20: スケーリング後 sigmoid 法で生成 した 28×28 pixel の全非零要素の濃度値分布 した 28×28 pixel の全非零要素の濃度値分布

上記のヒストグラムも先程と同様に、28×28 pixel の行列画像に対する結果である. また, 各 画像サイズのヒストグラムにおける平均と標準偏差を表 5.5 に示す. 前節のスケーリング前の 28×28 pixel の結果 (SuiteSparse 法: 平均 136.7, 標準偏差 81.03 sigmoid 法: 平均 135.0, 標準偏 差 47.73) と比較して SuiteSparse 法, sigmoid 法ともに若干分布が狭まった. SuiteSparse 法の分 布が狭まった点から, 1 や 255 等のグレースケール値を割り振る大雑把な濃度値を付与してい た SuiteSparse 法がその他のグレースケール値を割り振るようになったと言える. しかし, 2 つ のヒストグラムから, *C* によるスケーリングを実行後も分布の概形は大きく変わらなかった. 図 5.21 と 5.22 に 28×28 pixel における 875 個の行列に使われた濃度値分布の累積を示す. こ れは画像サイズを変えた際にも共通している特徴である.

Method		$28 \times 28$	56×56	112×112	224×224
Suite	平均	136.57	138.53	151.11	150.48
Sparse	標準偏差	79.348	80.258	80.290	86.488
sigmoid	平均	135.15	136.91	138.70	140.81
	標準偏差	47.155	46.076	47.427	48.207

表 5.5: 対角をスケーリングした非零要素の濃度分布に対する平均と標準偏差



図 5.21: SuiteSparse 法の濃度値の累積分布

図 5.22: sigmoid 法の濃度値の累積分布

次章ではここまでに説明した方法で生成した行列画像の分類を行った結果を示す.

# 第6章 実験と評価

## 6.1 K-fold 交差検証とモデルの評価方法

本研究では、分類モデルの評価の際に K-fold 交差検証を使用した. K-fold 交差検証とは、標本群を k 個に分割した後、そのうちの1つのクラスをテストとして残りの k – 1 個のクラスを 用いて訓練を行い、全てのクラスをテストとして実験を終了した後、k 個の正答率 (Accuracy) の平均値 (Average accuracy)を求めて結果とする方法である. K-fold 交差検証のメリットとし て、全てのデータを用いて検証を行うため、過学習やデータの偏りを防ぐことが出来るという 利点がある.



図 6.1: K-fold 交差検証の計算手順

本研究では, k = 5 として実験をした. また, テストデータの分類結果は, 表 6.1 のいずれか に対応する. 表 6.1 は Confusion Matrix と呼ばれており, 分類問題における評価の際に使用さ れる. 本研究において, TN (True Negative) は非収束行列を非収束と予測できた数, FN (False Negative) は非収束行列に対して, 収束と予測した数, FP (False Positive) は収束する行列に非収 束と予測した数, TP (True Positive) は収束する行列に対して収束と予測できた数を表す.

表 6.1: 実測と予測に対する Confusion Matrix

	Prediction label						
Truo		Not convergence	Convergence				
label	Not convergence	TN	FN				
label	Convergence	FP	TP				

本システムの評価には、以下の指標 Accuracy を利用した.

$$Accuracy = \frac{TN + TP}{TN + FN + FP + TP}$$

TN+FN+FP+TP はグループ全体のデータ数に等しい. 分割した 5 グループに対して, それぞれ Accuracy を求め, その平均である Average accuracy を算出し, 評価指標とする. また, 分類問題 におけるその他の評価指標としては, F 値と呼ばれる,

$$F = \frac{TP}{TP + \frac{1}{2}(FN + FP)}$$

という指標がある.これは収束/非収束の両方の誤検知の割合の調和平均を取った指標である.

### 6.2 データセットの構成

875 個の行列に対し, BiCG 法の収束 / 非収束は表 6.2 のようになった.

#### 表 6.2: BiCG 法に対する収束/非収束 の行列の数

	収束	非収束	合計
A	235	640	875
CA	289	586	875

表 6.2 より, *C* を掛けてスケーリングすることで 54 個の行列が収束するようになった. 表 6.2 の行列セットを用いて 3 種類のデータセット F, G, H を用意した. それぞれのデータセット の作り方について説明する.

- 1. A で収束する行列 235 個を 1~5 の 5 グループに分割する.
- 2. 残りの行列の中から CA のみで収束する 54 個の行列を 1~5 の 5 グループに分割する.
- 3. 残った A でも CA でも収束しない 586 個の行列を 1~5 の 5 グループに分割する.
- 4. 2., 3. で 5 分割した各グループから 47 個を選び, 1. の行列と合わせて 470 個の行列から 構成されるデータセット F とする.

データセット G, H は 875 個の行列全てを使用して構成したため, 内容は完全に一致している. しかし, データセット G では A の収束結果, データセット H では CA の収束結果に基づいて いるため, 収束 / 非収束の内訳が異なっている. また, F, G を構成する 5 つのグループを  $F_i, G_i$  $(1 \le i \le 5)$  とする.  $F_i$  は  $G_i$  の部分集合として,  $F_i \subseteq G_i$  となっている. 5 グループの構成は巻 末の付録に示す.

### 6.3 SuiteSparse 法を利用した分類結果

まず、 収束 / 非収束のデータ数が等しい F とデータセット全件を使用した G の Accuracy を 表 6.3 に示す.

size	Dotocot	1	2	3	4	5	Average
(pixel)	Dataset	(%)	(%)	(%)	(%)	(%)	(%)
28×28	F	84.0	77.7	80.9	83.0	74.5	80.0
20×20	G	84.6	86.3	86.3	89.7	83.4	86.1
56.56	F	79.8	78.7	79.8	83.0	73.4	78.9
30×30	G	85.1	82.3	85.1	87.4	84.5	84.9
112~112	F	78.8	80.9	77.7	83.0	78.7	79.8
112×112	G	79.4	79.4	84.0	86.3	80.6	81.9
224,2224	F	76.6	85.1	75.5	80.8	76.6	78.9
224 × 224	G	82.8	78.9	85.7	84.0	78.9	82.1

表 6.3: SuiteSparse 法で生成した画像から構成される FとGの Accuracy

表 6.3 より, 画像サイズを大きくするにつれて Average accuracy が減少しており, Average accuracy は 28×28 pixel の場合に最大となっている. また全てのケースでデータセット G の方 が Average accuracy が高くなっている. この点から非収束クラスが収束クラスの2~3 倍程度の データセットにおいては, 各クラスの要素数を揃えるよりも多くの行列のパターンを学習した 方が効果的であると言える. ここで, SuiteSparse 法の Average accuracy が最も高かった 28×28 pixel での各グループの分類結果の内訳を示す. またカッコ内は収束 / 非収束行列の検出率を 示す.

表 6.4: SuiteSparse 法で生成したデータ セット F における分類の内訳

	1	2	3	4	5	計
	(%)	(%)	(%)	(%)	(%)	(%)
TN	42	37	39	36	33	187
110	(89.3)	(78.7)	(82.9)	(76.5)	(70.2)	(79.5)
FN	10	11	10	5	10	46
FP	5	10	8	11	14	48
тр	37	36	37	42	37	189
11	(78.7)	(76.5)	(78.7)	(89.3)	(78.7)	(80.4)
計	94	94	94	94	94	470

表 6.5: SuiteSparse 法で生成したデータ セット G における分類の内訳

	1	2	3	4	5	計
	(%)	(%)	(%)	(%)	(%)	(%)
TN	116	114	122	116	113	581
111	(90.6)	(89.0)	(69.7)	(90.6)	(64.5)	(90.7)
FN	15	10	18	6	14	63
FP	12	14	6	12	15	59
тр	32	37	29	41	33	172
IF	(68.0)	(78.7)	(61.7)	(87.2)	(70.2)	(73.1)
計	175	175	175	175	175	875

表 6.4 では、TN の割合と TP の割合がいずれもおおよそ 8 割となっている. 一方で表 6.5 で は、TN の割合が 11.2%上昇し、逆に TP の割合は 7.3%減少した. これらの結果から非収束行列 のデータの方が多いと、TN の割合は上昇するが、TP の割合が減少してしまうことが分かった. 結果として、Accuracy は上昇しているものの収束する行列の検出率が下がってしまう点が課題 である. ここで、データセット F と G 両方で誤答した行列全 57 件を表 6.6 に示す.

#### 表 6.6: SuiteSparse 法で生成しデータセット FとG で誤答した行列

行列名	分野	相対残差ノルム
adder_dcop_24	subsequent circuit simulation problem	8.85E-05
adder_dcop_49	subsequent circuit simulation problem	1.23E-05
Baumann	2D/3D problem	8.6E+05
dw8192	electromagnetics problem	1.4E-01
epb3	thermal problem	2.7E-05
ex19	computational fluid dynamics problem	3.1E-05
ex27	computational fluid dynamics problem	3.4E-04
fpga_dcop_22	subsequent circuit simulation problem	1.1E-06
fs_183_1	2D/3D problem sequence	5.92E-06
goodwin	computational fluid dynamics problem	3.4E+01
gre_1107	directed weighted graph	1.0E+04
mark3jac020sc	economic problem	3.7E+06
pores_1	computational fluid dynamics problem	2.2E-03
raefsky3	structural problem	2.4E-04
raefsky6	structural problem	1.1E-05
rbsb480	robotics problem	1.6E+01
transient	circuit simulation problem	1.5E+00
utm5940	electromagnetics problem	1.5E-03
venkat50	subsequent computational fluid dynamics problem	4.9E-01
08blocks	combinatorial problem	8.24E-12
adder_dcop_25	subsequent circuit simulation problem	4.20E-07
adder_dcop_34	subsequent circuit simulation problem	5.32E-08
airfoil_2d	computational fluid dynamics problem	9.89E-11
ASIC_320ks	circuit simulation problem	9.56E-11
bwm2000	chemical process simulation problem	4.72E-11
cage3	directed weighted graph	1.56E-15
cage4	directed weighted graph	4.04E-18
cage5	directed weighted graph	1.07E-11
cavity01	subsequent computational fluid dynamics problem	8.36E-11
circuit_2	circuit simulation problem	7.49E-11
CoupCons3D	structural problem	9.82E-11
coupled	circuit simulation problem	8.75E-11
cz148	2D/3D problem	9.01E-11
dc2	subsequent circuit simulation problem	7.51E-11
ex18	computational fluid dynamics problem	2.84E-07
ex31	computational fluid dynamics problem	8.53E-11
fs_183_4	subsequent 2D/3D problem	2.22E-07
fs_680_1	subsequent 2D/3D problem	8.19E-11
ibm32	directed graph	2.87E-08
language	directed weighted graph	1.35E-11
LeGresley_2508	power network problem	9.02E-11
lop163	statistical/mathematical problem	6.86E-08
mult_dcop_01	circuit simulation problem sequence	9.99E-11
n3c6-b1	combinatorial problem	3.17E-11
orsreg_1	computational fluid dynamics problem	5.14E-11
Pd	counter-example problem	7.27E-11
pivtol	statistical/mathematical problem	7.86E-11
poisson2D	computational fluid dynamics problem	8.55E-11
poli	economic problem	3.13E-11
poli3	economic problem	7.80E-11
steam2	computational fluid dynamics problem	7.78E-11
tols340	computational fluid dynamics problem	2.91E-08
tols90	computational fluid dynamics problem	6.40E-11
tomography	computer graphics/vision problem	8.78E-11
torso2	2D/3D problem	4.30E-11
venkat01	computational fluid dynamics problem sequence	9.38E-11
wang4	semiconductor device problem	5.07E-11
L ~	*	

表 6.6 より, 反復停止時の相対残差ノルムを見ると, 非収束行列では収束条件である 1.0×10<sup>-6</sup> にあと少しで届きそうな行列が多いことが分かった.次節では, 同様の比較を sigmoid 法を用 いた場合で行い, SuiteSparse 法での結果とどのように違っているかを考察していく.

# 6.4 sigmoid 法を利用した分類結果

同様に収束/非収束のデータ数が等しい F とデータセット全件を使用した G の Accuracy を 表 6.7 に示す.

size	Detecat	1	2	3	4	5	Average
(pixel)	Dataset	(%)	(%)	(%)	(%)	(%)	(%)
28×28	F	86.1	88.2	79.7	79.7	89.7	82.7
20×20	G	85.1	84.0	85.7	83.4	82.3	84.1
56,56	F	74.4	76.6	79.8	81.9	75.5	77.6
50×50	G	84.6	81.7	83.4	86.3	80.6	83.3
112×112	F	81.9	85.1	83.0	79.7	76.6	81.2
112×112	G	80.6	77.7	86.3	88.0	80.6	82.6
224,2224	F	75.5	76.5	74.4	86.1	72.3	77.0
224 × 224	G	80.6	78.2	84.6	76.6	76.6	79.3

表 6.7: sigmoid 法で生成した画像から構成される FとGの Accuracy

表 6.7 でも、SuiteSparse 法の場合と同様の傾向がみられる. 画像サイズを大きくするにつれ て、全体的に Average accuracy が減少しており、Average accuracy の最大値は 28×28 pixel のと きとなっている. また、データセット G の方が Average accuracy は常に大きくなっており、こ の 2 つの性質は画像の生成方法によらないといえる. 前節の SuiteSparse 法の結果と比較して も、accuracy に大きな変化は見られない. ここで、sigmoid 法で Average accuracy が最も高かっ た 28×28 pixel における各グループの分類結果の内訳を表 6.8 と表 6.9 に示す.

表 6.8: sigmoid 法で生成したデータ セット F における分類の内訳

	1	2	3	4	5	計
	(%)	(%)	(%)	(%)	(%)	(%)
TN	44	46	33	30	36	189
	(93.6)	(97.8)	(70.2)	(63.8)	(76.5)	(80.4)
FN	10	10	5	2	8	35
FP	3	1	14	17	11	46
тр	37	37	42	45	39	200
11	(78.7)	(78.7)	(89.3)	(95.7)	(82.9)	(85.1)
計	94	94	94	94	94	470

表 6.9: sigmoid 法で生成したデータ セット G における分類結果の内訳

	1	2	3	4	5	計
	(%)	(%)	(%)	(%)	(%)	(%)
TN	118	115	121	104	113	571
	(92.1)	(89.8)	(94.5)	(81.2)	(88.2)	(89.2)
FN	16	15	18	5	16	70
FP	10	13	7	24	15	69
тр	31	32	29	42	31	165
11	(65.9)	(68.0)	(61.7)	(89.3)	(65.9)	(70.2)
計	175	175	175	175	175	875

SuiteSparse 法の場合, 収束/非収束の行列の数を一緒にした際, TN と TP の割合はいずれも 8 割であったが, 表 6.8 では, TP の比率が 4.6% ほど上昇している. しかし, 非収束行列の数を増 やした場合の結果表 6.9 では, TP の比率が 14.2%下がっており, 非収束行列の多いデータセッ トにおいて間違いやすい行列は収束する行列であることが分かる. グループ毎の accuracy の 高さも SuiteSparse 法における結果と傾向が似ており, 例えばグループ4の TP の割合が高い点 などから, SuiteSparse 法でも sigmoid 法でも分類の結果は類似すると言える. 次にデータセッ ト F でも G でも誤答した行列全 55 個のリストを表 6.10 に示す.

表 6.10: sigmoid 法で生成しデー	タセット	FとG	で誤答した行列
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行列名	分野	相対残差ノルム
adder_dcop_49	subsequent circuit simulation problem	1.23E-05
ASIC_100k	circuit simulation problem	5.4E+00
Baumann	2D/3D problem	8.6E+05
cell1	directed weighted graph	1.65E+02
dw8192	electromagnetics problem	1.4E-01
epb3	thermal problem	2.7E-05
ex19	computational fluid dynamics problem	3.1E-05
ex23	computational fluid dynamics problem	6.0E-04
ex27	computational fluid dynamics problem	3.4E-04
fpga_dcop_22	subsequent circuit simulation problem	1.1E-06
fs_183_1	2D/3D problem sequence	5.92E-06
goodwin	computational fluid dynamics problem	3.4E+01
graham1	computational fluid dynamics problem	8.7E-01
nnc666	2D/3D problem	2.0E-03
pores_1	computational fluid dynamics problem	2.2E-03
pores_2	computational fluid dynamics problem	9.1E-01
raefsky3	structural problem	2.4E-04
Tina_DisCal	directed graph	5.5E+08
transient	circuit simulation problem	1.5E+00
utm5940	electromagnetics problem	1.5E-03
venkat50	subsequent computational fluid dynamics problem	4.9E-01
08blocks	combinatorial problem	8.24E-12
adder_dcop_19	subsequent circuit simulation problem	9.41E-07
adder_dcop_21	subsequent circuit simulation problem	1.28E-07
adder_dcop_25	subsequent circuit simulation problem	4.20E-07
airfoil_2d	computational fluid dynamics problem	9.89E-11
ASIC_320k	circuit simulation problem	8.15E-11
ASIC_320ks	circuit simulation problem	9.56E-11
circuit_1	circuit simulation problem	5.41E-11
coupled	circuit simulation problem	8.75E-11
dc2	subsequent circuit simulation problem	7.51E-11
epb2	thermal problem	6.54E-11
fs_541_1	2D/3D problem sequence	5.07E-11
ibm32	directed graph	2.87E-08
Kaufhold	counter-example problem	7.54E-08
LeGresley_2508	power network problem	9.02E-11
lop163	statistical/mathematical problem	6.86E-08
ML_Laplace	structural problem	8.89E-11
mult_dcop_01	circuit simulation problem sequence	9.99E-11
n3c6-b1	combinatorial problem	3.17E-11
orsirr_1	computational fluid dynamics problem	1.14E-09
orsirr_2	computational fluid dynamics problem	7.54E-10
poli	economic problem	3.13E-11
poli_large	economic problem	6.29E-11
poli3	economic problem	7.80E-11
rajat03	circuit simulation problem	8.17E-11
rgg010	counter-example problem	1.02E-14
sherman3	computational fluid dynamics problem	8.38E-11
Tina_DisCog	directed graph	1.28E-11
tols340	computational fluid dynamics problem	2.91E-08
tols90	computational fluid dynamics problem	6.40E-11
tomography	computer graphics/vision problem	8.78E-11
utm3060	electromagnetics problem	3.34E-07
venkat01	computational fluid dynamics problem sequence	9.38E-11
wang4	semiconductor device problem	4.77E-11
<u> </u>	*	

表 6.10 を見てみると, 表 6.6 の SuiteSparse 法で生成したデータセット F と G のいずれでも 間違えた行列と重複している行列が非収束の行列 14 個と収束する行列 18 個の計 32 個ある. このことから, SuiteSparse 法でも sigmoid 法でも正答 / 誤答する行列の傾向はおおよそ類似し ていることが分かった.

### 6.5 スケーリング後の分類結果

#### 6.5.1 SuiteSparse 法

次に、非零要素値を変えることなくデータセットの行列全てを使用したデータセットGと、 対角をスケーリングし画像を生成したデータセットHにおける結果の比較を行う. 表 6.11 に データセットG,Hの5-fold 交差検証の結果を示す.GとHで各グループを構成する行列は同 じだが、54 個の行列の収束 / 非収束のラベルは異なっている. また、前節との結果比較のため、 表 6.12 には 28×28 pixel の内訳を示している.

表 6.11: SuiteSparse 法で生成した G と H 表 6.12: スケーリング後に SuiteSparse 法の Accuracy で生成した H における分類結果の内訳

size	Dotocat	1	2	3	4	5	Average
(pixel)	Dataset	(%)	(%)	(%)	(%)	(%)	(%)
28,228	G	84.6	86.3	86.3	89.7	83.4	86.1
20×20	Н	84.0	84.0	81.1	88.6	82.3	84.0
56.56	G	85.1	82.3	85.1	87.4	84.5	84.9
30×30	Н	87.4	84.0	84.6	85.1	85.1	85.3
112 112	G	79.4	79.4	84.0	86.3	80.6	81.9
112×112	Н	85.7	80.0	82.3	86.9	84.6	83.9
224~224	G	82.8	78.9	85.7	84.0	78.9	82.1
224×224	н	80.6	81.7	81.7	85.1	88.0	83.4

	1	2	3	4	5	計
	(%)	(%)	(%)	(%)	(%)	(%)
TN	98	105	100	105	98	506
	(83.7)	(88.9)	(85.4)	(89.7)	(83.7)	(86.3)
FN	9	15	16	8	12	60
FP	19	13	17	12	19	80
ТР	49	42	42	50	46	229
	(84.4)	(73.6)	(72.4)	(86.2)	(79.3)	(79.2)
計	175	175	175	175	175	875

表 6.11 より, 先程とは少し違い, データセット H では 56×56 pixel の時に Average accuracy が最大となった. しかし, 画像サイズを大きくするにつれて Average accuracy が減少していく様子はスケーリング前の分類と共通している.

次に,表6.12の結果を見ると,収束する行列が54個増えたことにより,データセットGの結果である表6.5よりTNの割合が4.4%減少し,TPの割合が6.1%増加した.そこで,どのような行列が正答するようになったのか,あるいはスケーリングしても誤答してしまうのかを調べた.スケーリングを実行しても誤答してしまった行列を表6.13に,TPの比率が上昇したことから,元々は誤答であったがCを掛けることで正答するようになった収束行列を表6.14に示す.

表 6.13 では, 表 6.6 と重複して誤答していた行列が非収束の行列 6 個と, 収束する行列 14 個 の計 20 個となった. 表 6.13 には収束する行列が計 19 個であり, これらの行列 19 個中 14 個が スケーリング前でも誤答していたことが分かった. また, これらの行列の中でも ex, mark3jac 系統の行列が複数誤答していることから, これらの行列は分類が困難であると考察される. 一 方で, スケーリングした結果, 正答するようになった行列を見てみると, adder\_dcop, cage, ck, fs 系統の行列が複数正答するようになっており, これらの行列の分類に対してはスケーリングが 有効であることが分かった.

行列名	分野	相対残差ノルム	スケーリング後の 相対残差ノルム
adder_dcop_24	subsequent circuit simulation problem	8.85E-05	1.27E-02
Baumann	2D/3D problem	8.6E+05	1.4E+03
bbmat	computational fluid dynamics problem	1.8E+01	2.2E+00
cell2	directed weighted graph	2.0E+04	2.4E+05
cz20468	2D/3D problem	9.4E+02	5.8E-01
ex21	computational fluid dynamics problem	1.1E-02	3.2E-03
ex27	computational fluid dynamics problem	3.0E-04	7.7E0-03
ex40	computational fluid dynamics problem	8.0E-06	2.3E-05
ex6	computational fluid dynamics problem	2.0E-02	2.3E+00
fp	electromagnetics problem	4.0E-04	6.7E+02
hvdc2	power network problem	8.8E-01	5.8E-01
mark3jac020	economic problem	2.2E+02	6.3E+03
mark3jac020sc	economic problem	8.1E+03	4.5E+08
mark3jac140	economic problem	3.7E+06	8.5E+06
mark3jac140sc	economic problem	1.0E+03	8.3E+05
odepa400	2D/3D problem	1.0E-04	3.3E-02
olm5000	computational fluid dynamics problem	1.4E-06	2.0E+06
onetone2	frequency-domain circuit simulation problem	5.2E+07	6.0E+07
pores_1	computational fluid dynamics problem	2.2E-03	1.0E+00
sherman2	computational fluid dynamics problem	1.5E-01	7.5E+01
torso1	2D/3D problem	4.4E-05	1.5E+00
transient	circuit simulation problem	1.5E+00	1.9E-01
tub1000	computational fluid dynamics problem	1.9E-02	1.1E-04
08blocks	combinatorial problem	8.24E-12	9.18E-11
ASIC_320ks	circuit simulation problem	9.56E-11	3.21E-11
bcircuit	circuit simulation problem	8.57E-11	7.74E-11
cage4	directed weighted graph	4.04E-18	1.57E-15
cavity01	computational fluid dynamics problem sequence	8.36E-11	2.01E-11
CoupCons3D	structural problem	9.90E-11	9.85E-11
coupled	circuit simulation problem	8.75E-11	9.04E-11
cz148	2D/3D problem	9.58E-11	5.46E-11
ex31	computational fluid dynamics problem	5.76E-09	8.85E-11
ibm32	directed graph	2.87E-08	9.90E-08
jg1009	counter-example problem	3.20E-15	3.20E-15
LeGresley_2508	power network problem	9.02E-11	4.09E-11
orsirr_1	computational fluid dynamics problem	1.14E-09	5.40E-11
pivtol	statistical/mathematical problem	7.86E-11	7.42E-11
Tina_AskCog	directed graph	1.28E-11	2.36E-12
tols90	computational fluid dynamics problem	6.40E-11	1.49E-11
tomography	computer graphics/vision problem	8.78E-11	4.33E-11
torso3	2D/3D problem	3.43E-11	5.21E-11
venkat01	computational fluid dynamics problem sequence	9.38E-11	6.82E-11

# 表 6.13: SuiteSparse 法で生成しデータセット G と H で誤答した行列

		ᇷᆇᇾᆠᅭ	スケーリング後の
打列者		相対残差ノルム	相対残差ノルム
adder_dcop_19	subsequent circuit simulation problem	9.41E-07	5.40E-11
adder_dcop_21	subsequent circuit simulation problem	1.28E-07	8.11E-11
adder_dcop_25	subsequent circuit simulation problem	4.20E-07	8.20E-11
adder_dcop_34	subsequent circuit simulation problem	5.32E-08	9.61E-11
adder_dcop_37	subsequent circuit simulation problem	4.31E-07	8.14E-11
adder_dcop_38	subsequent circuit simulation problem	9.95E-08	9.67E-11
adder_dcop_42	subsequent circuit simulation problem	3.59E-09	9.46E-11
adder_dcop_47	subsequent circuit simulation problem	3.94E-09	6.72E-11
airfoil_2d	computational fluid dynamics problem	9.89E-11	2.87E-11
bwm2000	chemical process simulation problem	8.92E-11	9.99E-11
cage13	directed weighted graph	2.02E-11	1.36E-11
cage3	directed weighted graph	1.56E-15	3.95E-16
cage5	directed weighted graph	1.07E-11	4.76E-11
cavity17	subsequent computational fluid dynamics problem	9.75E-11	8.11E-11
circuit_2	circuit simulation problem	7.49E-11	6.61E-11
ck104	2D/3D problem	3.09E-12	8.86E-11
ck656	2D/3D problem	2.10E-11	1.68E-11
dc2	subsequent circuit simulation problem	7.51E-11	9.15E-11
epb2	thermal problem	6.54E-11	4.42E-11
fs_183_4	subsequent 2D/3D problem	2.22E-07	3.11E-11
fs_541_1	subsequent 2D/3D problem	5.07E-11	7.82E-11
fs_680_1	2D/3D problem sequence	8.19E-11	5.64E-11
fs_760_1	2D/3D problem sequence	8.65E-11	4.18E-11
language	directed weighted graph	1.35E-11	5.94E-12
mult_dcop_01	circuit simulation problem sequence	9.99E-11	9.89E-11
orsirr_2	computational fluid dynamics problem	7.54E-10	7.34E-11
orsreg_1	computational fluid dynamics problem	5.14E-11	6.79E-11
Pd	counter-example problem	7.27E-11	8.86E-11
poisson2D	computational fluid dynamics problem	8.55E-11	9.12E-11
poli	economic problem	3.13E-11	3.13E-11
poli3	economic problem	7.80E-11	2.05E-11
psmigr_1	economic problem	2.52E-11	3.83E-11
rgg010	counter-example problem	1.02E-14	1.02E-14
steam2	computational fluid dynamics problem	7.78E-11	2.25E-11
tols340	computational fluid dynamics problem	2.91E-08	2.38E-11
torso2	2D/3D problem	4.30E-11	3.93E-11
wang4	semiconductor device problem	4.77E-11	8.50E-11

表 6.14: 対角をスケーリングしてから SuiteSparse 法を用いて正答するようになった収束行列

#### 6.5.2 sigmoid 法

同様に, 非零要素の値を変えず, データセットの全行列を画像にした G と対角成分をスケー リングした H を sigmoid 法で生成した. G と H の Accuracy を表 6.15 に, その分類結果のうち, 画像サイズ 28×28 pixel の内訳を表 6.16 に示す.

表 6.15: sigmoid 法で生成した G と H の 表 6.16: スケーリング後に sigmoid 法で生 Accuracy 成した H における分類結果の内訳

size	Detect	1	2	3	4	5	Average
(pixel)	Dataset	(%)	(%)	(%)	(%)	(%)	(%)
28.2.20	G	85.1	84.0	85.7	83.4	82.3	84.1
20×20	Н	81.7	81.1	81.1	84.6	79.4	81.6
56~56	G	84.6	81.7	83.4	86.3	80.6	83.3
30×30	Н	82.9	82.9	80.0	86.9	82.9	83.1
112~112	G	80.6	77.7	86.3	88.0	80.6	82.6
112×112	Н	82.9	81.7	85.7	82.9	82.3	83.1
224~224	G	80.6	78.2	84.6	76.6	76.6	79.3
224×224	Н	84.0	81.7	79.4	81.7	82.3	81.8

	1	2	3	4	5	計
	(%)	(%)	(%)	(%)	(%)	(%)
TN	94	99	99	103	102	497
110	(80.3)	(83.8)	(84.6)	(88.0)	(87.1)	(84.8)
FN	9	14	15	13	21	72
FP	23	19	18	14	15	89
TP	49	43	43	45	37	217
	(84.4)	(75.4)	(74.1)	(77.5)	(63.7)	(75.0)
計	175	175	175	175	175	875

表 6.15 より, Average accuracy の推移を見ると, データセット H の場合, Accuracy は画像の サイズが 56×56 pixel の場合と 112×112 pixel の場合で最大となっているが, 224×224 pixel の 場合では減少している. 次に, 表 6.16 の結果から, sigmoid 法の場合でも収束する行列が増えた ことで, データセット G の分類の内訳である表 6.9 より, TN の割合が 4.4%減少し, TP の割合 が 4.8% 上昇しており, この点は SuiteSparse 法における分類の結果と同様である.

次にデータセット G と H の分類結果から, sigmoid 法において, スケーリング前後ともに誤 答をしている行列の一覧を表 6.17 に, TP の比率が上昇したことから, スケーリングした結果 正答するようになった収束行列の一覧を表 6.18 に示す. スケーリング前の分類結果, 表 6.10 と 重複して誤答している行列が収束する行列が 16 個, 非収束の行列 13 個の計 29 個となった. ス ケーリング後の SuiteSparse 法での誤答傾向と類似して ex, mark3jac 系統の行列が複数誤答し ているのに加えて, スケーリング後の sigmoid 法では cz 系統の行列においても誤答している. 表 6.18 より, 対角をスケーリングすることで正答するようになった行列は adder\_dcop, cage, fs 系統の行列が複数正答している点から, スケーリング後の分類結果においても SuiteSparse 法 と sigmoid 法は類似することが分かった.

行列名	分野	相対残差ノルム	スケーリング後の
112		2.05.04	相対残左ノルム
cell2	directed weighted graph	2.0E+04	2.4E+05
cz20468	2D/3D problem	9.4E+02	5.8E-01
Jg1011	counter-example problem	1.1E-02	7.0E-03
1001000	computational fluid dynamics	1.9E-02	1.1E-04
exo	computational fluid dynamics	2.0E-02	2.3E+00
internet	directed weighted graph	7.5E+12	3.1E+15
mark5jac020sc	economic problem	8.1E+05	4.3E+08
mark3jac140	economic problem	3.7E+06	8.5E+06
raeisky3	2D(2D angle land	2.0E-04	1.5E-04
10		4.4E-03	1.3E+00
ex19	computational fluid dynamics problem	3.0E-05	1.9E+02
mac_econ_twd500	2D/2D much land	3.9E+13	0.2E+18
DD02D		1.0E-04	5.5E-02
PR02R	computational fluid dynamics problem	2.4E-01	7.3E+04
sayiri	computational fluid dynamics problem	7.2E-01	1.8E-06
dw8192	electromagnetics problem	1.4E-01	1.3E-02
ex23	computational fluid dynamics problem	6.0E-04	2.0E-05
ex40	computational fluid dynamics problem	8.0E-06	2.3E-05
Is_/60_3	subsequent 2D/3D problem	1.5E-03	2.4E+00
goodwin	computational fluid dynamics problem	3.4E+01	1.9E+01
mhd4800a	electromagnetics problem	1.2E+01	2./E+06
Tina_DisCal	directed graph	5.5E+08	3.4E+07
Baumann	2D/3D problem	8.6E+05	1.4E+03
mark3jac140sc	economic problem	1.0E+03	8.3E+05
pores_1	computational fluid dynamics problem	2.2E-03	1.0E+00
sherman2	computational fluid dynamics problem	1.5E-01	7.5E+01
transient	circuit simulation problem	1.5E+00	1.9E-01
08blocks	combinatorial problem	8.24E-12	9.18E-11
ASIC_320k	circuit simulation problem	8.15E-11	6.58E-11
ASIC_320ks	circuit simulation problem	9.56E-11	3.21E-11
beireuit	circuit simulation problem	8.57E-11	7.74E-11
cavity01	computational fluid dynamics problem sequence	8.36E-11	2.01E-11
CoupCons3D	structural problem	9.90E-11	9.85E-11
coupled	circuit simulation problem	8.75E-11	9.04E-11
cz148	2D/3D problem	9.58E-11	5.46E-11
cz308	2D/3D problem	2.25E-11	3.82E-11
1bm32	directed graph	2.87E-08	9.90E-08
Jgl009	counter-example problem	3.20E-15	3.20E-15
language	directed weighted graph	1.35E-11	5.94E-12
LeGresley_2508	power network problem	9.02E-11	4.09E-11
orsirr_1	computational fluid dynamics problem	1.14E-09	5.40E-11
orsreg_1	computational fluid dynamics problem	5.14E-11	6.79E-11
pivtol	statistical/mathematical problem	7.86E-11	7.42E-11
poli_large	economic problem	6.29E-11	6.29E-11
poli3	economic problem	7.80E-11	2.05E-11
psmigr_1	economic problem	8.22E-11	2.51E-11
rgg010	counter-example problem	1.02E-14	1.02E-14
sherman3	computational fluid dynamics problem	8.38E-11	4.09E-11
steam2	computational fluid dynamics problem	7.78E-11	2.55E-11
Tina_AskCog	directed graph	1.28E-11	2.36E-12
tols90	computational fluid dynamics problem	6.40E-11	1.49E-11
tomography	computer graphics/vision problem	8.78E-11	4.33E-11
torso3	2D/3D problem	3.43E-11	5.21E-11
venkat01	computational fluid dynamics problem sequence	9.38E-11	6.82E-11
wang4	semiconductor device problem	4.//E-11	8.50E-11
watt_2	computational fluid dynamics problem	7.52E-11	9.29E-11

行利夕	公照	相动成美 / 11.7	スケーリング後の
1177	ر ۲] ٤]،	伯刈戏をノルム	相対残差ノルム
adder_dcop_19	subsequent circuit simulation problem	9.41E-07	5.40E-11
adder_dcop_21	subsequent circuit simulation problem	1.28E-07	8.11E-11
adder_dcop_25	subsequent circuit simulation problem	4.20E-07	8.20E-11
adder_dcop_34	subsequent circuit simulation problem	5.32E-08	9.61E-11
adder_dcop_37	subsequent circuit simulation problem	4.31E-07	8.14E-11
adder_dcop_38	subsequent circuit simulation problem	9.95E-08	9.67E-11
adder_dcop_42	subsequent circuit simulation problem	3.59E-09	9.46E-11
adder_dcop_47	subsequent circuit simulation problem	3.94E-09	6.72E-11
airfoil_2d	computational fluid dynamics problem	9.89E-11	2.87E-11
bwm2000	chemical process simulation problem	8.92E-11	9.99E-11
cage3	directed weighted graph	1.56E-15	3.96E-16
cage4	directed weighted graph	4.04E-18	1.57E-15
cage5	directed weighted graph	1.07E-11	4.76E-11
cage7	directed weighted graph	6.10E-11	5.47E-11
circuit_1	circuit simulation problem	5.41E-11	9.28E-11
circuit_2	circuit simulation problem	7.49E-11	6.61E-11
ck656	2D/3D problem	2.10E-11	1.68E-11
dc2	subsequent circuit simulation problem	7.51E-11	9.15E-11
epb2	thermal problem	6.54E-11	4.42E-11
fs_183_4	subsequent 2D/2D problem	2.22E-07	3.11E-11
fs_183_6	2D/3D problem sequence	2.68E-07	4.95E-12
fs_541_1	subsequent 2D/2D problem	5.07E-11	7.82E-11
fs_680_1	2D/3D problem sequence	8.19E-11	5.64E-11
fs_760_1	2D/3D problem sequence	8.65E-11	4.18E-11
ML_Laplace	structual problem	8.89E-11	8.12E-11
mult_dcop_01	circuit simulation problem sequence	9.99E-11	9.89E-11
orsirr_2	computational fluid dynamics problem	7.54E-10	7.34E-11
Pd	counter-exmple problem	7.27E-11	8.86E-11
poisson2D	computational fluid dynamics problem	8.55E-11	9.12E-11
poli	economic problem	3.13E-11	3.13E-11
rajat03	circuit simulation problem	8.17E-11	8.54E-11
Tina_DisCog	directed graph	7.76E-11	3.68E-11
tols340	computational fluid dynamics problem	2.91E-08	3.93E-11
torso2	2D/3D problem	4.30E-11	3.93E-11

# 表 6.18: 対角をスケーリングしてから sigmoid 法を用いて正答するようになった収束行列

### **6.6** 収束条件を 10<sup>-10</sup> とした場合

本節では、収束の条件を制限し、 $\varepsilon = 10^{-10}$ として BiCG 法を実行、新たに 875 個の行列に対し てラベル付けをして再度分類を行ったときの結果を示す。前節までの結果から SuiteSparse 法で の分類結果と sigmoid 法での分類結果が類似するという点から、この実験については SuiteSparse 法のみで実行する.また、グループ構成については前節までの分け方をするとグループ間での 収束 / 非収束の割合が不均等になるため、再度グループを構成し直した。以降、データセット G と比べてラベル、各グループの構成が変化したこのデータセットを I と呼ぶ.はじめに、収束 / 非収束の割合を表 6.19 に示す.

表 6.19: 各クラスの行列の数

	収束	非収束	計
A	176 (20.0%)	699 (80.0%)	875

表 6.19 より, 20%の行列が収束し, 80%の行列が非収束であった. 各クラスの偏りは $\varepsilon = 10^{-6}$ の場合と比べて, 7%ほど大きくなっている. これらの行列を 5 等分し, 分類した結果を表 6.20 に, 更に I における 28×28 pixel の分類結果の内訳を表 6.21 に示す.

表 6.20: データセット I の Accuracy (%)

size	1	2	3	4	5	Average
28×28	84.0	86.2	86.2	86.8	81.7	85.0
56×56	87.4	86.8	86.2	86.8	81.7	85.7
112×112	86.2	86.8	88.0	88.0	81.7	86.1
224×224	86.8	82.8	86.8	86.8	81.7	85.0

表 6.21: 28×28 pixel の分類結果の内訳

	1	2	3	4	5	Total
	(%)	(%)	(%)	(%)	(%)	(%)
TN	129	129	135	127	130	650
110	(92.1)	(92.1)	(96.4)	(90.7)	(92.8)	(93.5)
FN	17	13	19	10	23	82
FP	11	11	5	13	9	49
TP	18	22	16	25	13	94
	(51.4)	(62.8)	(45.7)	(71.4)	(36.1)	(53.4)
Total	175	175	175	175	175	875

上記の表 6.20 から Average accuracy は 85%に達した. しかし, I における非収束行列の割合 は 80% である点, 及び, TP の割合を見るとグループ 3, 5 の結果では収束する行列の検出率 (TP) が 50%を割っている点から, 収束 / 非収束の分類を適切に行えていない様子が分かる. また, こ の結果から, 行列の分類には BiCG 法における収束条件よりも各クラスのデータ数に依存する ことが分かった.

# 第7章 まとめと考察

本研究では、行列の元々の性質に関する情報だけでは難しい BiCG 法の収束 / 非収束の結果 を事前に予測するために機械学習を用いた。手法は行列の非零要素の構造と大小関係を反映し たグレースケール画像を作成し、CNN を使って分類することとした。その際、最適なグレース ケール画像の作成方法を調べるために濃度付与方法として SuiteSparse 法と sigmoid 法, 行列 の対角要素をスケーリングした後の SuiteSparse 法, sigmoid 法を試した。画像サイズを 28×28 pixel から 56×56, 112×112, 224×224 pixel まで変更し、データセット内の行列の数を収束 / 非 収束で揃えた場合と、全ての行列を使用した場合を試した。

5 分割交差検証の結果,まずデータセットが含む行列の数において,非収束行列の割合が収 束する行列の2~3 倍であれば,収束する行列と非収束の行列を揃えるよりもデータセット全 体を使用した方が Accuracy が高くなり,28×28 pixel において,SuiteSparse 法では 80.0%から 86.1%へ6.1%, sigmoid 法では 82.7%から 84.1%へ1.4%ほど上昇した.次に画像サイズについ ては,基本的に28×28 pixel から56×56 pixel の間で結果が最大となり,画像サイズを大きくす るにつれて,Accuracy は減少した.濃度付与方法としては SuiteSparse 法, sigmoid 法で共に誤 答しやすい行列の傾向は似ていることが確認された.対角をスケーリングした場合について, データセット内に収束する行列が増えたことにより,収束する行列の検出漏れが減少している ことが確認された.

最後に BiCG 法における収束条件を  $\varepsilon = 10^{-10}$  とした場合について, 分類を行ったところ, Accuracy こそ高くなったが, TP の比率が 50%以下になる場合もあり, 相対残差ノルムの条件 よりもデータ数の割合が重視すべきであることが分かった.

以上の結果は、例えば、ロケットの軌道計算や回路方程式など、流体力学や電磁気学等のシ ミュレーション分野での反復解法選択の際に役立つと考えられる.また、行列の分類問題に対 して機械学習を用いた研究は未だ少なく、収束結果を予測する研究も行われていない点から、 本研究は数値計算分野における機械学習の応用範囲を広げており、学術的な価値は高いと考え られる.

結果から考えられることとして、データセットFとGの結果から、BiCG法の収束/非収束を 予測する場合でも、予測の精度はデータ数に依存していることが分かった.この結果は行列画像 に限らず、他の機械学習に関する問題と同様であり、セオリー通りの結果である.また、データ セットGとHの結果より、スケーリングした場合としなかった場合でAccuracyが大きく変わ らなかったという点から、スケーリングを行ったのちに行列画像を生成しても収束結果を予測 しやすくなる訳ではないと考察される.仮にスケーリングが有効に機能していた場合、その結 果は、行列を画像に変換した際に、非零要素値の変換パターンを減らせているということにな り、最適な前処理行列の予測など、収束/非収束以外の予測でも大きく役立つと考えられる.そのような点から、今後も他のスケーリング行列や前処理行列を適用した後の画像への変換、そして、その画像を用いた分類結果を調べる研究は価値があると考えられる.今回はSuiteSparse Matrix Collection の行列のみを使用した実験ではあるが、このような様々な分野の行列を使用して Accuracy が85%であるということから、今後、更にデータセットに含まれる行列の種類が増えた場合でも十分高い精度で収束予測ができるものと考える.しかし、画像から行列への逆変換は一意に対応していないため、画像の情報から行列の特徴に関する情報は得ることができなかった.

今後の課題として、収束条件を $\varepsilon = 10^{-10}$ にした場合にデータセットGと同程度の収束する 行列、非収束の行列を使った分類で結果がどう変わるのか確認すること、そして対角要素をCでスケーリングしていたが、他の前処理行列を使用した場合、グレースケール画像の濃度値分 布がどう変わっていくのかを調べることが挙げられる.また、今回 BiCG 法の初期値の取り方 を1通りしか試していなかったため、収束結果を予測するうえで初期値の取り方に対する依存 についても調べる必要がある.

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# 参考文献

- [1] Tim Davis. SuiteSparse Matrix Collection, https://sparse.tamu.edu/, 2019.
- [2] 藤野清次. Krylov部分空間法ことはじめ, 計算工学= Journal of The Society for Computational Engineering and Science (JSCES), Vol.11, 2006, pp.5-9.
- [3] Alex Krizhevsky, Ilya Sutskever, and Geoffrey E Hinton. ImageNet Classification with Deep Convolutional Neural Networks, Neural Information Processing Systems, 2012, pp.1097-1105.
- [4] Yousef Saad. Iterative Method for Sparse Linear Systems, Second Edition, SIAM, 2003, pp.252-254.
- [5] 皆本晃弥. C言語による数値計算入門, サイエンス社, 2016, pp.105-115.
- [6] Richard Barrett, Michael W Berry, Tony F Chan, et al. Templates for the solution of linear systems: building blocks for iterative methods, SIAM, 1994.
- [7] Nick McCLure. TensorFlow Machine Learning Cookbook. 株式会社クイープ訳. インプレス, 2017, pp.236-272.
- [8] 斎藤康毅. ゼロから作る Deep Learning Python で学ぶディープラーニングの理論と実装 オーム社, 2017, pp.205-273.
- [9] 原田達也. 画像認識, 講談社, 2017, pp.21-193.
- [10] Srivastava Nitish, Georey Hinton, Alex Krizhevsky, et al. Dropout: a simple way to prevent neural networks from overfitting. The journal of machine learning research 15.1, 2014, pp.1929-1958.
- [11] Gotz Markus and Hartwig Anzt. Machine Learning-Aided Numerical Linear Algebra: Convolutional Neural Networks for the Efficient Preconditioner Generation. IEEE/ACM 9th Workshop on Latest Advances in Scalable Algorithms for Large-Scale Systems (scalA). IEEE, 2018, pp.49-56.
- [12] Muralidharan Saurav, Manu Shantharam, Mary Hall, et al. Nitro: A framework for adaptive code variant tuning. 2014 IEEE 28th International Parallel and Distributed Processing Symposium. IEEE, 2014, pp.501-512.

- [13] 山田賢也, 片桐 孝洋, 永井 亨. 疎行列形状のカラー画像を入力としたディープラーニング による数値計算ライブラリの自動チューニング方式. 情報処理学会研究報告ハイパフォー マンスコンピューティング (HPC) 2017, pp.1-8.
- [14] Cui Hang, Shoichi Hirasawa, Hiroyuki Takizawa, et al. A code selection mechanism using deep learning. 2016 IEEE 10th International Symposium on Embedded Multicore/Many-core Systems-on-Chip (MCSoC). IEEE, 2016, pp.385-392.
- [15] Tensorflow-an open-source softwear library for Machine Intelligence, https://www. tensorflow.org/.
- [16] Yann LeCun, Leon Bottou, Yoshua Bengio, et al. Gradient-Based Learning Applied to Document Recognition, Proceedings of the IEEE, Vol.86, 1998, pp.2278-2324.
- [17] Tim Davis. SuiteSparse: A suite of sparse matrix softwear. https://faculty.cse.tamu.ddu/davis/suitesparse.html, 2015.

# 付録

### データセットに含まれる全ての行列における BiCG 法の実行結果を以下に示す. 紙面の都 合から行列を id で表現しているため, 行列名を含めたデータを https://www.dropbox. com/s/cgyxfp8z9sipvwm/ConvList.xlsx?dl=0 にアップロードする.

id	Group	type	N	nnz	field	iteration(A)	residual_norm(A)	iteration(CA)	residual_norm(CA)
1	5	JGD_SPG	300	592	combinatorial problem	97	8.24E-12	84	9.18E-11
2	3	Schenk_IBMSDS	27628	206670	semiconductor device problem	27628	3105130.562	27629	2.92E-04
3	1	Schenk_IBMSDS	54019	486129	semiconductor device problem	54019	0.564493253	16351	1.30E-05
4	3	Schenk_IBMSDS	28984	285092	semiconductor device problem	28984	357713.1058	28985	4.33E-04
5	5	Schenk_IBMSDS	51448	537038	semiconductor device problem	51448	27.1	14790	1.88E-05
6	2	Puri	23412	218484	model reduction problem	23412	0.00000189	4892	7.41E-11
7	2	Hamm	2395	13151	circuit simulation problem	416	5.24E-11	190	3.61E-11
8	2	Hamm	4960	19848	circuit simulation problem	96	6.82E-11	79	5 70E-11
9	1	Sandia	1813	11156	subsequent circuit simulation problem	883	7.79E-11	679	3.51E-11
10	2	Sandia	1813	11246	subsequent circuit simulation problem	1813	0 254830306	1814	1 31E+05
11	3	Sandia	1813	11148	subsequent circuit simulation problem	1813	0.000293412	1345	8.63E-11
12	2	Sandia	1813	11107	subsequent circuit simulation problem	1813	0.0002223412	1239	6.13E-11
12	1	Sandia	1813	11007	subsequent circuit simulation problem	1813	0.000257149	1718	0.15E 11 0.48E-12
1.5	5	Sandia	1813	11027	subsequent circuit simulation problem	1912	0.014088207	206	7.15E 11
14	2	Sandia	1813	11224	subsequent circuit simulation problem	1013	0.000775078	200	2.04E 11
15	2	Sandia	1013	11220	subsequent circuit simulation problem	1013	0.006775978	44.5	8.04E-11
10	5	Sandia	1813	11242	subsequent circuit simulation problem	1013	0.000223080	05	/./0E-11
1/	5	Sandia	1813	11239	subsequent circuit simulation problem	1813	0.3/8141298	90	4.15E-11
18	1	Sandia	1813	11232	subsequent circuit simulation problem	1813	0.001201109	82	8.10E-11
19	4	Sandia	1813	11243	subsequent circuit simulation problem	1813	0.000203503	6/	2.15E-11
20	3	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.0000625	28	5.54E-11
21	3	Sandia	1813	11245	subsequent circuit simulation problem	1813	0.00014554	1814	3.07E+01
22	5	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.0000648	29	1.47E-11
23	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.000994326	202	5.21E-11
24	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.002014699	26	6.88E-11
25	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000179	40	2.15E-11
26	5	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000656	18	6.34E-11
27	5	Sandia	1813	11245	subsequent circuit simulation problem	1813	0.000000941	18	5.40E-11
28	1	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.000452319	18	9.35E-11
29	5	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.000000128	18	8.11E-11
30	1	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000033	18	8.41E-11
31	2	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000147	25	6.56E-11
32	5	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.0000885	1814	1.27E-02
33	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000042	18	8.20E-11
34	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000359	20	8.60E-11
35	3	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000749	20	8.94E-11
36	1	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.0000603	21	6.67E-11
37	2	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.000123983	20	9.33E-11
38	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	2035 224283	1814	2 09E+04
39	1	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.0000367	19	7.85E-11
40	1	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.010769345	23	6.61E-11
40	1	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.0000936	14	0.01E 11
42	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	5 32E-08	20	9.61E-11
43	3	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000114	20	9.04E-11
44	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.000156184	27	6.85E-11
44	4	Sandia	1813	11240	subsequent circuit simulation problem	1813	0.000130184	23	8 1/F-11
4.5	2	Sandia	1015	11240	subsequent circuit simulation problem	1013	0.05E 08	20	0.67E 11
40	3	Sandia	1015	11240	subsequent circuit simulation problem	1013	7.73E-08	20	5.0/E-11 6.80E+01
4/	1	Sandia	1013	11240	subsequent circuit simulation problem	1013	0./2E-00 0.0000272	1014	0.09E+01
48	1	Sandia	1013	11240	subsequent circuit simulation problem	1013	0.0000273	21	0.00E-11
49	4	Sandia	1815	11240	subsequent circuit simulation problem	1813	0.000000691	27	0.02E-11
50	5	Sandia	1813	11246	subsequent circuit simulation problem	1815	3.39E-09	20	9.40E-11
51	5	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000431	18	9.00E-11
52	3	Sandia	1813	11245	subsequent circuit simulation problem	1813	0.0000263	25	/.18E-11
53	3	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.0000189	25	6.69E-11
54	5	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000111	18	9.67E-11
55	3	Sandia	1813	11246	subsequent circuit simulation problem	1813	3.94E-09	25	6.72E-11
56	1	Sandia	1813	11246	subsequent circuit simulation problem	1813	4.66E-09	25	6.68E-11
57	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.0000123	25	6.90E-11
58	2	Sandia	1813	11246	subsequent circuit simulation problem	1813	9.12E-08	25	6.86E-11
59	5	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.010349665	25	6.77E-11

60	5	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.000234741	25	6.64E-11
61	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000755	22	1.00E-10
62	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.000000749	25	6.64E-11
63		Sandia	1813	11246	subsequent circuit simulation problem	1813	0.000000325	25	6.75E-11
64	-	Sandia	1015	11240	subsequent circuit simulation problem	1013	0.000000323	25	6.64E 11
04	3	Sandia	1013	11240	subsequent circuit simulation problem	1013	9.2/E-08	25	0.04E-11
00	2	Sandia	1813	11240	subsequent circuit simulation problem	1813	6.59E-09	25	0.02E-11
66	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	1.76E-09	25	6.63E-11
67	3	Sandia	1813	11246	subsequent circuit simulation problem	1813	0.00000465	25	6.61E-11
68	4	Sandia	1813	11246	subsequent circuit simulation problem	1813	3.64E-09	21	8.06E-11
69	1	Sandia	1813	11246	subsequent circuit simulation problem	1813	4.04E-08	18	9.94E-11
70	5	Sandia	1813	11246	subsequent circuit simulation problem	1813	1.43E-08	23	9.66E-11
71	3	Sandia	1813	11246	subsequent circuit simulation problem	1813	5.23E-09	23	9.71E-11
72	5	Sandia	1813	11246	subsequent circuit simulation problem	1813	1.04E-09	25	6.57E-11
73	2	Sandia	1813	11246	subsequent circuit simulation problem	1813	6.85E-09	25	6.56E-11
74	3	Sandia	1813	11246	subsequent circuit simulation problem	1641	4.34E-11	18	1.00E-10
75	4	Sandia	1813	11246	subsequent circuit simulation problem	1486	9.61E-11	23	6.79E-11
76	5	Sandia	1813	11246	subsequent circuit simulation problem	1475	7.86E-11	25	6.57E-11
77	5	Sandia	1813	11246	subsequent circuit simulation problem	1467	7.41E-11	25	6.57E-11
78	4	Sandia	1814	14579	circuit simulation problem sequence	264	5.75E-11	48	7.08E-11
79	3	Sandia	1814	14579	subsequent circuit simulation problem	243	5 35E-11	48	7.08E-11
80	5	Bai	23560	460598	computational fluid dynamics problem	4576	8.83E-11	4168	8 24E-11
81	1	Engwirda	14214	250688	computational fluid dynamics problem	3067	0.05E 11	377	2.87E-11
82	2	SNAD	262111	1224877	directed graph	262111	20200	262111	2.87E+01
82	3	SNAP	400727	2200440	directed graph	400727	11700	400727	4.24E+02
8/		SNAP	410226	3356924	directed graph	410226	0230	410236	3.55E±01
04	1	SIMAR	402204	2297200	directed graph	410230	11100	402204	1.86E+01
85	4	SINAP	405394	338/388	directed graph	405594	9.025.11	403394	1.80E+UI
80	1	SIMON	14000	1855104	unected weighted random graph	109	0.23E-11	109	9.52E-11
8/	1	HB	130	1037	materials problem	1/	1./2E-11	8	4.45E-15
88	1	SNAP	31379	106762	directed weighted graph sequence	31379	0.00109	928	9.14E+02
89	1	Sandia	99340	940621	circuit simulation problem	99340	5.450539582	180	6.18E-11
90	4	Sandia	99190	578890	circuit simulation problem	734	9.97E-11	66	4.68E-11
91	1	Sandia	321821	1931828	circuit simulation problem	462	8.15E-11	145	6.58E-11
92	3	Sandia	321671	1316085	circuit simulation problem	99	9.56E-11	66	3.21E-11
93	4	Vavasis	41092	1683902	2D/3D problem	41092	25.35857046	41093	1.37E+02
94	1	Grund	1089	4144	chemical process simulation problem	1089	439.3883996	1090	2.80E+03
95	3	Grund	7	15	chemical process simulation problem	5	8.06E-16	6	4.25E-16
96	2	Grund	1089	3895	chemical process simulation problem	1089	63823.55913	1090	8.05E+04
97	1	Schenk_ISEI	113076	2129496	semiconductor device problem sequence	113076	2.66	113076	1.46E-06
98	1	Schenk_ISEI	115625	2158759	subsequent semiconductor device problem	115625	0.002074513	115625	3.71E-03
99	4	Cabank ICEI	115(05	2150750		115605	0.000010561	115605	1 705 00
	-	SCHERK_ISEI	115025	2158/59	subsequent semiconductor device problem	115625	0.000919561	115625	1./3E-03
100	3	Schenk_ISEI	115625	2158759	subsequent semiconductor device problem	115625	0.000919561	115625	1./3E-03 5.68E-06
100	3 4	Schenk_ISEI Schenk_ISEI	115625 115625 113076	2158759 2158759 2129496	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem	115625 115625 113076	0.000919561 0.0457 0.509859907	115625 115625 113076	1.73E-03 5.68E-06 1.06E-04
100 101 102	3 4 3	Schenk_ISEI Schenk_ISEI Schenk_ISEI	115625 115625 113076 113076	2158759 2158759 2129496 2129496	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem	115625 115625 113076 113076	0.000919561 0.0457 0.509859907 9.3	115625 115625 113076 113076	1./3E-03 5.68E-06 1.06E-04 2.17E-06
100 101 102 103	3 4 3 2	Schenk_ISEI Schenk_ISEI Schenk_ISEI Schenk_ISEI	115625 115625 113076 113076 113076	2158759 2158759 2129496 2129496 2129496	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem	115625 115625 113076 113076 113076	0.000919561 0.0457 0.509859907 9.3 404	115625 115625 113076 113076 113076	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03
100 101 102 103 104	3 4 3 2 2	Schenk_ISEI Schenk_ISEI Schenk_ISEI Schenk_ISEI Schenk_ISEI	113625 115625 113076 113076 113076 115625	2158759 2158759 2129496 2129496 2129496 2129496 2158759	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem	115625 115625 113076 113076 113076 115625	0.000919561 0.0457 0.509859907 9.3 404 0.0101	115625 115625 113076 113076 113076 113076 115625	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06
100 101 102 103 104 105	$\begin{array}{r} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \end{array}$	Schenk_ISEI Schenk_ISEI Schenk_ISEI Schenk_ISEI Schenk_ISEI Pothen	115625 115625 113076 113076 113076 115625 6691	2158759 2158759 2129496 2129496 2129496 2158759 46187	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem sequence structural problem	115625 115625 113076 113076 113076 115625 6691	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724	115625 115625 113076 113076 113076 115625 6692	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01
100 101 102 103 104 105 106	$\begin{array}{r} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 1 \end{array}$	Schenk_ISEI Schenk_ISEI Schenk_ISEI Schenk_ISEI Schenk_ISEI Pothen Pothen	113625 115625 113076 113076 113076 115625 6691 6019	2158759 2158759 2129496 2129496 2129496 2158759 46187 40965	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem	115625 115625 113076 113076 113076 115625 6691 6019	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644	115625           115625           113076           113076           113076           15625           6692           6020	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.37E+04
$     \begin{array}{r}       100 \\       101 \\       102 \\       103 \\       104 \\       105 \\       106 \\       107 \\     \end{array} $	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 1 \\ 2 \end{array}$	Schenk_ISEI Schenk_ISEI Schenk_ISEI Schenk_ISEI Schenk_ISEI Pothen Pothen Pothen	113625 115625 113076 113076 113076 115625 6691 6019 15606	2158759 2158759 2129496 2129496 2129496 2158759 46187 40965 107362	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem sequence structural problem structural problem	115625 115625 113076 113076 113076 115625 6691 6019 15606	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790 1	115625           115625           113076           113076           113076           15625           6692           6020           15607	1.75E-05 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08
$     \begin{array}{r}       100 \\       101 \\       102 \\       103 \\       104 \\       105 \\       106 \\       107 \\       108 \\     \end{array} $		Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson	113625 115625 113076 113076 113076 115625 6691 6019 15606 112211	2158759 2158759 2129496 2129496 2129496 2158759 46187 40965 107362 748331	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem structural problem 2D/3D problem	115625 115625 113076 113076 113076 115625 6691 6019 15606 112211	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612 4936	113625 113665 113076 113076 113076 113076 115625 6692 6020 15607 112212	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03
$     \begin{array}{r}       100 \\       101 \\       102 \\       103 \\       104 \\       105 \\       106 \\       107 \\       108 \\       109 \\       109     \end{array} $	3 4 3 2 2 2 2 1 2 5 4	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Rommes	113625 115625 113076 113076 113076 115625 6691 6019 15606 112211 40366	2158759 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem structural problem 2D/3D problem agained/wordel zeduction problem	115625 115625 113076 113076 113076 115625 6691 6019 15606 112211 40366	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533	115625 115625 113076 113076 113076 115625 6692 6692 6020 15607 112212 40367	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.70E+00
$\begin{array}{c} 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ \end{array}$	3 4 3 2 2 2 2 1 2 5 4	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Pothen Watson Rommes Grund	113625 115625 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735	2158759 2158759 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chamical proses simulation problem	115625 115625 113076 113076 113076 113076 115625 6691 66019 15606 112211 40366 57735	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12	113625 115625 113076 113076 113076 113076 115625 6692 6692 6020 15607 112212 40367 57736	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.95E+00
100 101 102 103 104 105 106 107 108 109 110	3       4       3       2       2       1       2       4	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Rommes Grund Grund	113625 115625 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13035	2158759 2158759 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63207	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem	115625 115625 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 12035	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 103316.0242	113625 113076 113076 113076 113076 113076 113625 6692 6020 15607 112212 40367 57736 12026	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.39E+00 5.55E-02
100 101 102 103 104 105 106 107 108 109 110 111	3       4       3       2       2       1       2       5       4       1       4       2	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Pothen Watson Rommes Grund Grund	113625 115625 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747	2138/359 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 145019 275094 63307 29105	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem abmical process simulation problem	113625 115625 113076 113076 113076 113076 115625 6691 6691 6691 15606 112211 40366 57735 13935 6747	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.55E-11	113625 113076 113076 113076 113076 113076 115625 6692 6020 15607 112212 40367 57736 13936 57736	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.95E+08 5.55E-02 1.44E-21
100 101 102 103 104 105 106 107 108 109 110 111 112 112	3       4       3       2       2       2       1       2       5       4       1       4       2	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund	113625 115625 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545	2138759 2158759 2129496 2129496 2129496 2158759 46187 46187 46065 107362 748331 145019 275094 63307 29195 95577	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process simulation problem	115625 113076 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 29545	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 2.56E+14	113625 113076 113076 113076 113076 113076 115625 6692 6020 115607 112212 40367 57736 113936 6748 20546	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.95E+08 5.55E-02 1.44E-21 1.45E-15
100 101 102 103 104 105 106 107 108 109 110 111 112 113	3       4       3       2       2       2       1       4       2       1       4       1       2	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund	113625 115625 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 236°	2138/39 2158/39 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process simulation problem chemical process simulation problem	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 113935 6747 20545 2368	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824606	113625 113076 113076 113076 113076 113076 113625 6692 6020 15607 112212 40367 57736 13936 6748 20546 2	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.79E+00 3.55E-02 1.44E-21 1.53E+15 5.57E-02
100 101 102 103 104 105 106 107 108 109 110 111 112 113 114	3       4       3       2       2       2       2       1       2       4       2       1       4       2       1       3       2       3	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund	113623 115625 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 3268 2009	2158759 2158759 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process simulation problem chemical process simulation problem chemical process simulation problem	113625 113076 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 3268 3208	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 50.2036575	113625 113076 113076 113076 113076 113076 113625 6692 6020 15607 112212 40367 57736 13936 6748 20546 3 2	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.95E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.50E-16
100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115	3 4 3 2 2 2 2 2 2 2 2 2 2 2 2 1 2 5 4 1 3 2 5 5 4 1 3 2 5 5 5 5 4 5 5 5 5 5 5 5 5 5 5 5 5 5	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund	113023 115625 113076 113076 113076 113076 113076 113076 115625 6691 6691 6691 6691 6019 15606 112211 40366 57735 13935 6747 20545 2055 205	2158759 2158759 2129496 2129496 2129496 2158759 46187 40965 107362 145019 275094 63307 29195 85537 20712 20715 20062	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem	115625 115625 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 3268 3008 3028	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 54.201217	113625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           115625           6692           6020           15507           112212           40367           57736           13936           6748           20546           3           3           3           2	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.79E+00 3.95E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.29E-16
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 117\\ 117\\ 117\\ 117\\ 117\\ 117$	3       4       3       2       2       2       2       1       4       1       3       2       5       4       1       3       2       5       3       2       5       3       2       5       3       2       5	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund	113625 115625 113076 113076 113076 113076 113076 115626 6691 6019 115606 115211 40366 57735 15606 112211 40366 57735 13935 6747 20545 3268 3008 3268 3008	2138/39 2158/39 2129496 2129496 2129496 2158/35 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20715	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem	115625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 3268 3008 3268 2009	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 2110.41562	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         112212         40367         57736         13936         6748         20546         3         3         3         3         3         3	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.79E+00 3.79E+00 3.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-
$\begin{array}{c} 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 119\\ 119\\ 110\\ 110\\ 111\\ 110\\ 110\\ 110$	3 4 3 2 2 2 2 2 1 2 5 4 4 1 3 2 5 3 3	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund	113625 115625 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 3268 3008 3268 3008	2138/359 2158/359 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20098	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 3268 3008 3268 3008 3268	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         15607         112212         40367         57736         13936         6748         20546         3	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.59E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 7.22E-16 1.51E-16 2.20E+02
100           101           102           103           104           105           106           107           108           109           110           111           112           113           114           115           116           117           118	3 4 3 2 2 2 2 2 1 2 5 4 1 2 5 4 1 3 2 5 3 3 2	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund	113023 115625 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 3268 3008 3268 3008 3268	2158759 2158759 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71564	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem semiconductor device problem sequence structural problem 2D/3D problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 3268 3008 3008 3008 3083 13326	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13807.767	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         15607         112212         40367         57736         13936         6748         20546         3         3         3         3         3         3084         12427	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.95E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 2.79E+02 1.50E-05
$\begin{array}{c} 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 122\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 122\\ 112\\ 112\\ 112\\ 112\\ 112\\ 112$	3 4 3 2 2 2 2 2 2 2 2 2 2 2 2 2	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund	113625 113076 113076 113076 113076 113076 113076 115626 6691 6019 15506 115211 40366 57735 6747 20545 3268 3008 3268 3008 3268 3008 3268 3008 3268 3083	2138/39 2158/39 2129496 2129496 2129496 2158/35 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71594	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem	115625 113076 113076 113076 113076 113076 115625 6691 6019 115625 6691 15506 112211 40366 57735 13935 6747 20545 3268 3008 3008 3	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076	113625 113076 113076 113076 113076 113076 113076 113076 115625 6692 6692 6692 6692 6020 112212 40367 57736 113936 6748 20546 3 3 3 3 3 3 3 3 3 3 3 3 3	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.79E+00 3.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 2.79E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+05 2.20E+02 1.50E+02 1.50E+05 2.20E+02 1.50E+02 1.50E+05 2.50E+02 1.50E+05 2.50E+
$\begin{array}{c} 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 120\\ 120\\ 120\\ 120\\ 120\\ 120\\ 120$	3       4       3       2       2       2       1       2       5       4       2       1       3       2       5       3       2       5       3       2       1       3       2       1       1       1       1       1	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund	113625 115625 113076 113076 113076 113076 115625 6691 6019 15505 6691 6019 15505 6797 112211 40366 57735 112211 40366 57735 112211 40366 57735 11235 6747 20545 3268 3008 3268 3008 3268 3008 3383 313436	2138/39 2158/39 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20058 11767 71594 11771722	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem	113625 113076 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 112211 40366 57735 113935 6747 20545 3268 3008 3268 3008 3268 3008 3383 113436	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.825483025	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         15607         11212         40367         57736         13936         6748         20546         3         3         3         3         3         3         3084         13437         38745	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.39E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 2.79E+02 1.50E+05 2.22E+00 2.22E+
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 120\\ 121\\ 121\\ 121\\ 121\\ 121\\ 121$	3       4       3       2       2       2       2       1       2       5       3       2       5       3       2       5       3       2       1       3       2       1       3       2       5       3       2       1       5       3       2       1       5	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Brund Grund B	113023 115625 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 3268 3008 3268 3008 3268 3008 3268 3008 38744 68902	2158759 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71594 1771722 375558	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15606 112211 40366 57735 13935 6747 20545 3268 3008 3068 3008 3083 13436 38744 58459 299	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.05E	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         112212         40367         57736         13936         6748         20546         3 </td <td>1.75E-05 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.39E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 2.79E+05 2.22E+00 7.74E-11 1.50E+05 2.22E+00 7.74E-11</td>	1.75E-05 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.39E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 2.79E+05 2.22E+00 7.74E-11 1.50E+05 2.22E+00 7.74E-11
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 121\\ 122\\ 122\\ 122\\ 122\\ 122$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 2 \\ 1 \\ 3 \\ 2 \\ 1 \\ 4 \\ 2 \\ 5 \\ 3 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5 \\ 5$	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Hamm Bai	113625 113076 113076 113076 113076 113076 6691 6019 15606 115211 40366 57735 6747 20545 3268 3008 3268 3008 3268 3008 3268 3008 3268 3083 13436 38744 668902 398	2138/359 2158/359 2129496 2129496 2129496 2158/359 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20715 20963 20698 11767 71594 1771722 375558 3678	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem computational fluid dynamics problem electromagnetics problem	115625 113076 113076 113076 113076 113076 115625 6691 6019 15505 15505 15505 15505 15505 15505 13935 6747 20545 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3275 30	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 2.355	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         15607         112212         40367         57736         13936         6748         20546         3	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.95E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 1.59E-16 1.51E-16 2.79E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 9.65E-11
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 107\\ 108\\ 109\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 122\\ 123\\ 123\\ 123\\ 123$	$\begin{array}{c} 3 \\ 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 1 \\ 3 \\ 2 \\ 5 \\ 3 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1$	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15506 6019 15506 6019 15506 6019 15506 57735 13935 6747 20545 3268 3008 3028 3008 3083 13436 38744 68902 398 62 57 50 50 50 50 50 50 50 50 50 50	2138/39 2158/39 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71594 1771722 375558 3678 450	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem	115625 113076 113076 113076 113076 113076 115025 6691 6019 15506 112211 40366 57735 13935 6747 20545 3268 3008 3083 3095 305	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         1553         55	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 1.45E+03 3.79E+00 1.45E+03 3.79E+00 1.45E+03 3.79E+00 1.53E+15 5.57E-16 1.59E-16 7.22E-16 7.22E-16 7.22E-16 2.27E+00 1.50E+05 2.22E+00 7.74E-11 9.65E-11 3.90E-11
$\begin{array}{c} 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 109\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ \end{array}$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 1 \\ 4 \\ 2 \\ 5 \\ 5 \\ 3 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 5 \\ 5 \\ 1 \\ 1 \\ 4 \\ 4 \\ \end{array}$	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15605 115625 6691 6019 15606 112211 40366 57735 13935 13935 6747 20545 3268 3008 3008 3008 3008 3008 3008 3008 3008 3008 3008 3088 3098 62 782 782 782 782 782 782 782 78	2138/39 2158/39 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71594 1771722 375558 3678 450 7514	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem sequence structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem electromagnetics problem electromagnetics problem	113625           115625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15606           112211           40366           57735           3035           6747           20545           3268           3008           3083           3083           13436           38744           58459           207           62           308	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         11212         40367         57736         13936         6748         20546         3 <td>1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.39E+00 3.39E+00 5.55E-02 1.44E-21 1.53E+15 5.57E-16 7.22E-16 1.51E-16 7.22E-16 1.51E-16 7.22E-16 1.51E-16 7.22E-16 1.51E-16 7.22E-16 1.51E-16 7.22E+00 7.74E-11 9.65E-11 3.90E-11 2.40E-11</td>	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.39E+00 3.39E+00 5.55E-02 1.44E-21 1.53E+15 5.57E-16 7.22E-16 1.51E-16 7.22E-16 1.51E-16 7.22E-16 1.51E-16 7.22E-16 1.51E-16 7.22E-16 1.51E-16 7.22E+00 7.74E-11 9.65E-11 3.90E-11 2.40E-11
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 124\\ 125\\ 124\\ 125\\ 125\\ 124\\ 125\\ 125\\ 125\\ 125\\ 125\\ 125\\ 125\\ 125$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 4 \\ 2 \\ 5 \\ 5 \\ 3 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 5 \\ 1 \\ 4 \\ 5 \\ 5 \\ 5 \\ 1 \\ 4 \\ 5 \\ 5 \\ 5 \\ 1 \\ 1 \\ 4 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5$	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Bai	113625 113076 112211 12313 13935 6747 20545 3008 3008 3008 3083 13436 68902 398 66902 398 66902 398 6782 13436 3083 3083 3083 3083 3083 3083 3083 30	2138/359 2158/359 2129496 2129496 2129496 2158/359 46187 40965 107362 748331 145019 275094 63307 29195 85537 20715 20715 20715 20715 20715 20963 20715 20963 20715 20963 207558 3678 450 7514 49044	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process problem electromagnetics problem electromagnetics problem	113625           113076           112211           40366           57735           3008           308           13275           207           62           308           13275	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         1507         112212         40367         57736         13936         6748         20546         3         3         3         3         3         3084         13437         38745         13600         153         55         246         322	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.395E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 1.59E-16 1.59E+16 2.79E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 2.40E-11 4.65E-11 4.65E-11
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 107\\ 108\\ 109\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 126\\ 126\\ 126\\ 126\\ 126\\ 126\\ 126$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 1 \\ 3 \\ 2 \\ 5 \\ 3 \\ 2 \\ 1 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 4 \\ 5 \\ 2 \\ 2 \\ 1 \\ 1 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2$	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Rommes Rommes	113625 115625 113076 113076 113076 113076 115625 6691 6019 115606 115211 40366 57735 13935 6747 20545 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3275 13275 15666	2138/39 2158/39 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71594 11771722 375558 3678 450 7514 49044 62198	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem sequence structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process problem electromagnetics problem electromagnetics problem eigenvalue/model reduction problem	113625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15606           112211           40366           57735           13935           6747           20545           3268           3008           3083           13436           3844           58459           207           62           308           13275           15666	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000598	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         15607         112212         40367         57736         13936         6748         20546         3         3         3084         13437         38745         13600         153         55         246         322         15067	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.79E+00 3.79E+00 3.55E-02 1.44E-21 1.53E+15 5.57E-16 1.51E-16 7.22E-16 1.51E-16 2.79E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 3.90E-11 2.40E-11 4.65E-11 1.25E-04
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 107\\ 108\\ 109\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ \end{array}$	$\begin{array}{c} 3 \\ 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 2 \\ 1 \\ 3 \\ 2 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 4 \\ 5 \\ 2 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1$	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Rommes Rommes Rommes Rommes	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15066 57735 12211 40366 57735 12211 40366 57735 12325 13935 6747 20545 3268 3008 3275 15425 1545	2138/39 2158/39 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71594 1771722 375558 3678 450 7514 49044 62198 66498	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem computational fluid dynamics problem electromagnetics problem electromagnetics problem eigenvalue/model reduction problem eigenvalue/model reduction problem	113625           113625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15606           112211           40366           57735           13935           6747           20545           3268           3008           3268           3008           3268           3008           3268           3008           3268           3008           3268           3008           3275           15066           16861	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000598 0.0000239	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         11525         6692         6020         15607         11212         40367         57736         13936         6748         20546         3 <td>1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.39E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 1.59E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 3.90E-11 2.40E-11 1.25E-04 1.60E-04</td>	1.75E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.39E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 1.59E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 3.90E-11 2.40E-11 1.25E-04 1.60E-04
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ \end{array}$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 4 \\ 2 \\ 5 \\ 5 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 4 \\ 5 \\ 2 \\ 1 \\ 5 \\ 5 \\ 2 \\ 1 \\ 5 \\ 5 \\ 2 \\ 1 \\ 5 \\ 5 \\ 5 \\ 2 \\ 1 \\ 5 \\ 5 \\ 5 \\ 1 \\ 5 \\ 5 \\ 5 \\ 2 \\ 1 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5$	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Rommes Rommes Rommes Rommes	113625 113076 112211 12017 13935 13935 13935 13935 13436 3008 3083 13436 8902 398 62 13275 13275 13275 13275 13275 13275 13275 13275 13275 13275 13275 13275	2138/39 2158/39 2129496 2129496 2129496 2158/39 46187 40965 107362 748331 145019 275094 63307 29195 85537 20715 20715 20715 20715 20715 20963 20715 20963 20715 20963 207558 3678 450 7514 49044 66498 75729	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process problem electromagnetics problem electromagnetics problem eigenvalue/model reduction problem eigenvalue/model reduction problem eigenvalue/model reduction problem eigenvalue/model reduction problem	113625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15606           112211           40366           57735           13935           6747           20545           3008           3083           3083           13275           15066           16861           21128	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000333 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000598 0.0000239 0.00008	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         1507         112212         40367         57736         13936         6748         20546         3         3         3         3         3         3084         13437         38745         13600         153         55         246         322         15067         16862         21129	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.395E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 1.59E-16 1.59E+16 2.22E+00 7.74E-11 9.65E-11 3.90E-11 2.40E-11 4.65E-11 1.52E-04 1.60E-04 3.74E+04
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 129\\ 129\\ 129\\ 129\\ 100\\ 101\\ 101\\ 101\\ 101\\ 101\\ 101\\ 10$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 1 \\ 3 \\ 2 \\ 5 \\ 3 \\ 2 \\ 1 \\ 1 \\ 3 \\ 2 \\ 5 \\ 5 \\ 1 \\ 1 \\ 4 \\ 5 \\ 5 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 4 \\ 5 \\ 2 \\ 1 \\ 5 \\ 4 \\ 5 \\ 2 \\ 1 \\ 5 \\ 4 \\ 5 \\ 4 \\ 4 \\ 5 \\ 5 \\ 4 \\ 4 \\ 5 \\ 5$	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Rommes Rommes Rommes Rommes	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15506 112211 40366 57735 6747 20545 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3275 15066 13275 15066 16861 21128 9735	2138/39 2158/39 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71594 1771722 375558 3678 450 7514 49044 62198 66498 75729 40983	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process problem electromagnetics problem electromagnetics problem eigenvalue/model reduction problem eigenvalue/model reduction problem eigenvalue/model reduction problem	115625           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15506           112211           40366           57735           13935           6747           20545           3008           3008           3008           3083           13436           38744           58459           207           62           308           13275           15066           16861           21128           9735	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000598 0.0000239 0.000028	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         12212         40367         57736         13936         6748         20546         3	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.75E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 2.79E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 1.25E-04 1.60E-04 3.74E+04 1.04E-13
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 107\\ 108\\ 109\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 130\\ \end{array}$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 2 \\ 5 \\ 4 \\ 2 \\ 1 \\ 1 \\ 3 \\ 2 \\ 5 \\ 3 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1$	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Rommes Rommes Rommes Rommes Rommes Rommes	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15506 6019 15506 57735 13935 6747 20545 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3275 11305 1505 1130	2138/39 2158/39 2129496 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20998 11767 71594 1771722 375558 3678 450 7514 49044 66498 75729 40983 44678	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process problem electromagnetics problem electromagnetics problem eigenvalue/model reduction problem eigenvalue/model reduction problem eigenvalue/model reduction problem eigenvalue/model reduction problem eigenvalue/model reduction problem eigenvalue/model reduction problem	113625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15066           12211           40366           57735           13935           6747           20545           3268           3008           3083           13436           38744           58459           207           62           308           13275           15066           16861           21128           9735           11305	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.35E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000598 0.0000239 0.00008 0.0082015831 557765.3129	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         15607         112212         40367         57736         13936         6748         20546         3         4000         153         55         <	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.379E+00 3.35E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 2.79E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 3.90E-11 2.40E-11 1.25E-04 1.60E-04 3.74E+04 1.04E-13 1.04E-13
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 130\\ 131\\ 11\end{array}$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 4 \\ 2 \\ 5 \\ 5 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 2 \\ 1 \\ 1 \\ 4 \\ 5 \\ 2 \\ 1 \\ 5 \\ 3 \\ 4 \\ 3 \\ 4 \\ \end{array}$	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Bai Rommes Rommes Rommes Rommes Rommes Rommes Rommes Rommes	113625 113076 113076 113076 113076 113076 113076 113076 115625 6691 6019 115606 112211 40366 112211 40366 112211 40366 112211 40366 3008 3068 3008 3268 3008 3268 3008 3083 13436 3008 3083 13436 3083 13436 3083 13436 3098 2025 13275 15066 16861 21128 9735 11305 7135	2138759 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20715 20715 20715 20715 20715 20963 20715 20705 20	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process problem electromagnetics problem eigenvalue/model reduction problem	113625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           11211           40366           57735           13935           6747           20545           3008           3008           3083           13436           38459           207           62           308           13275           15066           16861           21128           9735           11305           7135	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000333 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000598 0.0000598 0.0000581 557765.3129 5012847.823	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         1507         112212         40367         57736         13936         6748         20546         3	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.395E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 1.59E-16 1.59E-16 1.59E+16 2.22E+00 7.74E-11 9.65E-11 3.90E-11 2.40E-11 4.65E-11 1.60E-04 3.74E+04 1.04E-13 1.04E-13 1.04E-13 1.04E-13
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 130\\ 131\\ 132\\ 132\\ 132\\ 132\\ 132\\ 100\\ 101\\ 101\\ 101\\ 101\\ 101\\ 101\\ 10$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 2 \\ 1 \\ 3 \\ 2 \\ 5 \\ 4 \\ 1 \\ 1 \\ 3 \\ 2 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5$	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Bai Bai Rommes Rommes Rommes Rommes Rommes Rommes Rommes Rommes Rommes Rommes Rommes	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15506 115211 40366 57735 6747 20545 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3275 15066 13275 15066 13275 15066 13275 15066 13275 15066 13275 15066 13275 13057 7135 13057 7135 13057 7135 13057 7135 13057 7135 71357 71577 71577 71577 71577 7157 71577 71577 71577 715777 715777 7157777 71577777 7157777777777	2138/39 2158/39 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71594 1771722 375558 3678 450 7514 49044 62198 66498 75729 40983 44678 34738 3276	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process problem electromagnetics problem electromagnetics problem eigenvalue/model reduction problem	115625           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15506           112211           40366           57735           13935           6747           20545           3268           3008           3268           3008           3268           3008           3268           3008           3268           3008           3268           3008           13275           15066           16861           12128           9735           11305           7135	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000598 0.0000239 0.0000239 0.0000239 0.000028	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         12212         40367         57736         13936         6748         20546         3         3         3084         13437         38745         13600         153         55         246         322         15067         16862         21129         6         6         6         6         6         6         823	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.79E+00 3.55E-02 1.44E-21 1.53E+15 5.57E-16 1.51E-16 2.79E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 1.25E-04 1.60E-04 3.74E+04 1.04E-13 1.04E-13 1.04E-13 9.57E+00
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 107\\ 108\\ 109\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 130\\ 131\\ 132\\ 133\\ 133\\ 133\\ 133\\ 133\\ 133$	$\begin{array}{c} 3 \\ 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 5 \\ 1 \\ 1 \\ 2 \\ 5 \\ 3 \\ 2 \\ 1 \\ 1 \\ 3 \\ 2 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 2 \\ 1 \\ 1 \\ 5 \\ 2 \\ 1 \\ 1 \\ 3 \\ 3 \\ 4 \\ 1 \\ 3 \\ 3 \\ 1 \\ 3 \\ 1 \\ 3 \\ 1 \\ 1 \\ 3 \\ 1 \\ 1$	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Bai Rommes	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15506 6019 15506 6019 15506 6019 15506 57735 13935 6747 20545 3268 3008 3026 11211 11211 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 11305 7135 822	2158759 2158759 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71594 1771722 20715 20963 20698 11767 71594 1771722 375558 3678 450 7514 49044 66198 66498 75729 40983 44678 34738 3276	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem clectromagnetics problem electromagnetics problem electromagnetics problem eigenvalue/model reduction problem	115625           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15606           112211           40366           57735           13935           6747           20545           3008           3008           3083           13436           38744           58459           207           62           308           13275           15066           16861           21128           9735           11305           7135           822	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000239 0.0000239 0.00008 0.082015831 557765.3129 5012847.823 8.747035698 22.93607524	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         15607         112212         40367         57736         13936         6748         20546         3 </td <td>1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 1.45E+03 3.79E+00 1.45E+03 3.79E+08 1.45E+03 3.79E+08 1.45E+03 3.79E+08 1.45E+02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 1.59E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 1.25E-04 1.60E-04 1.60E-04 1.60E-04 1.04E-13 1.04E-14 1.04E-14 1.04E-15 1.04E-14 1.04E-15 1.04E-14 1.04E-15 1.04E-15 1.04E-15 1.04E-15 1.04E-16 1.04E-15 1.04E-15 1.04E-16 1.04E-</td>	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 1.45E+03 3.79E+00 1.45E+03 3.79E+08 1.45E+03 3.79E+08 1.45E+03 3.79E+08 1.45E+02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 7.22E-16 1.59E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 1.25E-04 1.60E-04 1.60E-04 1.60E-04 1.04E-13 1.04E-14 1.04E-14 1.04E-15 1.04E-14 1.04E-15 1.04E-14 1.04E-15 1.04E-15 1.04E-15 1.04E-15 1.04E-16 1.04E-15 1.04E-15 1.04E-16 1.04E-
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 100\\ 107\\ 108\\ 109\\ 100\\ 107\\ 108\\ 107\\ 108\\ 107\\ 110\\ 111\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 130\\ 131\\ 132\\ 133\\ 134\\ 134\\ 134\\ 130\\ 100\\ 100\\ 100\\ 100\\ 100\\ 100\\ 100$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 4 \\ 2 \\ 5 \\ 5 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 2 \\ 1 \\ 1 \\ 3 \\ 1 \\ 3 \\ 1 \\ 1 \\ 3 \\ 1 \\ 1$	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Bai Bai Rommes	113625 113076 113076 113076 113076 113076 113076 113076 115625 6691 6019 15506 112211 40366 57735 13935 6747 20545 3268 3008 3083 3075 15006 15606 11527 15006 15606 115275 15006 115275 11305 115	2138759 2158759 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20715 20715 20715 20715 20715 20705 20715 20705 20715 20705 20705 20715 20963 20715 20963 20795 11767 71594 11771722 375558 3678 450 7514 49044 62198 66498 75729 40983 44678 34738 3276 4661 4726	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem chemical process problem electromagnetics problem eigenvalue/model reduction problem	113625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           11302           6019           15606           112211           40366           57735           13935           6747           20545           3008           3008           3083           13436           38459           207           62           308           13275           15066           16861           21128           9735           11305           7135           822           822	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000333 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000598 0.0000598 0.0000598 0.0000581 557765.3129 5012847.823 8.747035698 22.93607524 7.970209683	113625         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         15607         112212         40367         57736         13936         6748         20546         3         3         3084         13437         38745         13600         153         55         246         322         15067         16862         21129         6         6         823         823	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.395E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 1.59E-16 1.59E-16 1.59E-16 2.22E+00 7.74E-11 9.65E-11 1.60E-04 3.74E+04 1.60E-04 3.74E+04 1.04E-13 1.04E-13 1.04E-13 1.04E-13 9.57E+00 6.61E+00 7.20E+00 E-00 1.20E+00
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 130\\ 131\\ 132\\ 133\\ 134\\ 135\\ 135\\ 100\\ 101\\ 101\\ 101\\ 101\\ 101\\ 101\\ 10$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 2 \\ 1 \\ 3 \\ 2 \\ 5 \\ 4 \\ 1 \\ 4 \\ 2 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 4 \\ 3 \\ 4 \\ 1 \\ 3 \\ 4 \\ 1 \\ 3 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5$	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Bai Bai Bai Bai Bai	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15506 115211 40366 57735 6747 20545 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3275 15006 13275 15006 16801 2112 9735 11305 7135 822 822 822	2138/39 2158/39 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20698 11767 71594 1771722 375558 3678 450 7514 49044 62198 66498 75729 40983 44678 34738 3276 4661 4726	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem computational fluid dynamics problem electromagnetics problem electromagnetics problem eigenvalue/model reduction problem	113625           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15506           112211           40366           57735           13935           6747           20545           3268           3008           3083           13436           38744           58459           207           62           308           13275           15066           16861           21128           9735           113005           7135           822           822           822           822	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000598 0.0000239 0.000028 0.0000239 0.000028 0.000028 0.000028 0.000028 0.000028 0.000028 0.000028 0.000028 0.000028 0.000028 0.000029 0.000028 0.00008 0.0008 0.00008 0.00008 0.00008 0.0008 0.0008 0.00	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         112212         40367         57736         13936         6748         20546         3         3         3084         13437         38745         13600         153         55         246         322         15067         16862         21129         6         6         823         823         823	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.79E+00 3.79E+00 3.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 1.59E-16 1.51E-16 2.79E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 1.25E-04 1.60E-04 3.74E+04 1.04E-13 9.57E+00 6.61E+00 7.20E+00 1.32E+01 1.32E+
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 110\\ 107\\ 108\\ 109\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 130\\ 131\\ 132\\ 133\\ 134\\ 135\\ 136\\ \end{array}$	$\begin{array}{c} 3 \\ 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 3 \\ 2 \\ 5 \\ 3 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1$	Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Schenk ISEI Pothen Pothen Watson Rommes Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Bai Bai Bai Bai Bai	113625 113076 113076 113076 113076 113076 113076 115625 6691 6019 15506 112211 40366 57735 13935 6747 20545 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3268 3008 3275 15066 16861 21128 9735 15066 16861 21128 9735 13057 11305 7135 822 822 822 822	2138/39 2158/39 2129496 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20963 20798 11767 71594 11771722 20715 20963 20698 11767 71594 1177722 375558 3678 450 7514 49044 62198 66498 75729 40083 44678 3276 4661 4726 4790 4841	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem semiconductor device problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem circuit simulation problem electromagnetics problem electromagnetics problem eigenvalue/model reduction problem subsequent optimization problem subsequent optimization problem	115625           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15606           112211           40366           57735           13935           6747           20545           3008           3008           3083           13436           38744           58459           207           62           308           13275           15066           16861           21128           9735           11305           7135           822           822           822           822           822           822           822           822           822	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 25243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000598 0.0000239 0.00008 0.0000239 0.00008 0.0000239 0.00008 0.0000239 0.00008 0.0000239 0.00008 0.0000239 0.00008 0.00005831 557765.3129 5012847.823 8.747035698 2.293607524 7.979029683 12.23528094 34.97258133	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         15067         112212         40367         57736         13936         6748         20546         3 </td <td>1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 1.45E+03 3.79E+00 1.45E+03 3.79E+00 1.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.50E+05 2.22E+00 7.74E-11 9.65E-11 1.25E-04 1.60E-04 1.60E-04 3.74E+04 1.64E-13 1.04E-14 1.04E-</td>	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 1.45E+03 3.79E+00 1.45E+03 3.79E+00 1.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.50E+05 2.22E+00 7.74E-11 9.65E-11 1.25E-04 1.60E-04 1.60E-04 3.74E+04 1.64E-13 1.04E-14 1.04E-
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 100\\ 107\\ 108\\ 109\\ 100\\ 111\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 131\\ 132\\ 133\\ 134\\ 135\\ 136\\ 137\\ 137\\ 137\\ 137\\ 137\\ 137\\ 137\\ 137$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 5 \\ 4 \\ 1 \\ 4 \\ 2 \\ 1 \\ 3 \\ 2 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1$	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Bai Bai Bai Bai Bai	113625 113076 113076 113076 113076 113076 113076 113076 115625 6691 6019 15065 57735 12211 40366 57735 13935 6747 20545 3268 3008 3068 3008 3268 3268 3008 3268 3268 3268 3268 3268 3268 3268 3268 3275 13436 13426 1346	2138/39 2158/39 2129496 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20963 20098 11767 71594 1771722 375558 3678 450 7514 49044 66498 75729 40943 44678 34738 3276 44661 4726 4790 4841 3802	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem circuit simulation problem eigenvalue/model reduction problem subsequent optimization problem subsequent optimization problem subsequent optimization problem subsequent optimization problem	113625           113625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           11302           6691           6019           15625           6691           40366           57735           13935           6747           20545           3268           3008           3083           13436           38744           58459           207           62           308           13275           15066           16861           21128           9735           11305           7135           822           822           822           822           822           822           822           822           822           822           822	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 13897.7076 18.25483025 8.57E-11 4.83E-11 3.33E-08 8.93E-11 954580.9075 0.0000239 12.23528094 34.97258133 14.10189448	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         11525         6692         6020         15607         11212         40367         57736         13936         6748         20546         3 <td>1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.39E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 2.79E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 1.25E-04 1.60E-04 3.74E+03 1.04E-14 1.04E-13 1.04E-14 1.04E-</td>	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.39E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 7.22E-16 1.51E-16 2.79E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 1.25E-04 1.60E-04 3.74E+03 1.04E-14 1.04E-13 1.04E-14 1.04E-
$\begin{array}{c} 100\\ 100\\ 101\\ 102\\ 103\\ 104\\ 105\\ 106\\ 107\\ 108\\ 109\\ 100\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 108\\ 107\\ 110\\ 111\\ 112\\ 113\\ 114\\ 115\\ 116\\ 117\\ 118\\ 119\\ 120\\ 121\\ 122\\ 123\\ 124\\ 125\\ 126\\ 127\\ 128\\ 129\\ 130\\ 131\\ 132\\ 133\\ 134\\ 135\\ 136\\ 137\\ 138\\ 138\\ 138\\ 138\\ 138\\ 138\\ 138\\ 138$	$\begin{array}{c} 3 \\ 4 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 1 \\ 2 \\ 2 \\ 1 \\ 1 \\ 3 \\ 2 \\ 5 \\ 4 \\ 1 \\ 1 \\ 3 \\ 2 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 5 \\ 1 \\ 1 \\ 5 \\ 1 \\ 1$	Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Schenk JSEI Pothen Pothen Pothen Watson Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Grund Bai Bai Bai Bai Bai Bai Bai Bai Bai Bai	113625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           115026           6019           15606           112211           40366           57735           3268           3008           3083           3874           68902           398           62           13275           15066           16861           16861           13275           1305           7135           822           822           822           822           822           822           822           822           822           822           822           822           822           822	2138/39 2158/39 2129496 2129496 2129496 2129496 2158759 46187 40965 107362 748331 145019 275094 63307 29195 85537 20712 20715 20715 20963 20712 20715 20963 20712 207558 3678 450 771594 1771722 375558 3678 450 75114 49044 62198 66498 75729 40983 44678 34738 3276 4661 4726 4790 4841 3802	subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem structural problem structural problem 2D/3D problem eigenvalue/model reduction problem chemical process simulation problem computational fluid dynamics problem electromagnetics problem eigenvalue/model reduction problem subsequent optimization problem subsequent optimization problem subsequent optimization problem subsequent optimization problem	113625           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           113076           115625           6691           6019           15606           112211           40366           57735           13935           6747           20545           3008           3083           3083           13436           3083           13275           15066           16861           21128           9735           11305           7135           822           822           822           822           822           822           822           822           822           822           822           822           822      <	0.000919561 0.0457 0.509859907 9.3 404 0.0101 0.134623724 52243.03644 215468790.1 863612.4936 0.0000533 4.02E+12 102316.9243 7.56E+11 3.55E+14 232.5824696 59.2936575 634.3917917 3119.414263 4063025.769 1382748025 8.57E-11 4.83E-11 9.54580.9075 0.0000598 0.0000239 0.0000239 0.0000239 0.000008 0.0000239 0.0000239 0.000008 0.0000239 0.0000239 0.000008 0.0000239 0.0000230 0.0000230 0.0000239 0.0000230 0.00000230 0.0000230 0.0000230 0.00	113625         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         113076         115625         6692         6020         1212         40367         57736         13936         6748         20546         3         3         3084         13437         38745         13600         153         55         246         322         15067         16862         21129         6         6         6         823         823         823         823         823         823	1.73E-03 5.68E-06 1.06E-04 2.17E-06 5.75E-03 6.61E-06 4.37E-01 4.31E+04 7.90E+08 1.45E+03 3.79E+00 3.95E+08 5.55E-02 1.44E-21 1.53E+15 5.57E-16 1.59E-16 1.59E-16 1.59E-16 1.51E-16 2.79E+02 1.50E+05 2.22E+00 7.74E-11 9.65E-11 1.25E-04 1.65E-11 1.25E-04 1.66E-04 3.74E+04 1.04E-13 9.57E+00 6.61E+00 7.20E+00 1.13E+01 2.65E+01 1.3E+01 2.65E+01 1.3E+01 2.65E+00 1.13E+01 2.65E+00 1.13E+01 2.65E+00 1.13E+01 2.65E+00 1.13E+01 2.65E+00 1.13E+01 2.65E+00 1.13E+01 2.65E+00 1.14E+02 1.49E+02

139 3	HB	822	4172	subsequent optimization problem	822	27.25509264	823	2.18E+01
140 1	HB	822	4534	subsequent optimization problem	822	8.726399142	823	1.14E+01
141 2	Bai	200	796	chemical process simulation problem	119	4.72E-11	101	4.84E-12
142 5	Bai	2000	7996	chemical process simulation problem	1078	8.92E-11	492	9.99E-11
145 2	IGD CAG	1910 364	195985	combinatorial problem	1910 364	0.012734044	365	8.40E-10 8.51E-06
145 3	IGD CAG	72	1012	combinatorial problem	72	0.001802594	73	3.48E+00
146 1	vanHeukelum	11397	150645	directed weighted graph	27	6.26E-11	21	7.27E-11
147 5	vanHeukelum	39082	559722	directed weighted graph	29	3.74E-11	22	4.98E-11
148 2	vanHeukelum	130228	2032536	directed weighted graph	28	3.81E-11	20	9.06E-11
149 5	vanHeukelum	445315	7479343	directed weighted graph	31	2.02E-11	23	1.36E-11
150 3	vanHeukelum	5	19	directed weighted graph	4	1.56E-15	6	1.49E-15
151 3	vanHeukelum	9	49	directed weighted graph	9	4.04E-18	10	1.57E-15
152 1	vanHeukelum	37	233	directed weighted graph	23	1.07E-11	21	4.76E-11
155 5	vanHeukelum	93	785	directed weighted graph	25	1.4E-11 6.1E-11	20	6.02E-11
155 4	vanHeukelum	1015	11003	directed weighted graph	26	7.23E-11	23	4 80F-11
156 1	vanHeukelum	3534	41594	directed weighted graph	28	7.86E-11	22	9.71E-11
157 4	Pajek	9664	16150	directed graph	9664	38.65870001	9665	6.99E+00
158 2	JGD_Margulies	85	254	combinatorial problem	85	0.059056857	86	9.42E-02
159 3	DRIVCAV	317	7280	computational fluid dynamics problem sequence	252	8.36E-11	184	2.01E-11
160 5	DRIVCAV	317	5923	subsequent computational fluid dynamics problem	317	0.004093135	318	6.25E-02
161 3	DRIVCAV	317	7311	subsequent computational fluid dynamics problem	317	0.029498632	318	3.49E-02
162 4	DRIVCAV	317	5923	subsequent computational fluid dynamics problem	317	0.103046933	318	6.88E-03
165 4	DRIVCAV	1182	32032	computational full dynamics problem sequence	5/0	7.02E-11 0.048462715	438	7.55E-11 1.11E-02
165 2	DRIVCAV	1182	32702	subsequent computational fluid dynamics problem	1182	0.000397195	1183	1.19E-01
166 1	DRIVCAV	1182	29675	subsequent computational fluid dynamics problem	1182	0.011209579	1183	1.78E-02
167 1	DRIVCAV	1182	32702	subsequent computational fluid dynamics problem	1182	0.08345384	1183	4.65E-02
168 4	DRIVCAV	2597	76171	computational fluid dynamics problem sequence	871	8.31E-11	588	5.11E-11
169 2	DRIVCAV	2597	71601	subsequent computational fluid dynamics problem	2597	0.000293118	2598	3.02E-05
170 5	DRIVCAV	2597	76258	subsequent computational fluid dynamics problem	2597	0.14059671	2598	1.49E-01
171 1	DRIVCAV	2597	71601	subsequent computational fluid dynamics problem	2597	0.084713794	2598	3.88E-02
172 3	DRIVCAV	2597	76258	subsequent computational fluid dynamics problem	2597	0.019719129	2598	1.75E+00
173 1	DRIVCAV	2597	/1601	subsequent computational fluid dynamics problem	2597	0.462663603	2598	8.45E-01
174 2	DRIVCAV	4562	131735	subsequent computational fluid dynamics problem	3039	9.05E-11 9.75E-11	2084	8.11E-11
176 5	DRIVCAV	4562	138040	subsequent computational fluid dynamics problem	4562	0.018045278	4563	2.55E-07
177 3	DRIVCAV	4562	131735	subsequent computational fluid dynamics problem	4562	0.00000796	4563	2.45E-03
178 3	DRIVCAV	4562	138040	subsequent computational fluid dynamics problem	4562	0.018920632	4563	2.14E-01
179 2	DRIVCAV	4562	131735	subsequent computational fluid dynamics problem	4562	0.000905135	4563	1.71E-02
180 2	DRIVCAV	4562	138040	subsequent computational fluid dynamics problem	4562	0.402653633	4563	2.52E+00
181 3	DRIVCAV	4562	131735	subsequent computational fluid dynamics problem	4562	0.123104948	4563	3.10E+01
182 2	DRIVCAV	4562	138040	subsequent computational fluid dynamics problem	4562	0.317392328	4563	1.16E+00
185 1	DRIVCAV	4562	131/35	subsequent computational fluid dynamics problem	4562	0.814394492	4505	2.42E+00
185 1	Bai	961	4681	computational fluid dynamics problem sequence	123	6.17E-11	124	6.17E-11
186 3	Bai	961	4681	subsequent computational fluid dynamics problem	138	4.68E-11	170	4.14E-11
187 3	Bai	961	4681	subsequent computational fluid dynamics problem	169	7.82E-11	170	7.82E-11
188 2	Bai	961	4681	subsequent computational fluid dynamics problem	165	3.63E-11	155	5.87E-11
189 5	Bai	961	4681	subsequent computational fluid dynamics problem	337	6.95E-11	330	9.75E-11
190 1	Bai	961	4681	subsequent computational fluid dynamics problem	159	4.97E-11	175	9.24E-11
191 3	Newman	297	2345	directed weighted graph	297	1.465667888	298	7.09E+01
192 1	Lucifora	7055	30082	directed weighted graph	7055	165.2123795	146/	8.88E-11
193 1	IGD Homology	600	2400	combinatorial problem	600	4 817567079	601	2.400403
195 3	JGD_Homology	141120	846720	combinatorial problem	141120	384.9545281	141121	1.49E+03
196 1	Muite	261	2319	structural problem	261	8.968101888	262	7.98E-07
197 4	Muite	2053	18447	structural problem	2053	1.88329687	1922	9.59E-11
198 1	Muite	4101	36879	structural problem	4101	58.70907093	552	5.93E-11
199 5	Muite	68121	5377761	structural problem	68121	8377252.508	68122	1.82E-02
200 5	Watson	40401	201201	2D/3D problem	80	2.99E-11	21	8.39E-11
201 3	Oberwolfach	20082	281150	model reduction problem	6814	9.93E-11	298	8.68E-11
202 4	Bombof	20082	281150	aircuit simulation problem	220	9.8E-11	275	4.54E-11
203 1	Bomhof	4510	21199	circuit simulation problem	582	7.49E-11	243	6.61E-11
205 4	Bomhof	12127	48137	circuit simulation problem	12127	1.203403503	12128	6.13E-03
206 4	Bomhof	80209	307604	circuit simulation problem	80209	0.127992524	80210	2.32E-05
207 4	YZhou	1020	5883	circuit simulation problem	1020	34.48161649	1021	nan
208 5	SNAP	34546	421578	directed graph	34546	6.22E+14	346	1.38E+00
209 1	SNAP	27770	352807	directed graph	27770	2.43E+18	595	1.70E+03
210 1	Bai	104	992	2D/3D problem	64	3.09E-12	102	8.86E-11
211 3	Bai	400	2860	2D/3D problem	201	3.46E-11	519	8.1/E-12
212 1	IBM FDA	49702	333020	circuit simulation problem	410	2.1E-11 0.0000136	49703	2.41E-01
213 2	IBM EDA	49702	332807	circuit simulation problem	49702	0.0000130	49703	3.35E-08
215 3	LAW	325557	3216152	directed graph	325557	330	325557	3.29E+02
216 4	Brethour	1348	19457	computational fluid dynamics problem	1348	16.31028266	1349	1.26E+01
217 3	Brethour	9540	207308	computational fluid dynamics problem	9540	9.649127742	9541	3.26E+01

218 2	Langemyr	1500	97645	structural problem	852	9.82E-11	912	9.82E-11
219 3	Janna	416800	17277420	structural problem	48349	9.90169E-11	280	9.85E-11
220 3	IBM_Austin	11341	97193	circuit simulation problem	1377	8.75E-11	484	9.04E-11
221 3	QLi	160000	1750416	optimization problem	559	8.98E-11	106	7.60E-11
222 3	Bai	10000	49699	materials problem	10000	0.00054766	10001	2.17E+02
223 1	Bai	2500	12349	materials problem	2500	0.014057705	2501	1.74E+04
224 5	Pajek	1882	1740	directed graph	1882	509699.5401	1883	1.59E+06
225 2	HB	54	291	2D/3D problem	54	0.021160595	55	1.28E-03
226 2	СРМ	10228	102876	2D/3D problem	8832	3.13E-11	4403	9.58E-11
227 3	СРМ	1268	12786	2D/3D problem	452	9.01E-11	413	8.03E-11
228 5	CPM	148	1527	2D/3D problem	71	9.58E-11	71	5.46E-11
229 1	CPM	20468	206076	2D/3D problem	20468	945.2753826	20469	5.8/E-01
230 4	CPM	2548	230/4	2D/3D problem	1287	0.54E-11	880	9.21E-11
231 3	CPM	308	3162 412148	2D/3D problem	22400	2.23E-11 6.7E-11	125	3.62E-11 1.85E+00
232 4	CPM	5108	51412	2D/3D problem	1992	6.72E-11	1781	6.85E 11
233 2	CPM	628	6246	2D/3D problem	211	1.9E 11	216	2.69E 11
234 1	Grund	87	230	chemical process simulation problem	87	0.401531148	88	4.47E+00
236 5	Grund	87	230	chemical process simulation problem	87	0.69530481	88	5.61E-01
230 3	Grund	53	144	chemical process simulation problem	53	0.032982351	54	1.25E+01
238 2	IBM EDA	116835	766396	circuit simulation problem sequence	116835	1 690168894	347	3 56E-11
239 5	IBM EDA	116835	766396	subsequent circuit simulation problem	3003	7.51E-11	280	9.15E-11
240 3	IBM_EDA	116835	766396	subsequent circuit simulation problem	116835	84119811.36	873	4.34E-11
241 1	Rommes	20738	73916	eigenvalue/model reduction problem	20738	0.0000366	20739	1.63E+02
242 2	Fluorem	903	11766	computational fluid dynamics problem	903	0.104196411	904	2.49E+01
243 4	Bai	2048	10114	electromagnetics problem	1532	6.64E-11	2049	5.62E-03
244 3	Bai	2048	10114	electromagnetics problem	1532	6.64E-11	2049	5.62E-03
245 2	Bai	512	2480	electromagnetics problem	512	0.000000143	435	8.37E-11
246 2	Bai	512	2500	electromagnetics problem	18	7.62E-11	13	1.20E-11
247 5	Bai	8192	41746	electromagnetics problem	8192	0.145878231	8193	1.30E-02
248 4	Bai	8192	41746	electromagnetics problem	8192	0.145878231	8193	1.30E-02
249 3	Bai	512	2480	electromagnetics problem	512	0.000000143	435	8.37E-11
250 4	Bai	512	2500	electromagnetics problem	18	7.62E-11	13	1.20E-11
251 1	Shen	17281	553562	2D/3D problem	17281	615.3793412	17282	3.16E+04
252 3	Pajek	23219	325592	directed weighted graph	23219	1270	23219	5.39E-01
253 5	Pajek	23219	325589	directed weighted graph	23219	1330000	23219	4.53E+00
254 4	Sanghavi	51993	380415	semiconductor device problem	51993	1.344114384	473	7.40E-11
255 2	SNAP	265214	420045	directed graph	265214	586	15	2.70E-01
256 2	LAW	69244	276143	directed graph	69244	10528.74555	519	3.03E+03
257 3	Pajek	4772	8965	directed graph	4772	3.122020195	4773	1.81E+01
258 4	Averous	1794	7764	thermal problem	1794	0.000140541	893	6.15E-11
259 1	Averous	14734	95053	thermal problem	882	7.51E-11	603	9.14E-11
260 2	Averous	25228	175027	thermal problem	743	6.54E-11	316	4.42E-11
261 5	Averous	84617	463625	thermal problem	6914	9.48E-11	3166	8.88E-11
262 4	Pajek	8497	6/26	directed graph	8497	161007.9014	8498	6.80E+02
203 3	FIDAP	210	4317	computational fluid dynamics problem	210	0.0000304	217	1.22E-07
204 1	FIDAP	12005	250577	computational fluid dynamics problem	12005	0.00000284	12006	2.73E+01
265 3	FIDAP	2203	67830	computational fluid dynamics problem	2203	0.0000308	2204	1.94E+02
267 2	FIDAP	656	18964	computational fluid dynamics problem	656	0.011868137	657	3.21E-03
268 4	FIDAP	839	22460	computational fluid dynamics problem	839	0.009288397	840	5.51E-09
269 4	FIDAP	1409	42760	computational fluid dynamics problem	1409	0.0005200557	1410	2.04E-05
270 3	FIDAP	2283	47901	computational fluid dynamics problem	2283	0.0000128	2284	9.84E-11
271 5	FIDAP	848	24369	computational fluid dynamics problem	848	0.075049147	849	5.44E-04
272 1	FIDAP	2163	74464	computational fluid dynamics problem	2163	0.013117746	2164	4.79E-04
273 3	FIDAP	974	37652	computational fluid dynamics problem	974	0.000340747	975	7.79E-03
274 5	FIDAP	2603	77031	computational fluid dynamics problem	2603	0.0000723	2604	8.05E-11
275 4	FIDAP	2870	23754	computational fluid dynamics problem	88	8.53E-11	25	4.70E-11
276 4	FIDAP	3909	91223	computational fluid dynamics problem	3909	5.76E-09	3910	8.85E-11
277 3	FIDAP	19716	227872	computational fluid dynamics problem	19716	0.00000455	19717	4.54E+04
278 1	FIDAP	3079	53099	computational fluid dynamics problem	3079	0.00000175	3080	4.55E-11
279 2	FIDAP	3565	67591	computational fluid dynamics problem	89	7.37E-11	31	5.08E-11
280 4	FIDAP	7740	456188	computational fluid dynamics problem	7740	0.00000801	7741	2.92E-05
281 2	FIDAP	1651	49062	computational fluid dynamics problem	1651	0.020542533	1652	2.30E+00
282 5	FIDAP	1633	46626	computational fluid dynamics problem	1004	9.27E-11	1634	4.97E-04
283 3	FIDAP	3096	90841	computational fluid dynamics problem	3096	0.000000176	3097	2.87E+01
284 5	Zitney	2837	10967	chemical process simulation problem	2837	34965738.98	2838	1.86E+07
285 3	Zitney	2836	10965	chemical process simulation problem sequence	2836	2367018.914	2837	3.68E+06
286 1	Pajek	10617	72176	directed weighted graph	10617	4.49014284	10618	7.17E+03
28/ 5	Hohn	/500	28462	materials problem	/500	855.5740221	/501	5.22E+01
288 3	Hohn	11532	44206	materials problem	11552	117.1202721	11555	5.48E+01
289 5	rionn Batanala'	10428	03400	thermal problem	10428	0.85E 11	10429	1.94E+02
290 3	Botonakis	1/080	430740	thermal problem	230	7.0JE-11	/0	7.42E-11 4.94E-11
291 4	Oberwolfeeb	14/900	5469300	medal reduction problem	0660	7.70E-11	33	4.04E-11
293 4	Paiek	13356	120238	directed weighted graph	13356	1 448093204	13357	5.52L-11 6.37E+00
293 4	i ajek Pajek	35	120236	directed weighted graph	35	1.440073294	36	2.71E+13
295 4	MKS	7548	834222	electromagnetics problem	7548	0.000438404	7549	6.77E+02
296 2	Sandia	1220	5892	circuit simulation problem sequence	1220	447 2567579	1221	5.46E+06
270 2	Sanara	1220	5672	encan simulation problem sequence	1220	. +1.2301319	1221	5.401100

297	5	Sandia	1220	5892	subsequent circuit simulation problem	1220	7.093560984	1221	3.95E+04
208	5	Condia	1220	5902	aukaaauant ainauit ainaulation maaklam	1220	0.001522026	1221	9 42E 04
298	5	Salidia	1220	3892	subsequent circuit sinulation problem	1220	0.001323030	1221	6.43E-04
299	5	Sandia	1220	5884	subsequent circuit simulation problem	1220	0.012512689	1221	8.63E-02
300	2	Sandia	1220	5852	subsequent circuit simulation problem	1220	0.003390688	1221	2.02E-04
201	1	Sandia	1220	5860	subsequent aircuit simulation problem	1220	0 120575472	1221	4 35E 02
301	1	Salidia	1220	3800	subsequent circuit simulation problem	1220	0.130373473	1221	4.5512-02
302	1	Sandia	1220	5855	subsequent circuit simulation problem	1220	0.014120488	1221	2.94E-02
303	3	Sandia	1220	5888	subsequent circuit simulation problem	1220	0.030749179	1221	9.43E-01
304	4	Sandia	1220	5888	subsequent circuit simulation problem	1220	0.013041759	1221	1.45E-01
205	-	Sandia Con dia	1220	5000	subsequent encuit simulation problem	1220	0.015041755	1221	1.45E 01
305	1	Sandia	1220	3884	subsequent circuit simulation problem	1220	0.000296753	1221	0.30E-04
306	1	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.00270788	1221	5.25E-02
307	4	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.013736088	1221	2.06E-01
208	5	Sandia	1220	5802	subsequent aircuit simulation problem	1220	0.0000414	1221	9 9 2 E 0 2
308	5	Saliula	1220	3892	subsequent circuit sinulation problem	1220	0.0000414	1221	8.8212-03
309	3	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.000304484	1221	7.27E-04
310	2	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.0000231	1221	2.45E-03
311	2	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.0000238	1221	3.73E-02
312	1	Sandia	1220	5802	subsequent circuit simulation problem	1220	0.000100775	1221	1.68E-01
212	1	Salua	1220	5002	subsequent encurt simulation problem	1220	0.000100775	1221	1.00E-01
313	2	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.00000328	1221	1./1E-01
314	2	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.00000754	1221	5.57E-04
315	5	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.00000779	1221	9.98E-03
316	2	Sandia	1220	5802	subsequent circuit simulation problem	1220	0.0000669	1221	5.05E-04
217	4	Sandia	1220	5802	subsequent circuit simulation problem	1220	0.0000000	1221	1.27E.02
317	4	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.00000104	1221	1.37E-02
318	4	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.000000795	1221	2.75E-03
319	4	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.00000636	1221	3.62E-04
320	1	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.000000712	1221	3.76E-04
321	5	Sandia	1220	5802	subsequent circuit simulation problem	1220	2 16E-08	1221	0 17E-04
321	5	Sanuia	1220	3092	subsequent circuit simulation problem	1220	2.10E-06	1221	7.1/E-04
322	4	Sandia	1220	5892	subsequent circuit simulation problem	1220	1.75E-08	1221	1.64E-03
323	3	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.00000017	1221	5.57E-04
324	4	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.00000121	1221	5.75E-05
325	4	Sandia	1220	5802	subsequent circuit simulation problem	1220	4 55E-08	1221	4.12E-04
323	+	Sandia	1220	3092	subsequent circuit simulation problem	1220	4.JJE-06	1221	4.12E-04
326	2	Sandia	1220	5892	subsequent circuit simulation problem	1220	1.82E-08	1221	1.69E-04
327	1	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.00000022	1221	1.30E-02
328	2	Sandia	1220	5892	subsequent circuit simulation problem	1220	1.58E-08	1221	1.57E-05
320	4	Sandia	1220	5802	subsequent circuit simulation problem	1220	7.83E-08	1221	3.96E-02
329	7	Salua	1220	5002	subsequent encurt simulation problem	1220	7.05E-00	1221	0.45E.02
330	2	Sandia	1220	5892	subsequent circuit simulation problem	1220	7.25E-08	1221	9.45E-03
331	2	Sandia	1220	5892	subsequent circuit simulation problem	1220	1.79E-08	1221	2.48E-05
332	3	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.000000497	1221	6.21E-02
333	5	Sandia	1220	5802	subsequent circuit simulation problem	1103	7.52E-11	1221	3 85E-03
333	3	Salua	1220	5002	subsequent encurt simulation problem	1175	7.521-11	1221	3.85E-03
334	3	Sandia	1220	5892	subsequent circuit simulation problem	1220	0.000000354	1221	3.89E-02
335	5	Sandia	1220	5892	subsequent circuit simulation problem	1157	4.63E-11	1221	3.08E-04
336	3	Sandia	1220	5892	subsequent circuit simulation problem	1141	4.62E-11	1221	8.59E-04
337	1	Sandia	1220	5892	subsequent circuit simulation problem	930	6 57E-11	1221	1 53E-03
220	1	Sandia	1220	5002	subsequent circuit simulation problem	064	5.6E 11	1221	2.17E.04
338	1	Salidia	1220	3892	subsequent circuit sinulation problem	904	3.0E-11	1221	2.1/E-04
339	5	Sandia	1220	5892	subsequent circuit simulation problem	808	9.35E-11	1221	2.66E-04
340	2	Sandia	1220	5892	subsequent circuit simulation problem	604	6.7E-11	1221	1.54E-05
341	5	Sandia	1220	5892	subsequent circuit simulation problem	586	9 73E-11	1221	2 20E-04
242	2	Candia	1220	5002	subsequent circuit simulation problem	605	7.02E 11	1221	2.04E 05
342	2	Salidia	1220	3892	subsequent circuit sinulation problem	003	7.03E-11	1221	3.04E-03
343	5	Sandia	1220	5892	subsequent circuit simulation problem	594	1.94E-11	1221	1.59E-05
344	1			5000		571			
345		Sandia	1220	5892	subsequent circuit simulation problem	597	7.45E-11	1221	1.05E-02
	4	Sandia Sandia	1220 1220	5892	subsequent circuit simulation problem subsequent circuit simulation problem	597 602	7.45E-11 2.82E-11	1221	1.05E-02 3.92E-06
246	4	Sandia Sandia	1220 1220	5892 5892	subsequent circuit simulation problem subsequent circuit simulation problem	597 602 595	7.45E-11 2.82E-11	1221 1221 1221	1.05E-02 3.92E-06
346	4 2	Sandia Sandia Sandia	1220 1220 1220	5892 5892 5892	subsequent circuit simulation problem subsequent circuit simulation problem subsequent circuit simulation problem	597 602 595	7.45E-11 2.82E-11 4.67E-11	1221 1221 1221	1.05E-02 3.92E-06 1.64E-01
346 347	4 2 4	Sandia Sandia Sandia Sandia	1220 1220 1220 1220	5892 5892 5892 7382	subsequent circuit simulation problem subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem sequence	597 597 602 595 564	7.45E-11 2.82E-11 4.67E-11 9.4E-11	1221 1221 1221 624	1.05E-02 3.92E-06 1.64E-01 6.80E-11
346 347 348	4 2 4 2	Sandia Sandia Sandia Sandia Sandia	1220 1220 1220 1220 1220	5892 5892 5892 7382 7382	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem sequence subsequent circuit simulation problem	597 602 595 564 621	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11	1221 1221 1221 624 877	1.05E-02 3.92E-06 1.64E-01 6.80E-11 8.04E-11
346 347 348 349	4 2 4 2 5	Sandia Sandia Sandia Sandia HB	1220 1220 1220 1220 1220 1220 183	5892 5892 5892 7382 7382 998	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem subsequent circuit simulation problem 2D/3D problem sequence	597 602 595 564 621 183	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592	1221 1221 1221 624 877 21	1.05E-02 3.92E-06 1.64E-01 6.80E-11 8.04E-11 3.48E-11
346 347 348 349 350	4 2 4 2 5 5	Sandia Sandia Sandia Sandia HB HB	1220 1220 1220 1220 1220 1220 183 183	5892 5892 5892 7382 7382 998 1069	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem subsequent circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem	597 602 595 564 621 183 183	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577	1221 1221 1221 624 877 21 32	1.05E-02 3.92E-06 1.64E-01 6.80E-11 8.04E-11 3.48E-11 9.62E-11
346         347           348         348           349         350	4 2 4 2 5 5 5	Sandia Sandia Sandia Sandia Sandia HB HB HB	1220 1220 1220 1220 1220 1220 183 183 183	5892           5892           5892           5892           7382           7382           998           1069           1069	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem sequence subsequent circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem cubsequent 2D/3D problem	597 602 595 564 621 183 183 183	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577	1221 1221 1221 624 877 21 32 21	1.05E-02 3.92E-06 1.64E-01 6.80E-11 8.04E-11 3.48E-11 9.62E-11 2.11E-11
346         347           347         348           349         350           351         351	4 2 4 2 5 5 5 2	Sandia Sandia Sandia Sandia HB HB HB HB	1220 1220 1220 1220 1220 183 183 183 183	3892           5892           5892           7382           7382           998           1069           1069	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem	597 602 595 564 621 183 183 183 183	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222	1221 1221 1221 624 877 21 32 21 32	1.05E-02 3.92E-06 1.64E-01 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.05E-12
346         347           347         348           349         350           351         352	4 2 4 2 5 5 5 2 1	Sandia Sandia Sandia Sandia Sandia HB HB HB HB	1220           1220           1220           1220           183           183           183	3892           5892           5892           7382           7382           998           1069           1000	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem	597         602           595         564           621         183           183         183           183         183	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000222	1221 1221 1221 624 877 21 32 21 19	1.05E-02 3.92E-06 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12
346         347           348         349           350         351           352         353	4 2 4 2 5 5 5 2 1 3	Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB	1220           1220           1220           1220           1220           183           183           183           541	3892           5892           5892           7382           7382           998           1069           1000           4282	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem subsequent 2D/3D problem	597         602           595         564           621         183           183         183           183         13	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.00000028 5.07E-11	1221 1221 624 877 21 32 21 19 8	1.05E-02 3.92E-06 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11
346           347           348           349           350           351           352           353           354	4 2 4 2 5 5 5 2 1 3 1	Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 183 183 183 183 541 541	3892           5892           5892           7382           7382           998           1069           1069           4282	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem	597         602           595         564           621         183           183         183           183         183           183         541	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000268 5.07E-11 0.00000539	1221 1221 624 877 21 32 21 19 8 137	1.05E-02 3.92E-06 1.64E-01 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11
346           347           348           349           350           351           352           353           354	4 2 4 2 5 5 2 1 3 1 2	Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 183 183 183 183 541 541 541	5892           5892           5892           7382           7382           998           1069           1000           4282           4282           4282	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem sequence subsequent circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem	597         602           595         564           621         183           183         183           183         13           541         541	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000222 0.000000228 5.07E-11 0.0000539 0.191673528	1221 1221 624 877 21 32 21 19 8 8 137 255	1.05E-02 3.92E-06 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.782E-11
346           347           348           349           350           351           352           353           354           355           355	4 2 4 2 5 5 5 2 1 3 1 2 2	Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 183 183 183 183 183 541 541 541	5892           5892           5892           7382           7382           998           1069           1000           4282           4282           4282           4282           4282	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem	597           602           595           564           621           183           183           183           183           183           183           541           541	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.00000268 5.07E-11 0.0000539 0.191673528 0.091673528	1221 1221 1221 624 877 21 32 21 19 8 137 255 102	1.05E-02 3.92E-06 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.782E-11 7.76E-11 7.76E-11
346           347           348           349           350           351           352           353           354           355           356	4 2 4 2 5 5 2 1 3 1 2 4 4	Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 183 183 183 183 541 541 541 541 541	5892           5892           5892           7382           7382           7382           998           1069           1000           4282           4282           4282           4282           4282	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem	597         602           595         564           621         183           183         183           183         541           541         541           542         541	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000222 0.000000268 5.07E-11 0.00000539 0.191673528 0.003084941	1221 1221 624 877 21 32 21 19 8 137 255 192	1.05E-02 3.92E-06 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.73E-11 7.64E-11
346           347           348           349           350           351           352           353           354           355           356           357	4 2 4 2 5 5 2 1 3 1 2 4 2 4 2 2 1 3 1 2 4 2 2 1 3 1 2 4 2 2 2 1 3 1 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2	Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220           1220           1220           1220           1220           183           183           183           541           541           541           541	3892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           2184	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem	597         602           595         564           621         183           183         183           183         13           541         541           541         370	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000000222 0.000000222 0.000000228 5.07E-11 0.00000339 0.191673528 0.003084941 8.19E-11	1221 1221 1221 624 877 21 32 21 19 8 8 137 255 192 68	1.05E-02 3.92E-06 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.64E-11 5.64E-11
346           347           348           349           350           351           352           353           354           355           356           357           358	4 2 4 2 5 5 5 2 1 1 3 1 2 4 2 5	Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 183 183 183 183 183 541 541 541 541 541 541 680 680	5892           5892           5892           7382           998           1069           1000           4282           4282           4282           4282           4284           4273           2184           2424	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem	597         602           595         564           621         183           183         183           183         183           183         541           541         541           541         680	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000268 5.07E-11 0.000000539 0.191673528 0.003084941 8.19E-11 0.00000412	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75	1.05E-02 3.92E-06 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.73E-11 7.64E-11 5.64E-11 8.23E-11
346           347           348           349           350           351           352           353           354           355           356           357           358           359	4 2 4 2 5 5 5 2 1 3 1 2 4 2 5 5 1	Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 183 183 183 183 541 541 541 541 541 680 680 680	3892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4282           4282           4282           4282           4282           4282           4282           4273           2184           2424           2471	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem	597           602           595           564           621           183           183           183           13           541           541           541           541           541           680	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000222 0.00000228 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000427	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100	1.05E-02 3.92E-06 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 7.82E-11 7.73E-11 7.64E-11 5.64E-11 5.64E-11 5.17E-11
346           347           348           349           350           351           352           353           354           355           356           357           358           359           360	4 2 4 2 5 5 5 2 1 3 1 2 4 2 5 5 1 3 1 2 4 2 5 5 1 3 1 2 4 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 183 183 183 183 541 541 541 541 541 541 680 680 680	3892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4282           4282           4282           5730	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence	597           602           595           564           621           183           183           183           13           541      <	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000268 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000427 8.65E 11	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5	1.05E-02 3.92E-06 1.64E-01 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.73E-11 7.64E-11 8.23E-11 5.74E-11 8.23E-11 5.17E-11 4.18E-11
346           347           348           349           350           351           352           353           354           355           356           357           358           359           360	4 2 4 2 5 5 5 2 1 3 1 2 4 2 5 5 5 2 1 3 5 5 5 5 5 5 5 5 5 5 5 5 5	Sandia Sandia Sandia Sandia Sandia MB HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4273           2184           2471           5739	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem	597           602           595           564           621           183           183           183           541           541           541           541           541           680           680           114	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000222 0.000000228 5.07E-11 0.00000539 0.191673528 0.003084941 8.19E-11 0.00000412 0.00000412 0.0000427 8.65E-11 0.0256752	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 597	1.05E-02 3.92E-06 (.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.73E-11 7.64E-11 5.64E-11 5.17E-11 4.18E-11 2.55E 11
346           347           348           349           350           351           352           353           354           355           356           357           358           359           360           361	4 2 4 2 5 5 5 2 1 1 3 1 2 4 4 2 5 5 1 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Sandia Sandia Sandia Sandia Sandia MB HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 183 183 183 183 183 541 541 541 541 541 541 680 680 680 680 680 760 760	3892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           5739           5739	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem	597         602           595         564           621         183           183         183           183         13           541         541           541         370           680         680           114         760	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000268 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000412 0.0000427 8.65E-11 0.025250272	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 192 68 75 100 5 5 586	1.05E-02 3.92E-06 6.80E-11 8.04E-01 6.80E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.73E-11 5.64E-11 5.64E-11 5.64E-11 8.23E-11 3.15E-11
346         347           348         349           350         351           352         353           354         355           356         357           358         359           360         361           362         362	4 2 4 2 5 5 5 2 1 3 1 2 4 2 5 5 1 1 2 2 4 2 5 5 5 1 3 3 5 5 4	Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 183 183 183 183 183 541 541 541 541 541 541 541 680 680 680 680 680 760 760	5892           5892           5892           7382           7382           998           1069           1000           4282           4282           4282           4282           2184           2424           2471           5739           5739           5816	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem	597           602           595           564           621           183           183           183           183           541           541           541           541           680           680           680           760           760	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000228 5.07E-11 0.000000259 0.191673528 0.003084941 8.19E-11 0.00000412 0.00000412 0.0000427 8.65E-11 0.025250272 0.001589629	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 586 761	1.05E-02 3.92E-06 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.73E-11 5.64E-11 8.23E-11 5.17E-11 4.18E-11 3.15E-11 2.41E+00
346           347           348           349           350           351           352           353           354           355           356           357           356           357           358           359           360           361           363	4 2 4 2 5 5 5 2 1 1 3 1 2 4 4 2 5 5 5 2 1 1 3 3 1 1 2 5 5 5 5 2 4 4 4	Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 183 183 183 183 541 541 541 541 541 541 541 680 680 760 760 760 760 2880	3892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           5739           5739           5816           18229	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem	597           602           595           564           621           183           183           183           13           541           541           541           541           680           114           760           2880	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.00000222 0.00000228 5.07E-11 0.00000339 0.191673528 0.003084941 8.19E-11 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572	1221 1221 1221 624 877 21 32 21 19 8 8 137 255 68 75 100 5 5 586 761 2881	1.05E-02 3.92E-06 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 7.73E-11 7.73E-11 7.64E-11 5.64E-11 8.23E-11 5.17E-11 4.18E-11 3.15E-11 2.41E-00 1.39E+28
346         347           348         349           350         351           352         353           354         353           355         356           357         358           359         360           361         362           363         364	4 2 4 2 5 5 2 1 3 1 2 4 2 5 5 5 2 1 3 5 5 1 3 5 5 1 3 5 5 5 5 5 5 5 5 5 5 5 5 5	Sandia Sandia Sandia Sandia Sandia MB HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4282           5739           5739           5816           18229           1829	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem conomic problem subsequent 2D/3D problem	597         602           595         564           621         183           183         183           183         183           13         541           541         541           541         541           541         541           541         70           680         680           670         760           780         2880	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000268 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000412 0.0000427 8.65E-11 0.0025250272 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216685.2572 0.001589629 216585.2572 0.00158565 0.0015856 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577 0.00158577	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 586 761 2881 2881	1.05E-02 3.92E-06 (6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.73E-11 5.64E-11 8.23E-11 5.17E-11 4.18E-11 3.15E-11 2.41E+00 1.39E+28 5.27E+21
346           347           348           349           350           351           352           353           354           355           356           357           358           359           360           361           362           363           364           364	4 2 4 2 5 5 2 1 3 1 2 4 4 2 5 5 2 1 1 2 4 4 2 5 5 5 2 1 1 3 5 5 5 5 5 5 5 5 5 5 5 5 5	Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 133 183 183 183 183 183 183 183 183 541 541 541 541 541 541 680 680 680 760 760 2880 2880 2880	3892           5892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4282           4273           2184           2471           5739           57316           18229           18229           1255	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem conomic problem economic problem	597           602           595           564           621           183           183           183           183           541           542           680           680           680           680           2880           2880           2880	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000222 0.000000222 0.00000028 5.07E-11 0.0000039 0.191673528 0.003084941 8.19E-11 0.00000412 0.00000412 0.00000412 0.00000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 05090 4721	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 586 761 2881 2881 2881 586	1.05E-02 3.92E-06 1.64E-01 6.80E-11 8.04E-11 3.48E-11 9.62E-11 3.11E-11 4.95E-12 7.82E-11 5.86E-11 7.73E-11 7.64E-11 5.64E-11 8.23E-11 5.17E-11 4.18E-11 3.15E-11 2.41E+00 1.39E+28 5.27E+21 2.26E-29
346           347           348           349           350           351           352           353           354           353           354           355           353           354           355           356           357           358           359           360           361           362           363           364           364           365	4 2 4 2 5 5 5 2 2 1 3 1 2 2 4 2 5 5 1 3 1 2 2 4 4 2 5 5 5 5 1 2 2 1 3 1 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4282           5739           5739           5739           5816           18229           42568	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem conomic problem economic problem	597           602           595           564           621           183           183           183           183           13           541           542           580           2880           5850	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000268 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 95989.42594	1221 1221 1221 624 877 21 32 21 19 8 8 137 255 192 68 75 100 5 5 586 761 2881 2881 2881 2881	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.64E-11           5.64E-11           5.7E-11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28
346           347           348           349           350           351           352           353           354           355           356           357           358           359           360           361           362           363           364           365           366	4 2 4 2 5 5 5 2 1 1 2 5 5 1 1 2 2 1 1 2 5 5 1 1 2 5 5 5 1 2 2 1 1 2 5 5 5 5	Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4273           2184           2471           5739           5816           18229           18229           42568           42568	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem	597           602           595           564           621           183           183           183           541           541           541           541           541           541           541           541           542           760           2880           2880           5850	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000228 5.07E-11 0.0000002539 0.191673528 0.003084941 8.19E-11 0.00000412 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.2471649	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 586 75 100 5 586 761 2881 2881 2881 2881 5851 5851	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           7.64E-11           8.23E-11           5.17E-11           4.18E-11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24
346           347           348           349           350           351           353           354           353           354           355           353           354           355           357           358           359           360           361           362           363           364           365           364           365           366           366           366	4 2 4 2 5 5 5 2 2 1 3 1 2 2 4 2 5 5 5 5 2 2 1 3 1 2 2 4 4 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           5739           5739           5739           5816           18229           42568           42568           107383	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem conomic problem economic problem economic problem economic problem	597           602           595           564           621           183           183           183           13           541           580           2880           2880           5850           5850           5850	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000228 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000412 0.0000412 0.0000412 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.2471649 438.8368655	1221 1221 1221 624 877 21 32 21 19 8 8 137 255 192 68 75 192 68 75 192 68 75 5 5 5 5 5 5 5 5 5 5 5 86 761 2881 2881 2881 58551 11791	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           5.64E-11           5.64E-11           5.7E-11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24           8.23E+18
346         347           348         349           350         351           352         353           354         353           355         356           357         358           359         360           361         362           363         -           364         365           364         365           364         365           366         366           367         368	4 2 4 2 5 5 5 5 2 1 3 1 2 4 2 5 5 5 5 5 5 5 5 7 1 3 1 2 4 4 2 5 5 5 5 5 5 5 5 5 5 5 5 5	Sandia Sandia Sandia Sandia Sandia MB MB HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           998           1069           1000           4282           4282           4282           4282           4282           4273           2184           2424           2471           5739           5816           18229           42568           42568           107383	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem conomic problem economic problem economic problem economic problem economic problem	597           602           595           564           621           183           183           183           183           541           541           541           541           541           541           541           542           543           760           2880           5850           5850           5850           5850           5850           11790	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000268 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000427 8.65E-11 0.0025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.2471649 438.8368655 2671.371033	1221 1221 1221 624 877 21 32 221 19 8 137 255 192 68 75 100 5 5 86 75 100 5 5 86 761 2881 2881 5851 5851 5851 11791 11791	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.1E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.64E-11           8.23E-11           5.64E-11           8.23E-11           5.17E-11           4.18E-11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24           8.23E+18           4.63E+21
346           347           348           349           350           351           352           353           354           352           353           354           355           356           357           358           359           360           361           363           364           365           366           366           366           366           367           368		Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4282           4282           4273           2184           2471           5739           5816           18229           18229           18229           18229           18229           18229           18229           18229           18229           182368           107383           107383           107383	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem conomic problem economic problem economic problem economic problem economic problem economic problem	597           602           595           564           621           183           183           183           183           541           541           541           541           541           541           541           542           543           760           2880           2880           2880           5850           11790           11790           11790	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000222 0.000000222 0.00000028 5.07E-11 0.000000412 0.0000412 0.0000412 0.0000412 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.24711649 438.8368655 2671.371033 112 9787029	1221 1221 1221 624 877 21 32 21 19 8 8 137 255 68 75 100 5 5 586 761 2881 2881 2881 2881 2881 5851 11791 11791	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           7.64E-11           8.23E-11           5.17E-11           4.18E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24           8.23E+18           4.65E+21
346           347           348           349           350           351           352           353           354           353           354           355           354           355           354           355           356           357           358           359           360           361           362           363           364           365           366           366           366           366           366           366           366           366           366           366           367           368           369           368           369	4 2 4 2 5 5 2 1 3 1 2 5 5 2 2 1 3 1 2 5 5 5 2 2 1 3 1 2 5 5 5 5 2 2 1 3 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5	Sandia Sandia Sandia Sandia Sandia Sandia MB MB HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           998           1069           1069           1069           1000           4282           4282           4282           4282           4282           4282           5739           5739           5739           5816           18229           42568           107383           107383           145157	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem conomic problem economic problem economic problem economic problem economic problem economic problem economic problem	597           602           595           564           621           183           183           183           183           541           580           5850           5850           5850           5850           5850           5850           5850           51790           11790	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000268 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000427 8.65E-11 0.0025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.2471649 438.8368655 2671.371033 112.9787029 1469.30525	1221 1221 1221 624 877 21 32 21 19 8 8 137 255 192 68 75 100 5 5 5 86 761 2881 2881 2881 2881 2881 2881 11791 11791 11791	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           7.64E-11           8.23E-11           5.64E-11           8.23E-11           5.17E-11           4.18E-11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24           8.23E+18           4.63E+21           5.91E+27           5.91E+27
346           347           348           349           350           351           352           353           354           355           356           357           358           359           360           361           362           366           366           366           366           367           368           367           368           367           368           367           368           367           368           367		Sandia Sandia Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4282           4282           4283           4284           2471           5739           5816           18229           18229           42568           107383           107383           145157           183325	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem conomic problem economic problem	597           602           595           564           621           183           183           183           541           541           541           541           541           541           541           542           760           2880           5850           5850           11790           11790           14760           17730	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000228 5.07E-11 0.0000002539 0.191673528 0.003084941 8.19E-11 0.00000412 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.2471649 438.8368655 2671.371033 112.9787029 1468.33252	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 586 761 2881 2881 2881 2881 2881 5851 5851 5851 11791 11791 11791 14761 17731	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           7.64E-11           8.23E-11           5.17E-11           4.18E-11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24           8.23E+18           4.63E+21           5.91E+27           1.08E+27
346           347           348           349           350           351           353           354           353           354           355           353           354           355           357           358           359           360           361           362           363           364           365           366           364           365           366           366           367           368           369           370           371	4       2       4       2       5       5       2       1       2       4       2       5       1       2       4       3       5       4       3       1       2       3       5       2       2       2       2       2       2       2       2	Sandia Sandia Sandia Sandia Sandia Sandia MB HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4273           2184           2424           2471           5739           5739           5816           18229           42568           107383           107383           107383           183325	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem 2J/3D problem sequence 2J/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem economic problem	597           602           595           564           621           183           183           183           183           13           541           580           5850           5850           5850           11790           11790           14760           17730           17730	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000228 5.07E-11 0.0000339 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.2471649 438.8368655 2671.371033 112.9787029 1468.33252	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 5 5 586 761 2881 2881 2881 2881 2881 2881 2881 11791 11791 11791 11791 11731	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           5.64E-11           5.64E-11           3.15E-11           4.18E-11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24           8.23E+18           4.63E+21           5.91E+27           1.08E+27           2.94E+30
346           347           348           349           350           351           352           353           354           355           356           357           358           359           360           361           363           364           365           366           367           366           367           368           369           370           371	4       2       4       2       5       5       2       1       3       1       2       5       1       3       5       4       3       5       2 <t< td=""><td>Sandia Sandia Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB</td><td>1220 1220 1220 1220 1220 1220 1220 1220</td><td>3892           5892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4273           2184           2471           5739           5816           18229           42568           407383           107383           145157           183325           259648</td><td>subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem conomic problem economic problem</td><td>597           602           595           564           621           183           183           183           183           541           541           541           541           541           541           541           542           543           680           680           680           680           5850           5850           5850           5850           11790           117730           23670</td><td>7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000105577 0.000000222 0.00000268 5.07E-11 0.00000539 0.191673528 0.003084941 8.19E-11 0.00000412 0.0000427 8.65E-11 0.0025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.2471649 438.836855 2671.371033 112.9787029 1468.33252 256.9230887 229.7534584</td><td>1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 586 761 2881 5851 5851 5851 11791 117731 12761 17731 23671</td><td>1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           7.64E-11           8.23E-11           5.64E-11           8.23E-11           5.17E-11           4.18E-11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24           8.23E+18           4.63E+21           5.91E+27           1.08E+27           2.94E+30           1.04E+28</td></t<>	Sandia Sandia Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4273           2184           2471           5739           5816           18229           42568           407383           107383           145157           183325           259648	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem conomic problem economic problem	597           602           595           564           621           183           183           183           183           541           541           541           541           541           541           541           542           543           680           680           680           680           5850           5850           5850           5850           11790           117730           23670	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000105577 0.000000222 0.00000268 5.07E-11 0.00000539 0.191673528 0.003084941 8.19E-11 0.00000412 0.0000427 8.65E-11 0.0025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.2471649 438.836855 2671.371033 112.9787029 1468.33252 256.9230887 229.7534584	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 586 761 2881 5851 5851 5851 11791 117731 12761 17731 23671	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           7.64E-11           8.23E-11           5.64E-11           8.23E-11           5.17E-11           4.18E-11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24           8.23E+18           4.63E+21           5.91E+27           1.08E+27           2.94E+30           1.04E+28
346           347           348           349           350           351           352           353           354           355           356           357           358           359           360           361           362           363           364           365           364           365           364           365           366           367           368           369           370           371           372	4       2       4       2       5       5       2       1       3       1       2       5       1       3       5       1       3       5       1       3       5       2       2       2       2       2       2       2       2       2       2       2       1	Sandia Sandia Sandia Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4282           4282           4273           2184           2471           5739           5739           5816           18229           18229           18229           18229           18229           1833107383           107383           107383           107383           107383           259648           259648	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem economic problem	597           602           595           564           621           183           183           183           183           541           540           680           680           2880           2880           5850           11790           11730           17730           23670      23670	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000228 5.07E-11 0.0000028 5.07E-11 0.0000412 0.0000412 0.0000412 0.0000412 0.0000412 0.0000412 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.2471649 438.8368655 2671.371033 112.9787029 1468.33252 256.9230887 229.7534584 62,5033403	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 5 586 761 1791 11791 11791 11791 11791 11791 117731 17731 17731 23671 23671 23671	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           5.64E-11           5.64E-11           5.64E-11           3.15E-11           4.18E-11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24           8.23E+18           4.63E+21           5.91E+27           1.08E+27           2.94E+30           1.04E+28
346           347           348           349           350           351           352           353           354           353           354           355           353           354           355           353           354           355           353           356           357           358           359           360           361           362           363           364           365           366           366           366           367           368           369           370           371           372           373	4         2         4         2         5         5         2         1         3         1         2         4         2         4         2         4         2         5         1         2         3         1         2         3         1         2 <td< td=""><td>Sandia Sandia Sandia Sandia Sandia Sandia MB HB HB HB HB HB HB HB HB HB HB HB HB HB</td><td>1220 1220 1220 1220 1220 1220 1220 1220</td><td>3892           5892           5892           5892           7382           7382           998           1069           1069           1069           1069           1000           4282           4282           4282           4282           4273           2184           2424           2471           5739           5739           5816           18229           42568           42568           107383           107383           145157           183325           259648           259648           25972</td><td>subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem economic problem</td><td>597           602           595           564           621           183           183           183           183           183           541</td><td>7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000268 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000412 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 95989.42594 438.8368655 2671.371033 112.9787029 1468.33252 256.933403 5.234404202</td><td>1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 586 761 2881 2881 5851 5851 11791 11791 11791 117731 23671 23671 23671 23671 23671</td><td>1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           7.64E-11           8.23E-11           5.64E-11           8.23E-11           5.77E-11           4.18E-11           3.15E-11           2.41E+00           1.39E+28           2.35E+24           8.23E+12           3.6E+28           2.35E+24           8.23E+11           5.91E+27           1.08E+27           1.08E+27           1.04E+28           1.88E+26           1.23E-21</td></td<>	Sandia Sandia Sandia Sandia Sandia Sandia MB HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           7382           998           1069           1069           1069           1069           1000           4282           4282           4282           4282           4273           2184           2424           2471           5739           5739           5816           18229           42568           42568           107383           107383           145157           183325           259648           259648           25972	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem economic problem	597           602           595           564           621           183           183           183           183           183           541	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000268 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000412 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 95989.42594 438.8368655 2671.371033 112.9787029 1468.33252 256.933403 5.234404202	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 586 761 2881 2881 5851 5851 11791 11791 11791 117731 23671 23671 23671 23671 23671	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           7.64E-11           8.23E-11           5.64E-11           8.23E-11           5.77E-11           4.18E-11           3.15E-11           2.41E+00           1.39E+28           2.35E+24           8.23E+12           3.6E+28           2.35E+24           8.23E+11           5.91E+27           1.08E+27           1.08E+27           1.04E+28           1.88E+26           1.23E-21
346           347           348           349           350           351           352           353           354           352           353           354           355           356           357           358           359           360           361           362           363           364           365           366           367           368           367           370           371           373           374	$\begin{array}{c} 4\\ 2\\ 4\\ 2\\ 5\\ 5\\ 5\\ 5\\ 2\\ 2\\ 1\\ 3\\ 1\\ 2\\ 4\\ 4\\ 2\\ 5\\ 5\\ 1\\ 1\\ 3\\ 5\\ 5\\ 4\\ 4\\ 4\\ 3\\ 5\\ 5\\ 2\\ 2\\ 2\\ 2\\ 2\\ 2\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\ 1\\$	Sandia Sandia Sandia Sandia Sandia HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4282           4282           4273           2184           2471           5739           5816           18229           18229           18229           18229           18229           183325           183325           183325           259648           335972	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem subsequent 2D/3D problem conomic problem economic problem	597           602           595           564           621           183           183           183           183           541           541           541           541           541           541           542           680           680           680           680           5850           5850           5850           11790           11790           117730           23670           29610	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.000000222 0.000000222 0.000000268 5.07E-11 0.00000539 0.191673528 0.003084941 8.19E-11 0.00000412 0.0000427 8.65E-11 0.025250272 0.001589629 216685.2572 4025.275366 95989.42594 292.2471649 438.8368655 2671.371033 112.9787029 1468.33252 256.9230887 229.7534584 62.5933403 5.714404283	1221 1221 1221 624 877 21 32 21 19 8 137 255 8 137 255 68 75 100 5 586 761 100 5 586 761 2881 2881 2881 2881 11791 11791 11791 117731 23671 23671 29611	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           7.64E-11           8.23E-11           5.17E-11           4.18E-11           3.36E+28           2.35E+24           8.23E+18           4.63E+21           5.91E+27           1.08E+27           2.94E+30           1.04E+28           1.88E+26           1.33E+21
346           347           348           349           350           351           352           353           354           355           353           354           355           353           354           355           357           358           359           360           361           362           363           364           365           366           366           366           367           368           369           370           371           372           373           374           375		Sandia Sandia Sandia Sandia Sandia Sandia MB MB HB HB HB HB HB HB HB HB HB HB HB HB HB	1220 1220 1220 1220 1220 1220 1220 1220	3892           5892           5892           5892           7382           7382           998           1069           1069           1000           4282           4282           4282           4282           4282           4282           4282           4282           4282           4273           2184           2424           2471           5739           5739           5816           18229           42568           107383           107383           107383           107383           107383           259648           259648           335972	subsequent circuit simulation problem subsequent circuit simulation problem circuit simulation problem circuit simulation problem 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence 2D/3D problem sequence subsequent 2D/3D problem 2D/3D problem sequence subsequent 2D/3D problem subsequent 2D/3D problem conomic problem economic problem	597           602           595           564           621           183           183           183           183           183           541           560           2880           2880           2880           2880           2880           11790           14760           17730           23670      29610      29610	7.45E-11 2.82E-11 4.67E-11 9.4E-11 8.04E-11 0.00000592 0.000165577 0.00000222 0.00000268 5.07E-11 0.0000539 0.191673528 0.003084941 8.19E-11 0.0000412 0.0000412 0.0000427 8.65E-11 0.0025250272 0.001589629 216685.2572 4025.275366 95989.42594 4025.275366 95989.42594 4025.275366 95989.42594 4025.275366 95989.42594 202.2471649 438.836855 2671.371033 112.9787029 1468.33252 256.9230887 229.7534584 62.5933403 5.714404283 841.8251127	1221 1221 1221 624 877 21 32 21 19 8 137 255 192 68 75 100 5 5 586 761 2881 2881 2881 2881 2881 11791 11791 11791 14761 17731 23671 23671 29611 29611	1.05E-02           3.92E-06           1.64E-01           6.80E-11           8.04E-11           3.48E-11           9.62E-11           3.11E-11           4.95E-12           7.82E-11           5.86E-11           7.73E-11           7.64E-11           8.23E-11           5.64E-11           8.23E-11           5.7E+11           3.15E-11           2.41E+00           1.39E+28           5.27E+21           3.36E+28           2.35E+24           8.23E+18           4.63E+21           5.91E+27           1.08E+27           2.94E+30           1.04E+28           1.33E+21           6.80E+21

376 3	Hollinger	35550	412306	economic problem	35550	670.2886172	35551	6.37E+28
377 5	Hollinger	35550	412306	economic problem	35550	79365.32116	35551	1.96E+25
378 4	Hollinger	41490	488633	economic problem	41490	22.54184863	41491	3.38E+17
379 5	Hollinger	41490	488633	economic problem	41490	25712537.74	41491	1.10E+17
380 5	Hollinger	47430	564952	economic problem	47430	7347.208266	47431	9.28E+15
381 5	Hollinger	47430	564952	economic problem	47430	7347.208266	47431	2.18E+22
382 5	Hollinger	53370	641290	economic problem	53370	2053.361608	53371	1.39E+16
383 3	Hollinger	53370	641290	economic problem	53370	29405.78602	53371	4.24E+17
384 5	Hollinger	59310	717620	economic problem	59310	3333.542719	59311	9.51E+13
385 1	Hollinger	59310	717620	economic problem	59310	12691466.4	59311	2.26E+16
386 5	Garon	3175	84723	computational fluid dynamics problem	3175	0.00000156	3176	9.27E-08
387 1	Garon	13535	373235	computational fluid dynamics problem	11972	9.73E-11	13536	9.41E-11
388 5	Pajek	352	458	directed graph	352	5.23E+14	353	8.89E+17
389 2	Pajek	638	1041	directed multigraph	638	5.507800231	639	6.32E+00
390 2	Pajek	052	645	directed weighted graph	311	2.13E+13	312	4.99E+15
391 5	Pajek	935	125	directed multigraph	430	0.62E+12	4	2.06E+13 8.40E+12
393 5	Pajek	23	87	directed multigraph	23	0.0000141	24	8.40E+15 8.94E-06
394 5	Pajek	1538	8032	directed graph	1538	14 29157494	1539	3.67E+00
395 5	Pajek	36	57	directed graph	36	5 09E+14	37	3.72E+14
396 5	Pajek	62	287	directed graph	62	0.002700967	63	4.17E-03
397 5	Pajek	1096	1677	directed multigraph	1096	3.25E+12	1097	2.68E+13
398 3	Pajek	180	229	directed graph	180	23249.64515	181	1.62E+04
399 1	Pajek	452	460	directed multigraph	452	1.01E+18	453	2.93E+19
400 2	Pajek	38	50	directed graph	38	2.13E+12	39	1.13E+13
401 5	Pajek	105	149	directed graph	105	1.36E+15	106	1.61E+15
402 5	HB	4929	33108	power network problem sequence	4929	17.51807364	4930	3.02E+00
403 2	HB	4929	33044	subsequent power network problem	4929	36.98271282	4930	3.81E+01
404 4	HB	113	655	statistical/mathematical problem	113	0.0000062	1	1.00E+00
405 4	Pajek	72	122	directed graph	72	2.42E+14	73	1.39E+14
406 4	Goodwin	7320	324772	computational fluid dynamics problem	7320	34.06011733	7321	1.99E+01
407 4	Graham	9035	335472	computational fluid dynamics problem	9035	0.878544677	9036	2.26E-01
408 2	HB	1107	5664	directed weighted graph	1107	10030.31361	1108	2.21E+03
409 4	HB	115	421	directed weighted graph	81	4.32E-11	116	3.0/E-04
410 1	HB	185	9/5	directed weighted graph	185	35.04201454	180	4.18E+02
411 5	ПВ	210	812	directed weighted graph	210	1470694421	217	3.23E-01 4.22E+11
412 2		242	1210	directed weighted graph	242	17 85042408	217	4.55E+11
413 3	HB	512	1976	directed weighted graph	512	1 052491413	513	3.05E+00
415 4	Fluorem	7980	430909	computational fluid dynamics problem	7980	0.025293894	7981	1 20E-06
416 1	Hamrle	32	98	circuit simulation problem	32	0.05319039	33	4.03E-01
417 3	Hamrle	5952	22162	circuit simulation problem	5952	13.82882028	13	3.14E-12
418 1	MathWorks	500	2636	directed graph	500	2.046612349	501	1.42E+00
419 5	Hamm	105676	513072	circuit simulation problem	8742	9.61E-11	3660	8.70E-11
420 2	Norris	3557	1385317	2D/3D problem	3557	0.049811819	3558	2.49E-04
421 5	Norris	2339	680341	2D/3D problem	2339	0.000104536	2340	4.85E-04
422 1	Norris	2339	680341	2D/3D problem	2339	0.000303247	2340	8.07E-05
423 5	Pajek	27240	342437	directed graph	27240	2.8E+16	612	2.60E+04
424 3	Pajek	27770	352807	directed graph	27770	2.43E+18	594	2.12E+01
425 3	HB	434	4182	directed weighted graph	434	36.10614802	435	1.74E+00
426 5	HVDC	24842	158426	power network problem	24842	5.356/16545	24843	3.82E+00
427 1	HVDC	189860	1339638	power network problem	189860	0.88	189860	9.89E-02
428 3	Zitney	5308	22080	chemical process simulation problem	5308	1/0080.3//4	5309	2./4E+03 5.89E±06
429 2	Sahark IPMSDS	51449	527028	comican process simulation problem sequence	51448	1330003.878	12700	7.52E 11
431 2	HB	32	126	directed graph	32	2 87E-08	33	9 90E-08
432 4	Schenk_ISEI	10938	130500	semiconductor device problem	10938	244.3294263	10939	4.59E-03
433 2	Szczerba	20896	191368	computational fluid dynamics problem	20896	0.00000167	20897	7.36E-06
434 3	HB	207	572	chemical process simulation problem	207	20.46686471	208	2.29E+01
435 4	HB	137	400	chemical process simulation problem	137	4.46731532	138	2.32E+00
436 3	HB	425	1255	chemical process simulation problem	425	18.27772173	426	1.72E+01
437 4	HB	225	1303	chemical process simulation problem	225	0.46929969	226	1.11E+01
438 5	Sandia	1813	11156	circuit simulation problem sequence	883	7.79E-11	679	3.51E-11
439 4	Oberwolfach	11730	328323	model reduction problem	11730	44243348.74	11731	4.06E+11
440 2	Pajek	124651	207214	directed weighted graph	124651	7.59E+12	124652	3.10E+15
441 5	POLYFLOW	30412	1793881	computational fluid dynamics problem	30412	596.7035436	30413	nan
442 4	Meszaros	3001	9000	linear programming problem	3001	1/86.7/0832	3002	/.62E+03
443 5	Hollinger	6774	33/44	economic problem	0//4	1495.303201	0//3	1.89E+08
444 4	Hollinger	0//4	33/44	economic problem	0//4	438/33/.44	0//3	1./1E-08 4.57E+07
445 5	Hollinger	13094	72734	economic problem	13094	260/8/2 19/	13095	+.3/E+0/ 4 32E±05
447 4	Hollinger	20614	111903	economic problem	20614	56014 82737	20615	1.32E+03
448 3	Hollinger	20614	111903	economic problem	20614	53702148.06	20615	7 13E+05
449 4	Hollinger	27534	151063	economic problem	27534	199215.4704	27535	1.02E+08
450 1	Hollinger	27534	151063	economic problem	27534	6461859173	27535	5.11E+04
451 3	Hollinger	34454	190224	economic problem	34454	2675706.293	34455	8.32E+06
452 1	Hollinger	34454	190224	economic problem	34454	69206858.76	34455	1.24E+06
453 2	Hollinger	41374	229385	economic problem	41374	267852581.2	41375	6.95E+06
454 1	Hollinger	41374	229385	economic problem	41374	4.32E+11	41375	5.32E+06

455	3	HB	9	50	counter-example problem	4	3.2E-15	5	3.20E-15
456	1	HB	11	76	counter-example problem	11	0.011550999	12	7.06E-03
457	4	HB	991	6027	semiconductor device problem	67	6.74E-11	64	7.43E-11
458	2	Rommes	40337	144945	eigenvalue/model reduction problem	40337	0.002474907	40338	1.27E+05
459	1	MathWorks	8765	42471	counter-example problem	8765	7.54E-08	8766	1.89E+12
460	2	Рајек	4470	12/31	directed graph	4470	5.9/E+20	44/1	4.55E+21
401	4	Raju	0/1/5	3/8885/	dimented mainted areast	0/1/5	0.00129516	0/1/4	1.21E-01 5.04E-12
462	2	OL	399130	5240084	ontimization problem	44	1.55E-11 201000	45	5.94E-12 1.25E+05
405	5	QLI	440020	3240084	directed multicromb	440020	1.04E+21	9944	1.23E+03
404	5	Fajek LaCraalau	0043	41001	directed multigraph	0043	1.04E+21	0044	7.53E+16
465	2	LeGresley	2508	10/2/	power network problem	2026	9.02E-11 0.008722012	11/3	4.09E-11 5.42E-02
400	2	LeGreeley	97026	502276	power network problem	4708 87026	0.008722912	4707 87027	1.45E-03
407	3	Mallyo	8/950	18427	shemical process simulation problem	87930	0.092477039	8/95/	6.22E-01
408	4	Mallya	2054	36875	chemical process simulation problem	2054	112 50312	2055	0.55E-02 0.37E±02
409	1	Mallya	4101	81057	chemical process simulation problem	4101	84 67020343	4102	1.21E-03
470	3	Mallya	4101	82682	chemical process simulation problem	4101	65 60885030	4102	1.21E-03
472	3	Mallya	7337	154660	chemical process simulation problem	7337	148 0020572	7338	6.22E-13
473	1	Mallya	7337	154508	chemical process simulation problem	7337	38 18766144	7338	nan
474	4	Mallya	10672	228395	chemical process simulation problem	10672	45 22994623	10673	1.88E+12
475	4	Mallya	10672	232633	chemical process simulation problem	10672	36.66134418	10673	nan
476	3	Mallya	10964	231806	chemical process simulation problem	10964	44.08921961	10965	7.60E-05
477	3	Mallya	10964	233741	chemical process simulation problem	10964	19.10012996	10965	nan
478	5	Mallya	14270	305750	chemical process simulation problem	14270	152.1709865	14271	nan
479	3	Mallya	14270	307858	chemical process simulation problem	14270	145.427595	14271	nan
480	3	Mallya	17576	379761	chemical process simulation problem	17576	66.47043744	17577	7.39E-01
481	2	Mallya	17576	381975	chemical process simulation problem	17576	318.4930858	17577	nan
482	4	Mallya	35152	746972	chemical process simulation problem	35152	134.6979236	35153	3.51E+00
483	3	Mallya	35152	764014	chemical process simulation problem	35152	144.0492446	35153	nan
484	5	Mallya	70304	1494006	chemical process simulation problem	70304	102.1669388	70305	5.74E+00
485	1	Mallya	70304	1528092	chemical process simulation problem	70304	189.6624326	70305	nan
486	4	Li	22695	1215181	electromagnetics problem	22695	0.000186057	22696	3.18E-02
487	3	Sorensen	324085	1208908	directed weighted graph	324085	2460000000	6	3.01E-01
488	5	HB	131	536	computational fluid dynamics problem	131	3.98315059	132	2.72E-04
489	4	HB	3937	25407	computational fluid dynamics problem	3937	0.304796641	3938	2.10E-03
490	3	HB	511	2796	computational fluid dynamics problem	511	0.075615972	512	3.31E-03
491	1	HB	131	536	computational fluid dynamics problem	131	0.004408853	132	1.78E-06
492	4	HB	511	2796	computational fluid dynamics problem	511	0.049220056	512	9.31E-02
493	5	HB	3937	25407	computational fluid dynamics problem	3937	0.115300419	3938	1.07E+00
494	3	Bai	163	935	statistical/mathematical problem	163	6.86E-08	164	1.97E+01
495	2	Norris	1650	7419	computational fluid dynamics problem	1650	0.000309407	228	9.04E-11
496	2	Norris	109460	492564	computational fluid dynamics problem	109460	0.011796828	211	9.17E-11
497	2	Rommes	682	1633	eigenvalue/model reduction problem	682	0.031435468	683	3.22E+00
498	3	Rommes	528	1317	eigenvalue/model reduction problem	528	0.530096786	529	1.53E-02
499	1	JGD_Homology	200200	800800	combinatorial problem	200200	826.7792617	200200	8.26E+02
500	3	Rommes	1182	2881	eigenvalue/model reduction problem	1182	1.134412766	1183	8.83E+00
501	2	Rommes	1028	2547	eigenvalue/model reduction problem	1028	0.062789646	1029	9.40E-02
502	1	Rommes	2182	5341	eigenvalue/model reduction problem	2182	0.33019982	2183	7.36E+00
503	2	Rommes	2028	5007	eigenvalue/model reduction problem	2028	0.427151983	2029	5.93E-03
504	2	Rommes	4182	10261	eigenvalue/model reduction problem				0.000 00
505	4	Domentoo			eigenvaluerinouer reduction problem	4182	0.249477754	4183	8.93E+01
506	3	Kommes	4028	9927	eigenvalue/model reduction problem	4182 4028	0.249477754 20.13406152	4183 4029	8.93E+01 2.24E-03
507		Williams	4028 206500	9927 1273389	eigenvalue/model reduction problem economic problem	4182 4028 206500	0.249477754 20.13406152 3.9556E+15	4183 4029 206500	8.93E+01 2.24E-03 4.99E+21
אוור ו	3	Williams HB	4028 206500 1258	9927 1273389 7682	eigenvalue/model reduction problem economic problem economic problem	4182 4028 206500 1258 250	0.249477754 20.13406152 3.9556E+15 0.00821695	4183 4029 206500 1259	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11
500	3 5	Williams HB QLi	4028 206500 1258 160000	9927 1273389 7682 1750416	eigenvalue/model reduction problem economic problem economic problem optimization problem	4182 4028 206500 1258 259	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11	4183 4029 206500 1259 92 2120	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11
508	3 5 2	Williams HB QLi Hollinger	4028 206500 1258 160000 9129 0122	9927 1273389 7682 1750416 52883 53882	eigenvalue/model reduction problem economic problem optimization problem economic problem	4182 4028 206500 1258 259 9129 0120	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 2760209.005	4183 4029 206500 1259 92 9130 0120	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.50E+09
509 510	3 5 2 2 4	Williams HB QLi Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18280	9927 1273389 7682 1750416 52883 52883 106802	economic problem economic problem economic problem economic problem economic problem economic problem economic problem	4182 4028 206500 1258 259 9129 9129 9129 18280	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.8715947	4183 4029 206500 1259 92 9130 9130 18200	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02
509 510 511	3 5 2 2 4 2	Williams HB QLi Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18289 18289	9927 1273389 7682 1750416 52883 52883 106803 106803	economic problem economic problem economic problem optimization problem economic problem economic problem economic problem	4182 4028 206500 1258 259 9129 9129 9129 18289 18289	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305795	4183 4029 206500 1259 92 9130 9130 18290 18290	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 9.57E+06
509 510 511 512 513	$\begin{array}{c} 3\\ 5\\ 2\\ 2\\ 4\\ 2\\ 4\\ 2\\ 4 \end{array}$	Williams HB QLi Hollinger Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18289 18289 27440	9927 1273389 7682 1750416 52883 52883 106803 106803 160722	economic problem economic problem economic problem optimization problem economic problem economic problem economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 18289 27440	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057282	4183 4029 206500 1259 92 9130 9130 18290 18290 27450	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02
509 510 511 512 513 514	3 5 2 4 2 4 5	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18289 18289 27449 27449	9927 1273389 7682 1750416 52883 52883 106803 106803 160723	economic problem economic problem economic problem economic problem economic problem economic problem economic problem economic problem economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 18289 27449 27449	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809 97	4183 4029 206500 1259 92 9130 9130 18290 18290 27450 27450	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 184E+06
500 509 510 511 512 513 514 515	3 5 2 2 4 2 4 5 2	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18289 18289 27449 27449 27449 36609	9927 1273389 7682 1750416 52883 106803 106803 160723 160723 214643	economic problem economic problem economic problem economic problem economic problem economic problem economic problem economic problem economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 18289 27449 27449 27449 23600	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.0424844	4183 4029 206500 1259 92 9130 9130 18290 18290 27450 27450 27450 36610	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00
500 509 510 511 512 513 514 515 516	3 5 2 2 4 2 4 5 2 5 5	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18289 18289 27449 27449 27449 36609 36609	9927 1273389 7682 1750416 52883 52883 106803 106803 106803 160723 160723 160723 214643 214643	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 27449 27449 27449 36609	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625 12701	4183 4029 206500 1259 92 9130 18290 18290 27450 27450 27450 36610	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06
508           509           510           511           512           513           514           515           516	3 5 2 2 4 4 5 2 5 4	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18289 18289 27449 27449 27449 36609 36609	9927 1273389 7682 1750416 52883 52883 106803 106803 160723 160723 214643 214643 268563	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 18289 27449 27449 27449 36609 36609	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628	4183 4029 206500 1259 92 9130 18290 18290 18290 27450 27450 27450 27450 36610 36610	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+00
509 509 510 511 512 513 514 515 516 517 518	3 5 2 2 4 4 2 4 5 5 4 1	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18289 18289 27449 27449 27449 36609 36609 36609 45769	9927 1273389 7682 1750416 52883 52883 106803 160723 160723 214643 214643 214643 214643	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 18289 18289 18289 27449 27449 27449 36609 36609 36609 45769	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789	4183 4029 206500 1259 92 9130 9130 18290 18290 27450 27450 27450 27450 36610 36610 36610 45770	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+05
508           509           510           511           512           513           514           515           516           517           518           519	$     \begin{array}{r}       3 \\       5 \\       2 \\       2 \\       4 \\       2 \\       4 \\       5 \\       2 \\       5 \\       4 \\       1 \\       4 \\       4     \end{array} $	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18289 18289 27449 27449 27449 27449 36609 36609 36609 45769 45769 54929	9927 1273389 7682 1750416 52883 52883 106803 106803 160723 160723 214643 214643 214643 214643 268563 268563 322483	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 27449 27449 27449 27449 27449 27449 36609 36609 45769 45769 54929	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921	4183 4029 206500 1259 92 9130 9130 18290 27450 27450 27450 27450 27450 36610 36610 45770 45770 54930	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+03
500           509           510           511           512           513           514           515           516           517           518           519           520	$     \begin{array}{r}       3 \\       5 \\       2 \\       2 \\       4 \\       2 \\       4 \\       5 \\       2 \\       5 \\       4 \\       1 \\       4 \\       4 \\       4     \end{array} $	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18289 27449 27449 27449 27449 27449 36609 36609 45769 45769 45769 54929 54929	9927 1273389 7682 1750416 52883 52883 106803 106803 160723 160723 160723 214643 214643 2268563 2268563 2268563 322483 322483	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 27449 27449 27449 27449 27449 36609 36609 45769 45769 45769 54929 54929	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887	4183 4029 206500 1259 92 9130 18290 27450 27450 27450 36610 45770 45770 45770 54930	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+03 6.86E+03 7.55E+05
500           509           510           511           512           513           514           515           516           517           518           519           520           521	$     \begin{array}{r}       3 \\       5 \\       2 \\       2 \\       4 \\       2 \\       4 \\       5 \\       2 \\       5 \\       4 \\       1 \\       4 \\       2 \\       2     \end{array} $	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 9129 18289 18289 18289 27449 27449 27449 27449 36609 36609 45769 54929 54929 54929	9927 1273389 7682 1750416 52883 52883 106803 106803 106803 160723 214643 214643 214643 214643 214643 268563 322483 322483 322483 376395	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 18289 27449 27449 27449 27449 36609 36609 45769 45769 54929 54929 54929	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816	4183 4029 206500 1259 92 9130 18290 18290 27450 27450 27450 27450 27450 36610 36610 45770 45770 54930 54930 64090	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+05 6.86E+05 6.86E+05
500           509           510           511           512           513           514           515           516           517           518           519           520           521           522	$ \frac{3}{5} $ $ \frac{2}{2} $ $ \frac{4}{4} $ $ \frac{4}{5} $ $ \frac{5}{5} $ $ \frac{4}{4} $ $ \frac{1}{4} $ $ \frac{4}{2} $ $ \frac{5}{5} $	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger	4028 206500 1258 160000 9129 9129 18289 18289 18289 27449 27449 27449 27449 36609 36609 36609 36609 36609 45769 54929 54929 54929	9927 1273389 7682 1750416 52883 52883 106803 106803 106803 106803 106723 214643 214643 214643 214643 2248563 322483 322483 322483 376395	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 18289 27449 27449 27449 27449 36609 36609 36609 36609 45769 45769 54929 54929 54929 64089	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053	4183 4029 206500 1259 92 9130 18290 18290 27450 27450 27450 27450 36610 36610 36610 45770 45770 45770 54930 54930 64090 64090	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+05 6.86E+03 7.55E+05 6.86E+03 7.55E+05 8.38E+05
500           509           510           511           512           513           514           515           516           517           518           519           521           522           523	$ \frac{3}{5} $ $ \frac{2}{2} $ $ \frac{4}{4} $ $ \frac{4}{5} $ $ \frac{5}{5} $ $ \frac{4}{4} $ $ \frac{4}{2} $ $ \frac{4}{5} $ $ \frac{1}{1} $ $ \frac{4}{4} $ $ \frac{1}{5} $ $ 1$	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Schenk JBMSDS	4028 206500 1258 160000 9129 9129 18289 27449 27449 27449 27449 27449 36609 36609 36609 36609 45769 36609 45769 54929 54929 54929 54929 54929	9927 1273389 7682 1750416 52883 52883 106803 160723 160723 214643 214643 214643 214643 214643 2248563 322483 376395 376395 1205518	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 27449 27449 27449 27449 27449 27449 27449 27449 27449 27449 27449 27449 27469 45769 45769 45769 54929 64089 64089 103430	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053 17081471776	4183 4029 206500 1259 92 9130 18290 27450 27450 27450 27450 36610 36610 45770 45770 45770 54930 54930 54930 64090 64090 1478	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+03 7.55E+05 4.63E+05 6.68E+03 7.55E+05 4.63E+05 6.66E+11
$\begin{array}{r} 500\\ \hline 500\\ \hline 510\\ \hline 511\\ \hline 512\\ \hline 513\\ \hline 514\\ \hline 515\\ \hline 516\\ \hline 517\\ \hline 518\\ \hline 519\\ \hline 520\\ \hline 521\\ \hline 522\\ \hline 522\\ \hline 523\\ \hline 524\\ \end{array}$	$ \frac{3}{5} $ 2 2 4 4 5 5 4 1 4 4 2 5 1 3	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Schenk.IBMSDS Schenk.JBMSDS	4028 206500 1258 160000 9129 9129 18289 18289 18289 18289 27449 27449 27449 36609 36609 45769 45769 54929 54929 54929 54929 54929 54929 54929 54929 54929 54929	9927 1273389 7682 1750416 52883 52883 106803 106803 106803 106803 160723 214643 214643 214643 214643 268563 322483 376395 376395 376395 1205518 893984	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 27449 27449 27449 27449 27449 27449 27449 36609 45769 45769 45769 54929 54929 54929 64089 64089 64089 103430 125329	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053 17081471776 6766482.197	4183 4029 206500 1259 92 9130 18290 27450 27450 27450 27450 36610 45770 45770 54930 54930 64090 64090 1478 99971	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.10E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+05 6.86E+03 8.38E+05 8.38E+05 8.38E+05 6.69E-11 5.63E-08
$\begin{array}{r} 500\\ \hline 509\\ \hline 510\\ \hline 511\\ \hline 512\\ \hline 513\\ \hline 514\\ \hline 515\\ \hline 516\\ \hline 517\\ \hline 518\\ \hline 519\\ \hline 520\\ \hline 521\\ \hline 522\\ \hline 524\\ \hline 525\\ \end{array}$	$     \begin{array}{r}       3 \\       5 \\       2 \\       2 \\       4 \\       2 \\       4 \\       5 \\       2 \\       5 \\       4 \\       4 \\       4 \\       2 \\       5 \\       1 \\       3 \\       5 \\     $	Kolinites Williams HB QLi Hollinger	4028 206500 1258 160000 9129 9129 18289 18289 18289 18289 27449 27449 27449 27449 36609 36609 36609 36609 45769 54929 54	9927 1273389 7682 1750416 52883 52883 106803 106803 1060723 214643 214643 214643 214643 22483 322483 322483 376395 376395 1205518 893984 49920	eigenvalue/model reduction problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 18289 27449 27449 27449 27449 36609 36609 36609 45769 45769 45769 54929	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053 17081471776 6766482.197 3.847283143	4183 4029 206500 1259 92 9130 18290 18290 27450 27450 27450 27450 27450 36610 36610 45770 45770 54930 54930 64090 64090 1478 9971 497	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+05 6.86E+03 7.55E+05 8.38E+05 6.69E-11 5.63E-08 8.60E+00
$\begin{array}{r} 500\\ \overline{500}\\ \overline{500}\\ \overline{511}\\ \overline{511}\\ \overline{512}\\ \overline{513}\\ \overline{514}\\ \overline{515}\\ \overline{516}\\ \overline{517}\\ \overline{516}\\ \overline{517}\\ \overline{518}\\ \overline{519}\\ \overline{520}\\ \overline{521}\\ \overline{522}\\ \overline{522}\\ \overline{522}\\ \overline{524}\\ \overline{526}\\ \overline{526}\end{array}$	$ \frac{3}{5} $ 2 2 4 4 5 4 2 4 4 5 5 4 4 1 4 4 4 5 5 1 3 5 1	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Schenk_IBMSDS Schenk_IBMSDS HB	4028 206500 1258 160000 9129 9129 18289 18289 18289 27449 27449 27449 27449 36609 36609 36609 36609 36609 45769 54929 54	9927 1273389 7682 1750416 52883 52883 106803 106803 160723 214643 214643 214643 2248563 322483 322483 322483 322483 322483 922483 376395 1205518 893984 49920	economic problem economic problem semiconductor device problem economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 18289 27449 27449 27449 36609 36609 36609 36609 45769 45769 45769 54929 54929 54929 64089 103430 125329 496	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053 17081471776 6766482.197 3.847283143 10.68214921	4183 4029 206500 1259 92 9130 9130 18290 27450 27450 27450 27450 27450 27450 27450 36610 36610 45770 45770 54930 54930 54930 64090 1478 9971 497	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+05 6.86E+03 7.55E+05 6.86E+03 7.55E+05 6.86E+05 6.83E+05 8.38E+05 6.69E-11 5.63E-08 8.60E+00 2.33E+01
$\begin{array}{r} 500\\ \overline{500}\\ \overline{510}\\ \overline{511}\\ \overline{512}\\ \overline{513}\\ \overline{513}\\ \overline{514}\\ \overline{515}\\ \overline{516}\\ \overline{517}\\ \overline{516}\\ \overline{517}\\ \overline{518}\\ \overline{519}\\ \overline{521}\\ \overline{522}\\ \overline{523}\\ \overline{524}\\ \overline{525}\\ \overline{526}\\ \overline{527}\\ \end{array}$	$     \begin{array}{r}       3 \\       5 \\       2 \\       2 \\       4 \\       4 \\       2 \\       4 \\       2 \\       5 \\       4 \\       4 \\       4 \\       2 \\       5 \\       1 \\       3 \\       5 \\       1 \\       4 \\     $	Kolinites Williams HB QLi Hollinger	4028 206500 1258 160000 9129 9129 18289 27449 27449 27449 27449 36609 45769 36609 45769 36609 45769 54929 54929 64089 64089 64089 103430 125329 496	9927 1273389 7682 1750416 52883 52883 106803 160723 160723 214643 214643 268563 268563 322483 322483 322483 376395 1205518 893984 49920 49920	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 27449 27449 27449 27449 27449 27449 27449 36609 45769 45769 45769 45769 45769 45769 45769 24929 64089 103430 125329 496 496	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053 17081471776 6766482.197 3.847283143 10.68214921 52.29068474	4183 4029 206500 1259 92 9130 18290 27450 27450 27450 27450 36610 45770 45770 45770 45770 45770 45730 64090 64090 1478 9971 497 497	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+03 6.86E+03 7.55E+05 4.63E+05 8.38E+05 8.38E+05 8.60E+00 2.33E+01 4.66E+02
$\begin{array}{r} 509\\ \overline{509}\\ \overline{509}\\ \overline{510}\\ \overline{511}\\ \overline{512}\\ \overline{512}\\ \overline{512}\\ \overline{514}\\ \overline{515}\\ \overline{516}\\ \overline{517}\\ \overline{518}\\ \overline{519}\\ \overline{520}\\ \overline{521}\\ \overline{522}\\ $	$     \begin{array}{r}       3 \\       5 \\       2 \\       2 \\       4 \\       2 \\       4 \\       2 \\       5 \\       4 \\       4 \\       2 \\       5 \\       1 \\       3 \\       5 \\       1 \\       4 \\       2 \\       5 \\       1 \\       4 \\       2 \\       5 \\       1 \\       3 \\       5 \\       1 \\       4 \\       2 \\       5 \\       1 \\       3 \\       5 \\       1 \\       4 \\       2 \\       2 \\       5 \\       1 \\       3 \\       5 \\       1 \\       4 \\       2 \\       2 \\       5 \\       1 \\       3 \\       5 \\       1 \\       4 \\       2 \\       2 \\       5 \\       1 \\       3 \\       5 \\       1 \\       4 \\       2 \\       2 \\       5 \\       1 \\       3 \\       5 \\       1 \\       4 \\       2 \\       2 \\       5 \\       1 \\       3 \\       5 \\       1 \\       4 \\       2 \\       2 \\       3 \\       5 \\       1 \\       4 \\       2 \\       3 \\       5 \\       1 \\       4 \\       2 \\       2 \\       3 \\       5 \\       1 \\       4 \\       2 \\       3 \\       5 \\       1 \\       4 \\       2 \\       3 \\       5 \\       1 \\       4 \\       2 \\       3 \\       5 \\       1 \\       3 \\       5 \\       1 \\       3 \\       5 \\       1 \\       3 \\       3 \\       5 \\       1 \\       3 \\       3 \\       5 \\       1 \\       3 \\       3 \\       3 \\       5 \\       1 \\       1 \\       3 \\       3 \\       3 \\       3 \\       5 \\       1 \\       1 \\       3 \\     $	Kolinites Williams HB QLi Hollinger HB	4028 206500 1258 160000 9129 9129 18289 18289 18289 18289 18289 27449 27449 27449 27449 36609 45769 45769 54929 54929 54929 54929 54929 54929 54929 54929 54929 54929 54929 103430 125329 496 496	9927 1273389 1750416 52883 52883 106803 106803 106803 106723 214643 214643 214643 214643 214643 22483 322483 322483 376395 376395 1205518 893984 49920 41063 2659	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 27449 27449 27449 27449 27449 27449 27449 36609 45769 45769 45769 45769 45769 64089 64089 64089 103430 125329 496 496 180	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053 17081471776 6766482.197 3.847283143 10.68214921 52.29068474 0.184549426	4183 4029 206500 1259 92 9130 18290 27450 27450 27450 36610 45770 45770 54930 64090 64090 64090 1478 9971 497 497 497 102	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.63E+05 8.38E+05 6.69E+11 5.63E-08 8.60E+00 2.33E+01 4.66E+02 5.86E-11
$\begin{array}{r} 509\\ 509\\ 510\\ 511\\ 512\\ 513\\ 514\\ 515\\ 516\\ 517\\ 518\\ 519\\ 520\\ 521\\ 522\\ 523\\ 524\\ 525\\ 526\\ 527\\ 528\\ 529\\ 529\\ 529\\ \end{array}$		Kolinites Williams HB QLi Hollinger HB	4028 206500 1258 160000 9129 9129 18289 18289 18289 27449 27449 27449 27449 36609 36609 36609 36609 36509 45769 45769 45769 45769 4089 64089 103430 125329 496 496 180 765	9927 1273389 7682 1750416 52883 52883 106803 106803 106803 160723 214643 214643 214643 22483 322483 322483 322483 376395 376395 1205518 893984 49920 41063 26559 24382	economic problem economic problem semiconductor device problem economic problem economic problem economic problem economic problem economic problem economic problem economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 18289 18289 27449 27449 27449 27449 36609 36609 45769 45769 45769 54925 54929 54925 54925 54925 54925 54925 54925 54925	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053 17081471776 6766482.197 3.847283143 10.68214921 52.29068474 0.184549426 0.016966636	4183 4029 206500 1259 92 9130 18290 18290 27450 27450 27450 27450 27450 36610 36610 45770 45770 45770 54930 64090 64090 1478 9971 497 497 497 497	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+05 6.86E+03 7.55E+05 6.86E+03 7.55E+05 8.38E+05 6.69E-11 5.66E+00 2.33E+01 4.66E+02 5.86E-11 6.63E-11
$\begin{array}{r} 509 \\ \overline{509} \\ \overline{509} \\ \overline{510} \\ \overline{511} \\ \overline{511} \\ \overline{511} \\ \overline{513} \\ \overline{514} \\ \overline{515} \\ \overline{516} \\ \overline{517} \\ \overline{518} \\ \overline{519} \\ \overline{521} \\ \overline{522} \\ \overline{523} \\ \overline{525} \\ \overline{526} \\ \overline{527} \\ \overline{528} \\ \overline{529} \\ \overline{529} \\ \overline{530} \\$	$\begin{array}{c} 3 \\ 5 \\ 2 \\ 2 \\ 4 \\ 2 \\ 4 \\ 5 \\ 5 \\ 5 \\ 4 \\ 4 \\ 4 \\ 4 \\ 2 \\ 5 \\ 1 \\ 3 \\ 5 \\ 1 \\ 4 \\ 2 \\ 2 \\ 5 \\ 5 \\ 5 \\ 1 \\ 1 \\ 4 \\ 2 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5 \\ 5$	Kolinites Williams HB QLi Hollinger Grund	4028 206500 1258 160000 9129 9129 18289 27449 27449 27449 27449 36609 36609 36609 36609 36609 36609 45769 54929 54	9927 1273389 1273389 7682 1750416 52883 52883 106803 160723 160723 214643 214643 214643 214643 22483 322483 322483 322483 322483 322483 322483 322483 322483 322518 893984 49920 41063 2659 24382 58142	eigenvalue/model reduction problem economic problem	4182           4028           206500           1258           259           9129           18289           27449           27449           27449           36609           45769           45769           45769           54929           64089           103430           125329           496           496           180           765           2904	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053 17081471776 6766482.197 3.847283143 10.68214921 52.29068474 0.184549426 0.016966636 54005.01946	4183 4029 206500 1259 92 9130 18290 27450 27450 27450 27450 36610 45770 45770 45770 45770 54930 54930 54930 54930 64090 1478 9971 497 497 497 497 102 367 2905	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+05 6.86E+03 7.55E+05 6.86E+03 7.55E+05 6.86E+05 6.83E+05 6.69E-11 5.63E+08 8.60E+00 2.33E+01 4.66E+02 5.86E-11 6.63E-11 3.07E+04
$\begin{array}{c} 309\\ 509\\ 509\\ 510\\ 511\\ 511\\ 513\\ 514\\ 515\\ 516\\ 517\\ 518\\ 519\\ 520\\ 521\\ 522\\ 522\\ 522\\ 522\\ 522\\ 522\\ 522$	$\begin{array}{c} 3 \\ 5 \\ 2 \\ 2 \\ 4 \\ 4 \\ 5 \\ 2 \\ 4 \\ 5 \\ 5 \\ 5 \\ 1 \\ 4 \\ 2 \\ 2 \\ 5 \\ 5 \\ 5 \\ 5 \\ \end{array}$	Kolinites Williams HB QLi Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Hollinger Schenk.IBMSDS Schenk.IBMSDS HB HB HB HB HB HB HB HB HB HB HB HB HB	4028 206500 1258 160000 9129 9129 18289 18289 18289 18289 27449 27449 27449 27449 36609 36609 45769 54929 54956 54929 549577 549577 540577777777777777777777777777777777	9927 1273389 7682 1750416 52883 52883 106803 160723 160723 214643 214643 214643 2248563 322483 322483 322483 322483 322483 322483 322483 322483 322518 893984 49920 49920 49920 41063 2659 24382 58142 99147	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 27449 27449 27449 27449 27449 27449 27449 27449 27449 27449 27449 27449 27449 45769 45769 45769 45769 45769 45769 45769 45429 64089 64089 64089 103430 125329 496 496 180 765 2904 1090	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053 17081471776 6766482.197 3.847283143 10.68214921 52.29068474 0.184549426 0.016966636 54005.01946 9.85E-11	4183 4029 206500 1259 92 9130 18290 27450 27450 27450 27450 36610 45770 45770 45770 45770 45770 45770 45770 45770 45770 45770 45770 45770 4977 497 497 497 497 497 497 3667 2905 326	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+03 6.86E+03 5.63E+05 8.38E+05 6.69E-11 5.63E-08 8.60E+00 2.33E+01 4.66E+02 5.86E-11 6.63E-11 3.07E+04 6.88E-11
$\begin{array}{c} 509 \\ \overline{509} \\ \overline{509} \\ \overline{510} \\ \overline{511} \\ \overline{511} \\ \overline{511} \\ \overline{513} \\ \overline{513} \\ \overline{514} \\ \overline{515} \\ \overline{517} \\ \overline{518} \\ \overline{517} \\ \overline{517} \\ \overline{518} \\ \overline{517} \\ \overline{520} \\ \overline{521} \\ \overline{522} \\ \overline{523} \\ \overline{530} \\ \overline{532} \\ \overline{532} \\ \end{array}$	$     \begin{array}{r}       3 \\       5 \\       2 \\       2 \\       2 \\       4 \\       2 \\       4 \\       5 \\       5 \\       5 \\       1 \\       4 \\       4 \\       4 \\       2 \\       5 \\       5 \\       1 \\       4 \\       4 \\       2 \\       5 \\     $	Kolinites Williams HB QLi Hollinger	4028 206500 1258 160000 9129 9129 9129 18289 18289 18289 18289 27449 27449 27449 27449 36609 45769 45769 45769 45769 45769 45769 45769 4089 103430 125329 496 496 496 496 180 765 2904 17758 3200	9927 1273389 7682 1750416 52883 52883 106803 106803 106803 160723 214643 214643 214643 214643 2248563 322483 322483 322483 322483 322483 376395 1205518 893984 49920 41063 2659 24382 58142 99147 68026	economic problem economic problem	4182 4028 206500 1258 259 9129 9129 18289 27449 27449 27449 27449 27449 36609 45769 45769 45769 45769 45769 45769 45769 45769 45769 454929 64089 64089 64089 64089 64089 103430 125329 496 496 496 180 765 2904 1090 3200	0.249477754 20.13406152 3.9556E+15 0.00821695 9.78E-11 220.6433719 3769308.985 23.87153947 7805.305285 103.057383 1260809.97 118.9424844 60625.12001 5057.009628 5858.661789 398.0668921 84197.79887 2698.158816 1019.827053 17081471776 6766482.197 3.847283143 10.68214921 52.29068474 0.184549426 0.016966636 54005.01946 9.85E-11 0.030410373	4183 4029 206500 1259 92 9130 18290 27450 27450 27450 27450 36610 45770 45770 54930 64090 64090 64090 64090 1478 9971 497 497 102 367 2905 326 3201	8.93E+01 2.24E-03 4.99E+21 7.87E-04 7.72E-11 2.19E+06 4.59E+08 2.41E+02 8.52E+06 1.09E+02 1.84E+06 8.07E+00 1.71E+06 3.23E+02 4.86E+05 6.86E+03 7.55E+05 4.63E+05 8.38E+05 6.69E-11 5.63E-08 8.60E+00 2.33E+01 4.66E+02 5.86E-11 6.63E-11 3.07E+04 6.88E+11 8.40E+04
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534	5	Bai	416	8562	electromagnetics problem	416	0.07271983	417	1.09E±01
554	5	Dai	410	0002	electroniagienes problem	410	0.07271905	417	1.092101
535	2	Rommes	13251	48737	eigenvalue/model reduction problem	13251	0.00000867	13252	1.15E+08
536	3	Rommes	13250	48735	eigenvalue/model reduction problem	13250	11.29929777	33	6.71E-11
537	4	Rommes	13300	18872	eigenvalue/model reduction problem	13300	0.026767217	13310	5.22E+06
557	+	Rollines	13307	40072	eigenvalue/model reduction problem	15505	0.020707217	15510	5.221.400
538	5	POLYFLOW	29957	1990919	computational fluid dynamics problem	29957	0.048048537	29958	nan
539	1	Janna	377002	27582698	structural problem	7082	8.89E-11	1700	8.12E-11
540	5	Sandia	25187	103276	circuit simulation problem sequence	1180	0 00F-11	2810	9.89E-11
540	5	Sandia	25107	193270	circuit simulation problem sequence	1100	9.992-11	2017	9.89E-11
541	1	Sandia	25187	193276	subsequent circuit simulation problem	25187	0.0000947	1781	3.23E-11
542	2	Sandia	25187	193216	subsequent circuit simulation problem	25187	3672.271057	595	3.88E-11
542	2	ICD Homology	105	210	combinatorial problem	2	2 17E 11	1	1.00E+00
545	2	JOD_Homology	105	210	comoniatorial problem	3	3.1712-11	1	1.00E+00
544	2	JGD_Homology	6435	51480	combinatorial problem	1	1	1	1.00E+00
545	5	Schenk_ISEI	18588	237130	semiconductor device problem	18588	0.021425251	18589	8.65E-05
546	4	LID	1274	9599	2D/2D problem	1274	0.002017106	1275	1 50E+02
540	4	пв	1374	8388	2D/5D problem	1374	0.002017100	1373	1.501.+05
547	1	HB	261	1500	2D/3D problem	261	0.039493895	262	2.74E-02
548	4	HB	666	4032	2D/3D problem	666	0.010919691	667	1.20E+00
540	5	Pommas	11695	44041	aiganvalua/model reduction problem	11695	0.0000274	196	9 22E 11
349	3	Rommes	11085	44941	eigenvalue/model reduction problem	11085	0.0000374	180	8.55E-11
550	4	Barabasi	325729	929849	directed graph	325729	220	200	1.34E+00
551	1	FEMLAB	20414	1679599	computational fluid dynamics problem	1278	8E-11	3542	9.82E-11
552	2	Poi	400	1201	2D/2D problem	400	0.000120251	401	2 28E 02
332	3	Bai	400	1201	2D/3D problem	400	0.000130331	401	5.58E-02
553	3	Pajek	2909	18246	directed multigraph	2909	0.421624355	2910	5.44E+00
554	1	Schenk_ISEI	181343	6869939	semiconductor device problem	181343	0.003041717	181343	3.79E-04
555	1	Bai	100	306	computational fluid dynamics problem	100	7 36E-10	73	177E-11
333	1	Dai	100	570	computational nulu dynamics problem	100	7.50E-10	15	1.7712-11
556	3	Ваі	1000	3996	computational fluid dynamics problem	1000	0.000000324	1001	1.73E+04
557	1	Bai	2000	7996	computational fluid dynamics problem	2000	0.000000341	2001	1.43E+06
558	5	Bai	500	1996	computational fluid dynamics problem	500	1 17E-08	501	1.67E+07
550			5000	10007	compatitional nate dynamics problem	5000	0.00000117	5001	2.025.00
559	3	Ваі	5000	19996	computational fluid dynamics problem	5000	0.00000145	5001	2.02E+06
560	1	ATandT	36057	335552	frequency-domain circuit simulation problem	36057	381276.6023	36058	9.08E+06
561	5	ATandT	36057	222596	frequency-domain circuit simulation problem	36057	52489466	36058	6.07E+07
501	5	/ france i	30037	222390	requercy-domain circuit simulation problem	30037	32402400	2520	0.0711107
562	1	HB	2529	90158	economic problem	2529	21.34211146	2530	5.34E-02
563	1	HB	1030	6858	computational fluid dynamics problem	1030	1.14E-09	448	5.40E-11
564	1	HB	886	5070	computational fluid dynamics problem	886	7.54E-10	468	7 34E-11
504	1	IID	000	5510	computational fluid dynamics problem	000	7.54E-10	400	7.542-11
565	3	HB	2205	14133	computational fluid dynamics problem	353	5.14E-11	414	6.79E-11
566	3	Sandia	430	1544	circuit simulation problem sequence	430	1.506099789	431	1.18E+01
567	3	Sandia	430	1544	subsequent circuit simulation problem	430	5 65533462	/31	4.69E-01
507	5	Sandia	430	1344	subsequent encun sinulation problem	430	5.05555402	4.51	4.092-01
568	4	Sandia	430	1544	subsequent circuit simulation problem	430	0.531443273	431	6.12E+00
569	4	Sandia	430	1544	subsequent circuit simulation problem	430	0.814961766	431	1.70E-01
570	5	Sandia	430	1544	subsequent circuit simulation problem	430	0 506214318	431	3 50E+00
570	5	Sandia	430	1344	subsequent encun sinulation problem	430	0.500214518	4.51	5.50E+00
5/1	5	Sandia	430	1544	subsequent circuit simulation problem	430	0.055881581	431	2.82E+01
572	4	Sandia	430	1544	subsequent circuit simulation problem	430	0.019280575	431	4.33E-02
573	1	Sandia	430	1544	subsequent circuit simulation problem	430	0 37821242	431	1.12E+01
575	1	G	430	1544	subsequent encent simulation problem	430	5.501225521	401	1.02E.00
574	1	Sandia	430	1544	subsequent circuit simulation problem	430	5.781335521	431	1.92E+00
575	4	Sandia	430	1544	subsequent circuit simulation problem	430	0.452628103	431	4.95E-01
576	5	Sandia	430	1544	subsequent circuit simulation problem	430	1 157167279	431	7.98E-02
570	5	G	430	1544	subsequent encent simulation problem	430	0.202700240	401	7.962 02
577	4	Sandia	430	1544	subsequent circuit simulation problem	430	0.393709248	431	3.93E-01
578	2	Sandia	430	1544	subsequent circuit simulation problem	430	0.23123033	431	7.57E-02
579	1	Sandia	430	1544	subsequent circuit simulation problem	430	0.654017302	431	9.09E-01
517	1	G	430	1544	subsequent encent simulation problem	430	0.054017502	401	1.000 01
580	5	Sandia	430	1544	subsequent circuit simulation problem	430	0.852697649	431	1.26E-02
581	3	Sandia	430	1544	subsequent circuit simulation problem	430	1.046442111	431	2.93E-02
582	3	Sandia	430	1544	subsequent circuit simulation problem	430	0.071740578	431	3.79E-03
592	2	Condia	420	1544	auhoassant simulation mahlam	420	0.052970024	421	6 19E 01
385	3	Sanura	450	1344	subsequent circuit simulation problem	450	0.032870934	451	0.18E-01
584	5	Sandia	430	1544	subsequent circuit simulation problem	430	0.341823893	431	2.95E+01
585	1	Sandia	430	1544	subsequent circuit simulation problem	430	0.37179837	431	3.17E-01
586	3	Sandia	430	1544	subsequent circuit simulation problem	430	0.604678547	431	3.01E-01
500	5	Gandia	420	1544	subsequent cheuri sinuidion problem	420	1.407502210	421	5.01E-01
28/	5	Sandia	430	1544	subsequent circuit simulation problem	430	1.48/592218	431	5.96E+01
588	2	Sandia	430	1544	subsequent circuit simulation problem	430	1.241638348	431	1.88E-02
589	5	Sandia	430	1544	subsequent circuit simulation problem	430	1.941407578	431	1.68E-01
500	1	Sandia	420	1544	subsequent aircuit simulation problem	420	2 591076200	421	140E 01
390	1	Janua	450	1,544	subsequent circuit simulation problem	430	5.501070299	431	1.401-01
591	2	Sandia	430	1544	subsequent circuit simulation problem	430	2.816148456	431	9.78E-01
592	4	Sandia	430	1544	subsequent circuit simulation problem	430	1.003041446	431	1.34E-02
503	1	Sandia	430	1544	subsequent circuit simulation problem	430	0.709690258	431	8 87E-02
595	1	Galua	420	1544	subsequent encurt simulation problem	100	0.109090230	401	0.07E-02
594	3	Sandia	430	1544	subsequent circuit simulation problem	430	2.155655882	431	4.69E-02
595	1	Sandia	430	1544	subsequent circuit simulation problem	430	13.38834973	431	7.78E-02
596	5	Sandia	430	1544	subsequent circuit simulation problem	430	0.049912503	431	8 18E-02
500		Can d'a	420	1544	subsequent circuit simulation problem	420	0.102010.145	421	1.57E . 00
397	4	Sandia	450	1544	subsequent circuit simulation problem	430	0.123919445	431	1.37E+00
598	3	Sandia	430	1544	subsequent circuit simulation problem	430	1.54823202	431	4.33E-02
599	4	Sandia	430	1544	subsequent circuit simulation problem	430	0.01897083	431	7.17E+00
600	5	Condia	420	1544	subcompant aircuit cimulation problem	420	4 247208140	421	1 50E 01
000	3	Sanuia	450	1.344	subsequent circuit simulation problem	450	+.24/206149	431	1.J9E-01
601	3	Sandia	430	1544	subsequent circuit simulation problem	430	1.091305884	431	9.37E-01
602	1	Sandia	430	1544	subsequent circuit simulation problem	430	0.009853882	431	2.31E+00
603	1	Sandia	430	1544	subsequent circuit simulation problem	430	0 187114723	431	7.63E-01
005	1	Janua	450	1,544	subsequent circuit simulation problem	430	0.10/114/23	431	1.0312-01
604	3	Sandia	430	1544	subsequent circuit simulation problem	430	0.154691327	431	1.37E+00
605	5	Sandia	430	1544	subsequent circuit simulation problem	430	0.071570333	431	8.97E-01
606	2	Sandia	430	1544	subsequent circuit simulation problem	430	0 567310377	431	6 50E-02
000	-	Galua	420	1544	subsequent encurt simulation problem	100	0.110040251	401	0.501-02
607	1	Sandia	430	1544	subsequent circuit simulation problem	430	0.113043256	431	5.64E-02
608	4	Sandia	430	1544	subsequent circuit simulation problem	430	0.483016413	431	2.39E+00
600	4	Sandia	430	1544	subsequent circuit simulation problem	430	3 233460185	431	1 31E-02
009	-	Galua	420	1544	subsequent encurt simulation problem	100	0.0000000000	401	1.5112-02
610	5	Sandia	430	1544	subsequent circuit simulation problem	4.50	0.068096823	431	1.41E+00
611	3	Sandia	430	1544	subsequent circuit simulation problem	430	0.592181803	431	3.03E-01
612	1	Sandia	430	1544	subsequent circuit simulation problem	430	0.035441743	431	2.00E-02
1 014		Jununa	450	1.777	subsequent encurt simulation problem	7.50	0.000771/70	1 7.7 1	2.000 02

613 1	Sandia	430	1544	subsequent circuit simulation problem	430	0.361261861	431	1.72E-01
614 2	Sandia	430	1544	subsequent circuit simulation problem	430	0 300319675	431	1.05E+00
615 1	Sandia	430	1544	subsequent circuit simulation problem	430	0.12054139	431	2.01E-01
616 4	Sandia	430	1544	subsequent circuit simulation problem	430	0.421310713	431	1.72E+00
617 4	Sandia	430	1544	subsequent circuit simulation problem	430	3 595423444	431	2 59E-01
618 4	Sandia	430	1544	subsequent circuit simulation problem	430	0.289210505	431	8.74E-01
619 4	Sandia	430	1544	subsequent circuit simulation problem	430	1.688936726	431	5.08E-01
620 4	Sandia	430	1544	subsequent circuit simulation problem	430	0.21002735	431	1.68E+00
621 3	Sandia	430	1544	subsequent circuit simulation problem	430	0.175194382	431	2.64E-02
622 2	Sandia	430	1544	subsequent circuit simulation problem	430	0 264898471	431	2.39E-01
623 5	Sandia	430	1614	circuit simulation problem	430	0.000314769	431	6.84E-01
624 1	SNAP	10879	39994	directed graph	10879	68 56017142	10880	1 18E+01
625 4	SNAP	8846	31839	directed graph	8846	2 166326337	8847	1 31E+00
626 3	SNAP	8717	31525	directed graph	8717	8 936495445	8718	4 36E+01
627 4	SNAP	6301	20777	directed graph	6301	5.140148069	6302	3.59E+00
628 5	SNAP	8114	26013	directed graph	8114	2.275198535	8115	2.99E+00
629 4	SNAP	26518	65369	directed graph	26518	0.439784095	26519	1.20E+00
630 5	SNAP	22687	54705	directed graph	22687	0.855030511	22688	2.05E-01
631 3	SNAP	36682	88328	directed graph	36682	2.97020675	36683	3.29E+01
632 5	SNAP	62586	147892	directed graph	62586	14.8	62586	1.48E+01
633 1	Schenk_ISEI	155924	2094873	subsequent semiconductor device problem	155924	0.0206	155924	1.41E+01
634 2	Schenk_ISEI	153226	2930882	semiconductor device problem	153226	1.76	153226	7.63E-05
635 2	Schenk_ISEI	155924	2094873	semiconductor device problem sequence	155924	0.001542913	155924	2.78E+00
636 1	Schenk_ISEI	155924	2094873	subsequent semiconductor device problem	155924	0.000915712	155924	6.14E-03
637 3	Schenk_ISEI	155924	2094873	subsequent semiconductor device problem	155924	0.0062	155924	1.24E-01
638 3	Schenk_ISEI	155924	2094873	subsequent semiconductor device problem	155924	0.00927	155924	1.26E-01
639 1	Schenk_ISEI	155924	2094873	subsequent semiconductor device problem	155924	0.00327	155924	1.43E-01
640 4	Pajek	240547	560943	directed weighted graph	240547	5.57E+25	26	7.85E+02
641 4	MathWorks	8081	13036	counter-example problem	119	7.27E-11	121	8.86E-11
642 4	Bai	225	1065	2D/3D problem	71	5.15E-11	70	9.56E-11
643 3	Bai	2961	14585	2D/3D problem	221	6.49E-11	185	7.64E-11
644 3	Bai	900	4380	2D/3D problem	144	2.02E-11	132	8.05E-11
645 5	Oberwolfach	2025	100015	model reduction problem	2025	0.000114344	2026	2.89E-05
646 5	MathWorks	102	306	statistical/mathematical problem	30	7.86E-11	22	7.42E-11
647 5	HB	1919	9662	2D/3D problem	1919	4.03E+11	1920	4.04E+11
648 1	HB	362	1/60	2D/3D problem	362	7.08E+13	363	7.42E+13
649 1	FEMLAB	367	2417	computational fluid dynamics problem	12	8.55E-11	69	9.12E-11
650 4	FEMLAB	13514	352762	computational fluid dynamics problem	184	3.01E-11	192	0.30E-11
652 2	TEMLAB	83023	2374949	computational nulu dynamics problem	341	9.04E-11	408	7.382-11
	Newman	1/100	10025	directed multigraph	1/00	6730007/1/6	1/01	5 02E-01
653 1	Newman	1490	19025 8188	directed multigraph economic problem	1490	6.239992476 3.13E-11	1491	5.02E-01 3.13E-11
652         5           653         1           654         2	Grund Grund	1490 4008 15575	19025 8188 33033	directed multigraph economic problem economic problem	1490 35 36	6.239992476 3.13E-11 6.29E-11	1491 36 37	5.02E-01 3.13E-11 6.29E-11
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund	1490 4008 15575 16955	19025 8188 33033 37849	directed multigraph economic problem economic problem economic problem	1490 35 36 35	6.239992476 3.13E-11 6.29E-11 7.8E-11	36 37 36	5.02E-01 3.13E-11 6.29E-11 2.05E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund	1490 4008 15575 16955 33833	19025 8188 33033 37849 73249	directed multigraph economic problem economic problem economic problem	1490 35 36 35 42	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11	1491       36       37       36       43	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11
652         3           653         1           654         2           655         2           656         2           657         5	Newman Grund Grund Grund HB	1490 4008 15575 16955 33833 30	19025 8188 33033 37849 73249 180	directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem	1490 35 36 35 42 30	6.2399924/6 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163	1491       36       37       36       43       31	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB	1490 4008 15575 16955 33833 30 1224	19025 8188 33033 37849 73249 180 9613	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem	1490 35 36 35 42 30 1224	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981	1491 36 37 36 43 31 1225	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB	1490 4008 15575 16955 33833 30 1224 532	19025 8188 33033 37849 73249 180 9613 3474	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem	1490 35 36 35 42 30 1224 532	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584	1491 36 37 36 43 31 1225 403	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo	1490 4008 15575 16955 33833 30 1224 532 15838	19025 8188 33033 37849 73249 180 9613 3474 64424	driected multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem	1490 35 36 35 42 30 1224 532 15838	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657	1491           36           37           36           43           31           1225           403           15839	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem	1490 4008 15575 16955 33833 30 1224 532 15838 161070	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem	1490           35           36           35           36           37           30           1224           532           15838           161070	6.239992476 3.13E-11 6.29E-11 7.8E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24	1491           36           37           36           43           31           1225           403           15839           161070	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136 2779	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem	1490           35           36           35           42           30           1224           532           15838           161070           103	6.239992476 3.13E-11 6.29E-11 7.8E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11	1491           36           37           36           43           31           1225           403           15839           161070           416	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB LiuWenzhuo Fluorem FEMLAB HB	1490           4008           15575           16955           33833           30           1224           532           15838           161070           415           3140	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136 2779 543160	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem	1490       35       36       35       42       30       1224       532       15838       161070       103       2137	6.239992476 3.13E-11 6.29E-11 7.8E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11	1491       36       37       36       43       31       1225       403       15839       161070       416       39	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB LiuWenzhuo Fluorem FEMLAB HB HB	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136 2779 543160 543022	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem	1490 35 36 35 42 30 1224 532 15838 161070 103 2137 3140	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467	1491       36       37       36       43       11225       403       15839       161070       416       39       3141	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB HB	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136 2779 543160 540022 543160	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem	1490 35 36 37 30 1224 532 15838 161070 103 2137 3140 50	6.239992476 3.13E-11 6.29E-11 7.8E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11	1491       36       37       36       43       31       1225       403       15839       161070       416       39       3141       3141	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB HB HB Bai	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 1484	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136 2779 543160 540022 543160 6110 6120	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem economic problem	1490 35 36 37 30 1224 532 15838 161070 103 2137 3140 50 1484	6.239992476 3.13E-11 6.29E-11 7.8E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 9.15E-11 8.22E-11 50.13002423 0.02926512	1491       36       37       36       43       31       1225       403       15839       161070       416       39       3141       3141       1485	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 6.69E-14
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB HB Bai Bai	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 1484 768	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136 2779 543160 6110 2934 2254	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem economic problem power network problem power network problem	1490 35 36 35 42 30 1224 532 15838 161070 103 2137 3140 50 1484 768 993	6.239992476 3.13E-11 6.29E-11 7.8E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 9.000266449	1491       36       37       36       43       11225       403       15839       161070       416       39       3141       3141       1485       7692	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-02
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB LiuWenzhuo Fluorem FEMLAB HB HB HB Bai Bai Bai Zitray	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 3140 415 3140 3140 3140 3140 3140 3140 3140 3140	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           12000	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem 2D/3D problem economic problem economic problem economic problem economic problem power network problem power network problem power network problem	1490 35 36 37 30 1224 532 15838 161070 103 2137 3140 50 1484 768 882 1049	6.239992476 3.13E-11 6.29E-11 7.8E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 2.80267225	1491       36       37       36       43       11225       403       15839       161070       416       39       3141       3141       1485       769       883       1040	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.72E-01
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB HB HB Bai Bai Bai Bai Bai Eai	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 3140 3140 2342 2342	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136 2779 543160 540022 543160 6110 2934 3354 13299 203400	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem power network problem economic problem economic problem economic problem power network problem power network problem power network problem power network problem power network problem chemical process simulation problem	1490 35 36 35 37 42 30 1224 532 15838 161070 103 2137 3140 50 1484 768 882 1048 201	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E 12	1491       36       37       36       43       31       1225       403       15839       161070       416       39       3141       3141       3141       3141       883       1049       202	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 0.78E+11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB HB HB Bai Bai Bai Bai Zitney Simon Simon	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 1484 768 882 1048 3242	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136 2779 543160 540022 543160 6110 2934 3354 13299 293409 293409 29355	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem power network problem power network problem power network problem chemical process simulation problem computational fluid dynamics problem sequence eubsequenced fluid dynamics problem sequence	1490 35 36 35 37 30 1224 532 15838 161070 103 2137 3140 50 1484 768 882 1048 291	6.239992476 3.13E-11 6.29E-11 7.8E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E 11	1491       36       37       36       43       31       1225       403       15839       161070       416       39       3141       3141       1485       769       883       1049       292       430	5.02E-01 3.13E-11 6.29E-11 2.05E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-04 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+01 9.73E+01 9.73E-11 5.91E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB HB Bai Bai Bai Bai Zitney Simon Simon Simon	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 1484 768 882 8140 3140 3140 3140 3140 3140 3140 3140 3	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           6410           2934           3354           13299           293409           293551           1488768	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem 2D/3D problem economic problem economic problem economic problem power network problem power network problem power network problem chemical process simulation problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem	1490       35       36       35       30       1224       532       15838       161070       103       2137       3140       50       1484       768       882       1048       291       524       21200	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.00024384	1491       36       37       36       43       11225       403       15839       161070       416       39       3141       3141       1485       769       883       1049       292       430       211	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-10 1.13E+01 3.83E-11 2.51E-04 9.73E+01 9.73E+01 9.73E+01 9.73E+01 1.58E-04
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB HB Bai Bai Bai Zitney Simon Simon Simon	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 3140 3140 3140 3140	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136 2779 543160 540022 543160 6110 2934 3354 13299 293409 293551 1488768 167178	directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem power network problem power network problem power network problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem sequence	1490       35       36       35       36       35       42       30       1224       532       15838       161070       103       2137       3140       50       1484       768       882       1048       291       524       21200       6316	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.4414557 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297	1491       36       37       36       43       31       1225       403       15839       161070       416       39       3141       3141       3141       769       883       1049       292       430       211       27	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+11 5.91E-11 1.58E-04 8.25E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB HB HB Bai Bai Zitney Simon Simon Simon Simon	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 3140 3140 3140 3140	19025 8188 33033 37849 180 9613 3474 64424 8185136 2779 543160 540022 543160 6110 2934 3354 13299 293409 293409 293551 1488768 167178 130371	directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem power network problem power network problem power network problem power network problem chemical process simulation problem computational fluid dynamics problem subsequent computational fluid dynamics problem computational fluid dynamics problem structural problem	1490       35       36       35       36       35       42       30       1224       532       15838       161070       103       2137       3140       50       1484       768       882       1048       291       524       21200       6316       3402	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.00026449 0.00026449 0.00026449 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.00009	1491       36       37       36       43       31       1225       403       15839       161070       416       39       3141       3141       3141       3141       3141       3141       3141       3485       1049       292       430       211       27       28	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-10 1.13E+01 3.83E-11 2.51E-04 9.73E+01 9.73E+01 9.73E+01 9.73E+01 1.58E-04 8.25E-11 1.58E-04 8.25E-11 4.30E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund HB	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 1484 768 882 1048 3242 21200 6316 3400 24	19025 8188 33033 37849 73249 180 9613 3474 64424 8185136 2779 543160 540022 543160 6110 2934 3354 13299 293409 293551 1488768 167178 10371 81	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem power network problem power network problem chemical process simulation problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem structural problem structural problem	1490         35         36         35         36         35         42         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24	6.239992476 3.13E-11 6.29E-11 7.8E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000109 2.42E+11	1491       36       37       36       43       31       1225       403       15839       161070       416       39       3141       3141       3141       1485       769       883       1049       292       430       211       27       28       25	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-04 1.13E+01 3.83E-11 2.51E-04 9.73E+01 9.73E+01 9.73E+01 9.73E+01 9.73E+01 1.58E-04 8.25E-11 4.30E-11 2.68E+10
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund HB	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 415 3140 3140 3140 1484 768 882 1048 3242 3242 21200 6316 3400 24 23	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           130371           81           64	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem power network problem power network problem power network problem chemical process simulation problem computational fluid dynamics problem computational fluid dynamics problem structural problem structural problem	1490         35         36         35         36         37         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.62E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.0000243484 2748836.297 0.0000109 2.42E+11 1321561984	1491       36       37       36       43       11225       403       15839       161070       416       39       3141       3141       1485       769       883       1049       292       430       211       27       28       25       24	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+01 9.73E+01 1.58E-04 8.25E-11 4.30E-11 2.68E+10 1.35E+09
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB HB HB Bai Bai Bai Bai Zitney Simon Simon Simon Simon Simon Simon Pajek Pajek Rajat	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 3140 3140 3140 3140	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           130371           81           64           1300261	directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem power network problem power network problem power network problem power network problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem structural problem directed weighted graph directed weighted graph circuit simulation problem	1490           35           36           35           42           30           1224           532           15838           161070           103           2137           3140           50           1484           768           882           1048           291           524           21200           6316           3402           24           23           263743	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 39.85875467 2.52E-11 39.85875467 2.52E-11 39.85875467 2.52E-11 39.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000109 2.42E+11 1321561984 1.58641E-06	1491       36       37       36       43       31       1225       403       15839       161070       416       99       3141       3141       3141       3145       769       883       1049       292       430       211       27       28       25       24       263743	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.73E+01 9.73E+01 9.73E+01 9.73E+11 1.591E-11 1.58E-04 8.25E-11 4.30E-11 2.68E+10 1.35E+09 2.51E-02
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB Bai Bai Bai Bai Zitney Simon Simon Simon Simon Pajek Pajek Rajat Rajat	1490           4008           4008           15575           16955           3383           30           1224           532           15838           161070           415           3140           3142           1048           3242           21200           6316           3402           24           23           263743           6833	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           130371           81           64           1300261           43250	directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem power network problem power network problem power network problem power network problem computational fluid dynamics problem subsequent computational fluid dynamics problem subsequent computational fluid dynamics problem structural problem directed weighted graph circuit simulation problem	1490           35           36           35           36           35           42           30           1224           532           15838           161070           103           2137           3140           50           1484           768           882           1048           291           524           21200           6316           3402           24           23           263743           6833	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.000009 2.42E+11 1321561984 1.58641E-06 0.01357997	1491         36         37         36         43         31         1225         403         15839         161070         416         39         3141         3141         3141         3141         3141         3485         769         883         1049         292         430         211         27         28         25         24         263743         6834	5.02E-01 3.13E-11 6.29E-11 2.05E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+01 9.73E+01 1.58E-04 8.25E-11 2.68E+10 1.35E+02 2.51E-02 4.55E-02
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund HB	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 3140 3140 3140 3140	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           1300261           43250           32653	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem power network problem power network problem power network problem chemical process simulation problem computational fluid dynamics problem computational fluid dynamics problem structural problem structural problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         42         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000109 2.42E+11 1321561984 1.58641E-06 0.013579997 8.17E-11	1491         36         37         36         43         31         1225         403         15839         161070         416         39         3141         3141         3141         3141         1485         769         883         1049         292         430         211         27         28         25         24         263743         6834         143	5.02E-01 3.13E-11 6.29E-11 2.05E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 2.51E-04 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+01 9.73E+01 1.58E-04 8.25E-11 1.58E-04 8.25E-11 1.35E+09 2.51E-02 8.54E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund HB HB HB HB HB HB HB HB HB HB Bai Bai Zitney Simon Simon Simon Simon Simon Simon Pajek Pajek Rajat Rajat Rajat	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 415 3140 415 3140 1415 3140 1484 768 882 1048 3242 3242 21200 6316 3402 24 23 263743 6833 7602 24 1041	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           130371           81           64           1300261           43250           32653           8725	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem power network problem chemical process simulation problem computational fluid dynamics problem structural problem structural problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         42         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         23         263743         6833         257         1041	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 50.13002423 0.00026449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.0000243484 2748836.297 0.0000109 2.42E+11 1321561984 1.58641E-06 0.013579997 8.17E-11 0.0000136	1491         36         37         36         31         1225         403         15839         161070         416         39         3141         3141         1485         769         883         1049         292         430         211         27         28         25         24         263743         6834         143         357	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-04 9.59E-04 1.13E+01 3.83E-11 2.51E-04 9.73E+01 9.73E+01 9.73E+01 9.73E+01 1.35E-04 8.25E-11 4.30E-11 2.51E-02 4.55E-02 8.54E-11 4.97E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund HB	1490           4008           15575           16955           3833           30           1224           532           15838           161070           415           3140           3140           3140           3140           3140           3140           3140           3140           3140           3142           3242           3242           3242           21200           6316           3402           24           23           242           263743           6833           7602           1041	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293551           1488768           167178           1300261           43250           32653           8725           1250	directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem power network problem power network problem power network problem power network problem computational fluid dynamics problem economic problem power network problem power network problem power network problem power network problem drete a simulation problem structural problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem circuit simulation problem circuit simulation problem	1490         35         36         35         42         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 39.85875467 2.52E-11 39.85875467 2.52E-11 39.85875467 2.52E-11 39.000266449 0.0010364489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000109 2.42E+11 1321561984 1.58641E-06 0.013579997 8.17E-11 0.0000136 0.186054221	1491         36         37         36         43         31         1225         403         31         1225         403         15839         161070         416         39         3141         3141         3141         3485         769         883         1049         292         430         211         27         28         25         24         263743         6834         143         357         302	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.75E-10 9.75E+11 5.91E-11 1.58E-04 8.25E-11 4.30E-11 2.51E-02 4.55E-02 8.54E-11 4.97E-11 3.84E-04
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund HB HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB Bai Bai Bai Bai Zitney Simon Simon Simon Simon Pajek Pajek Rajat Raj Rajat	1490           4008           4008           15575           16955           3383           30           1224           532           15838           161070           415           3140           3242           21200           6316           3402           24           23           7602           1041           301           135	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           130371           81           64           1300261           43250           32653           8725           1250           665	directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem economic problem power network problem power network problem power network problem computational fluid dynamics problem economic problem power network problem power network problem computational fluid dynamics problem subsequent computational fluid dynamics problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem circuit simulation problem circuit simulation problem circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         36         37         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301         135	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.000043484 2748836.297 0.0000109 2.42E+11 1321561984 1.58641E-06 0.013579997 8.17E-11 0.0000136 0.186054221 0.000370509	1491         36         37         36         43         31         1225         403         15839         161070         416         39         3141         3141         3141         3141         3141         2485         25         24         263743         6834         143         357         302         100	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-10 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+01 9.73E+01 1.58E-04 8.25E-11 1.58E+00 1.35E+00 2.51E-02 4.55E-02 8.54E-11 3.84E-04 1.82E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman         Grund         Grund         Grund         HB         HB         HB         HB         HB         HB         HB         HB         HB         Bai         Bai         Bai         Simon         Simon         Simon         Pajek         Pajek         Rajat         Rajat         Rajat         Rajat         Rajat         Rajat         Rajat         Rajat	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 3140 3140 3140 3140	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           130371           81           64           1300261           43250           32653           8725           1250           665           12818	driected multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem power network problem power network problem power network problem chemical process simulation problem computational fluid dynamics problem computational fluid dynamics problem gower network problem chemical process simulation problem subsequent computational fluid dynamics problem structural problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         42         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301         135         1879	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000109 2.42E+11 1321561984 1.58641E-06 0.013579997 8.17E-11 0.0000136 0.186054221 0.0000370509 622.3583621	1491         36         37         36         43         31         1225         403         15839         161070         416         39         3141         3141         3141         3141         3141         292         430         211         27         28         25         24         263743         6834         143         357         302         100         414	5.02E-01 3.13E-11 6.29E-11 2.05E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 2.51E-10 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+01 9.73E+01 9.73E+01 1.58E-04 8.25E-11 4.30E-11 2.68E+10 1.35E+09 2.51E-02 8.54E-11 4.97E-11 3.84E-04 1.82E-11 4.74E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman         Grund         Grund         Grund         Grund         HB         HB         HB         HB         Fluorem         FEMLAB         HB         Bai         Bai         Zitney         Simon         Simon         Simon         Pajek         Pajek         Rajat         Rajat         Rajat         Rajat         Rajat         Rajat         Rajat	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 415 3140 1484 768 882 1048 3140 1484 3140 1484 3242 3242 3242 3242 3242 3242 3242 3	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           543160           6110           2934           3354           13299           293409           293551           1488768           167178           1300261           43250           32653           8725           1250           665           12818           48762	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem chemical process simulation problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem structural problem directed weighted graph circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         42         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301         135         1879         7598	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000109 2.42E+11 1321561984 1.58641E-06 0.013579997 8.17E-11 0.0000136 0.186054221 0.000370509 622.3583621 600.3254928	1491         36         37         36         31         1225         403         15839         161070         416         39         3141         3141         1485         769         883         1049         292         430         211         27         28         25         24         263743         6834         143         357         302         100         414         158	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-04 9.59E-04 1.13E+01 3.83E-11 2.51E-04 9.73E+01 9.73E+01 9.73E+01 9.73E+01 1.14E-03 9.73E+01 9.73E+01 1.58E-04 8.25E-11 4.30E-11 2.51E-02 4.55E-02 8.54E-11 4.97E-11 3.84E-04 1.82E-11 4.74E-11 9.29E-11
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund Grund HB	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 3140 3140 3140 3140	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           1300261           43250           32653           8725           1250           665           12818           48762           1475	driected multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem power network problem power network problem power network problem power network problem computational fluid dynamics problem economic problem power network problem power network problem power network problem drete and fluid dynamics problem structural problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         42         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301         135         1879         7598         180	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 39.85875467 2.52E-11 39.85875467 2.52E-11 39.85875467 2.52E-11 39.000266449 0.0010364489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000109 2.42E+11 1321561984 1.58641E-06 0.013579997 8.17E-11 0.000036 0.186054221 0.000036 0.186054221 0.0000326 622.3583621 60003224928 0.0000322	1491         36         37         36         43         31         1225         403         15839         161070         416         39         3141         3141         3141         3141         28         25         24         263743         6834         143         357         302         1000         414         158         85	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+11 5.91E-11 1.58E-04 8.25E-11 4.30E-11 2.51E-02 4.55E-02 8.54E-11 4.97E-11 3.84E-04 1.82E-11 4.74E-11 9.29E-11 6.41E-11 9.29E-11 6.41E-11 9.29E-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund HB HB HB HB LiuWenzhuo Fluorem FEMLAB HB HB Bai Bai Bai Bai Zitney Simon Simon Simon Simon Simon Pajek Pajek Rajat Raja	1490           4008           4008           15575           16955           3383           30           1224           532           15838           161070           415           3140           3242           21200           6316           3402           24           23           7602           1041           301           135           1879           7598           37261	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           1300261           43250           32653           8725           1250           665           12818           48762           1475           443573	directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem economic problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         42         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301         135         1879         7598         180         37261	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000196 2.42E+11 1321561984 1.58641E-06 0.013579997 8.17E-11 0.0000136 0.186054221 0.000370509 622.3583621 600.3254928 0.000322	1491         36         37         36         43         31         1225         403         15839         161070         416         39         3141         3141         3141         3141         3141         248         292         430         211         27         28         25         24         6834         143         357         302         100         414         158         85         37262	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-10 1.13E+01 3.83E-11 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+01 9.78E-11 1.58E-04 8.25E-11 4.30E-11 2.68E+10 1.35E+00 2.51E-02 4.55E-02 8.54E-11 4.74E-11 3.74E-01 3.74E-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund Grund HB	1490 4008 15575 16955 33833 30 1224 532 15838 30 161070 415 3140 3140 3140 3140 3140 3140 3140 3140	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           130371           81           64           1300261           43250           32653           8725           12818           48762           1443573           476766	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem power network problem chemical process simulation problem computational fluid dynamics problem subsequent computational fluid dynamics problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301         135         1879         7598         180         97261         94294	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000199 2.42E+11 1321561984 1.58641E-06 0.01357997 8.17E-11 0.000032 0.000032 0.0003259928 0.0000322 622.3583621 600.3254928 0.0000322	1491         36         37         36         43         31         1225         403         15839         161070         416         39         3141         3141         3141         3141         3141         3141         292         430         211         27         28         25         24         263743         6834         143         357         302         100         414         158         85         37262         94295	5.02E-01 3.13E-11 6.29E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-04 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+01 9.73E+01 1.58E-04 8.25E-11 4.30E-11 2.68E+10 1.35E+09 2.51E-02 8.54E-11 4.97E-11 3.84E-04 1.82E-11 4.74E-11 9.29E-11 6.41E-11 3.74E-01 1.49E-04 1.49E-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund Grund HB Bai Bai Bai Bai Zitney Simon Simon Simon Simon Simon Pajek Pajek Rajat Raj	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 415 3140 415 3140 1484 768 882 81048 3242 3242 21200 6316 3402 24 23 263743 6833 7602 7602 7602 7602 7602 7602 7602 7602	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           1300261           43250           32653           8725           1250           665           12818           48762           1475           443573           476766           479246	directed multigraph economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem computational fluid dynamics problem 2D/3D problem economic problem economic problem economic problem power network problem power network problem power network problem computational fluid dynamics problem power network problem computational fluid dynamics problem subsequent computational fluid dynamics problem computational fluid dynamics problem structural problem structural problem directed weighted graph circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         36         37         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301         135         1879         7598         180         37261         94294         94294	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000109 2.42E-11 1321561984 1.58641E-06 0.013579997 8.17E-11 0.0000136 0.186054221 0.000370509 622.3583621 600.3254928 0.0000322 6288971.974 0.000125017 0.003467119 0.0033627 0.000370509 1.22517 0.0003467119 0.0003467119 0.0003467119 0.000367059 0.00036719 0.00036719 0.00036719 0.00036719 0.00036719 0.00036719 0.00036719 0.00036719 0.00036719 0.00036719 0.00036719 0.00036729 0.0003725 0.0003725 0.00037559 0.00037559 0.00037559 0.00037559 0.000325 0.000325 0.000325 0.00036719 0.00036719 0.00036759 0.00037559 0.00037559 0.00037559 0.00037559 0.000325 0.00037559 0.00037559 0.000325 0.000325 0.000325 0.00037559 0.000325 0.000325 0.00037559 0.000325 0.00037559 0.000325 0.00037559 0.00035559 0.000355559 0.000355555555555555555555555555555	1491         36         37         36         37         36         37         36         37         36         37         36         37         36         37         36         37         36         37         36         3141         1485         769         883         1049         292         430         211         27         28         25         24         263743         6834         143         357         302         100         414         158         85         37262         94295         94295	5.02E-01 3.13E-11 6.29E-11 2.05E-11 2.05E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-04 1.13E+01 3.83E-11 2.51E-04 9.73E+01 9.73E+01 9.73E+01 9.73E+01 1.58E-04 8.25E-11 4.30E-11 2.51E-04 8.54E-11 4.30E-11 1.35E+09 2.51E-02 4.55E-02 8.54E-11 4.74E-11 9.29E-11 3.84E-04 1.82E-11 4.74E-11 9.29E-11 3.74E-01 1.49E-04 1.55E-04 1.50E-04 1.55E-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman Grund Grund Grund Grund Grund HB Bai Bai Bai Bai Bai Bai Bai Simon Simon Simon Simon Simon Simon Simon Rajat R	1490           4008           4008           4008           15575           16955           3383           30           1224           532           15838           161070           415           3140           3242           21200           6316           3402           24           23           6833           7602           1041           301           135           180           37261           94294 <td>19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           2934           3354           13299           293409           29351           1488768           167178           1300261           43250           32653           8725           1250           665           12818           48762           1475           443573           476766           479246           479151           260</td> <td>directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem computational fluid dynamics problem structural problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem</td> <td>1490         35         36         35         36         35         42         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301         135         180         37261         94294         94294         94294         94294</td> <td>6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000243484 2748836.297 0.0000199 2.42E+11 1321561984 1.58641E-06 0.013579997 8.17E-11 0.0000136 0.186054221 0.000370509 622.3583621 60033254928 0.00012517 0.003467119 0.010293268</td> <td>1491       36       37       36       43       31       1225       403       15839       161070       416       39       3141       3141       3141       3141       3141       288       25       24       263743       6834       143       357       302       100       414       158       85       37262       94295       94295       94295       94295</td> <td>5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.75E-04 1.14E-03 9.73E+01 9.75E+11 1.58E-04 8.25E-11 4.30E-11 2.51E-02 4.55E-02 8.54E-11 1.32E+11 4.37E-11 3.84E-04 1.82E-11 4.74E-11 9.29E-11 6.41E-11 3.74E-01 1.49E-04 1.15E-01 1.59E-04 1.59E-04 1.59E-04 1.59E-04 1.59E-04 1.59E-04 1.59E-11 3.84E-04 1.59E-</td>	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           2934           3354           13299           293409           29351           1488768           167178           1300261           43250           32653           8725           1250           665           12818           48762           1475           443573           476766           479246           479151           260	directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem computational fluid dynamics problem structural problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         42         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301         135         180         37261         94294         94294         94294         94294	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.000266449 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000243484 2748836.297 0.0000199 2.42E+11 1321561984 1.58641E-06 0.013579997 8.17E-11 0.0000136 0.186054221 0.000370509 622.3583621 60033254928 0.00012517 0.003467119 0.010293268	1491       36       37       36       43       31       1225       403       15839       161070       416       39       3141       3141       3141       3141       3141       288       25       24       263743       6834       143       357       302       100       414       158       85       37262       94295       94295       94295       94295	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.75E-04 1.14E-03 9.73E+01 9.75E+11 1.58E-04 8.25E-11 4.30E-11 2.51E-02 4.55E-02 8.54E-11 1.32E+11 4.37E-11 3.84E-04 1.82E-11 4.74E-11 9.29E-11 6.41E-11 3.74E-01 1.49E-04 1.15E-01 1.59E-04 1.59E-04 1.59E-04 1.59E-04 1.59E-04 1.59E-04 1.59E-11 3.84E-04 1.59E-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Newman         Grund         Grund         Grund         HB         HB         HB         LiuWenzhuo         Fluorem         FEMLAB         HB         Bai         Bai         Bai         Simon         Simon         Simon         Simon         Simon         Simon         Rajat	1490 4008 15575 16955 33833 30 1224 532 15838 161070 415 3140 3140 3140 3140 3140 3140 3140 3140	19025           8188           33033           37849           73249           180           9613           3474           64424           8185136           2779           543160           540022           543160           6110           2934           3354           13299           293409           293551           1488768           167178           1300261           43250           32653           8725           12818           48762           1475           443573           476766           479246           479246	directed multigraph economic problem economic problem economic problem economic problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem power network problem economic problem economic problem economic problem economic problem economic problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem subsequent computational fluid dynamics problem directed weighted graph directed weighted graph circuit simulation problem circuit simulation problem	1490         35         36         35         36         35         36         37         30         1224         532         15838         161070         103         2137         3140         50         1484         768         882         1048         291         524         21200         6316         3402         24         23         263743         6833         257         1041         301         135         1879         7598         180         37261         94294         94294         1157         \$6016	6.239992476 3.13E-11 6.29E-11 7.8E-11 6.86E-11 0.002230163 0.914198981 0.000881584 12.44145657 0.24 9.15E-11 8.22E-11 39.85875467 2.52E-11 50.13002423 0.00026649 0.001034489 3.893673826 9.66E-11 8.01E-11 0.000243484 2748836.297 0.0000243484 2748836.297 0.0000109 2.42E+11 1321561984 1.58641E-06 0.01357997 8.17E-11 0.0000136 0.186054221 0.00037509 622.3583621 600.3254928 0.000125017 0.0032268 0.00028796	1491         36         37         36         37         36         37         36         37         36         37         36         37         36         37         36         37         36         37         36         311         1225         403         3141         28         25         24         263743         6834         143         357         302	5.02E-01 3.13E-11 6.29E-11 2.05E-11 7.81E-11 1.05E+00 8.14E-03 9.15E-11 1.71E+00 7.57E+03 2.91E+00 2.51E-11 1.13E+01 3.83E-11 2.51E-04 9.59E-04 1.14E-03 9.73E+01 9.73E+01 9.73E+01 1.58E-04 8.25E-11 4.30E-11 2.68E+10 1.35E+00 2.51E-02 4.55E-02 8.54E-11 4.74E-11 3.84E-04 1.82E-11 4.74E-11 3.74E-01 1.49E-04 1.59E-04 1.59E-04 1.59E-04 1.59E-01 1.59E-04 1.59E-01 1.59E-04 1.59E-01 1.59E-04 1.59E-01 1.59E-04 1.59E-04 1.59E-01 1.59E-04 1.59E-

692 1	Raiat	411676	1876011	circuit simulation problem	411676	4 57	411676	6 86E-02
602 4	Pajat	20800	105420	aircuit simulation problem	20800	0.000251026	20000	5.66E.08
093 4	Rajai	39899	193429	circuit sinulation problem	39899	0.000331030	39900	5.001-08
694 2	Rajat	110355	555441	circuit simulation problem	110355	0.036476565	110356	1.30E-08
695 2	Rajat	358172	1946979	circuit simulation problem	358172	0.015968944	92355	2.48E-09
696 4	Rajat	87190	606489	circuit simulation problem	87190	35 45744605	87191	8 59E-11
607 1	Pajat	51022	247529	airauit simulation problem	51022	0.000036386	51022	2.09E.09
600 2	Rajat	20640	247326	circuit simulation problem	20640	0.000930280	20641	2.962-08
698 2	Rajat	20640	97353	circuit simulation problem	20640	0.00451249	20641	1.48E-03
699 4	Rajat	87190	606489	circuit simulation problem	87190	0.000118599	87191	3.88E-09
700 3	Bai	480	17088	robotics problem	480	6.429194346	481	6.40E+00
701 4	Bai	480	17088	robotics problem	480	16 0141591	481	3 36E+01
701 4	Dai	400	7200	iobolics problem	400	0.005 11	401	5.502+01
/02 3	Bai	1250	/300	computational fluid dynamics problem	123	2.38E-11	107	5.95E-11
703 4	Bai	1250	7300	computational fluid dynamics problem	138	8.66E-11	329	7.79E-11
704 5	Bai	200	1120	computational fluid dynamics problem	35	6.05E-11	36	7.84E-11
705 5	Bai	200	1120	computational fluid dynamics problem	47	9 59E-11	51	5 68E-11
706 2	Pai	2048	12022	computational fluid dynamics problem	176	0.0E 11	227	0.04E 11
700 2	Bai	2048	12032	computational fund dynamics problem	170	9.90-11	237	9.04E-11
707 3	Bai	2048	12032	computational fluid dynamics problem	134	9.89E-11	139	5.88E-11
708 4	Bai	3200	18880	computational fluid dynamics problem	229	9.76E-11	315	4.59E-11
709 3	Bai	450	2580	computational fluid dynamics problem	62	7.55E-11	65	3.65E-11
710 3	Bai	450	2580	computational fluid dynamics problem	74	7.81E-11	451	1 83E-04
710 5	Dai	5000	20600	computational fluid dynamics problem	297	5.42E 11	222	5 45E 11
/11 4	Bai	5000	29600	computational fuild dynamics problem	287	5.43E-11	332	5.45E-11
712 2	Bai	800	4640	computational fluid dynamics problem	110	8.81E-11	474	9.02E-11
713 4	Bai	968	5632	computational fluid dynamics problem	122	7.74E-11	413	8.99E-11
714 1	Zitney	4134	94408	chemical process simulation problem	4134	8788163.442	4135	2.14E+02
715 5	Zitney	3198	56834	chemical process simulation problem	3198	1 140821795	3199	1 49E+04
716 1	Zitaan	2209	61904	shamiaal maaaaa simulati a saabbaa	2208	4207 740992	2200	2.075.00
/10 1	∠itney	2398	01890	chemical process simulation problem	2398	4307.749883	2399	5.27E+00
717 4	HB	10	76	counter-example problem	4	1.02E-14	5	1.02E-14
718 2	Goodwin	22560	1014951	computational fluid dynamics problem	22560	2.842141049	22561	4.86E+00
719 3	Fluorem	381689	37464962	computational fluid dynamics problem	381689	0.248	381689	1.74E+02
720 5	Pour	46925	2220002	computational fluid dynamics problem	16925	0.052061462	16926	1.92E.02
720 3	Боуа	40633	2329092	computational nuid dynamics problem	40655	0.00001400	40650	1.63E-02
/21 4	Morandini	120	870	robotics problem	120	0.010004983	121	1./2E+02
722 5	Pajek	1022	5075	directed graph	1022	3.93363001	1023	4.42E+00
723 3	Morandini	100	708	structural problem	100	0.057797504	101	nan
724 3	Morandini	791	10685	structural problem	791	0.012976712	792	5.80E-01
724 5	D	121	10005	structural problem	126	0.012970712	192	21(E:02
725 1	Bai	136	479	statistical/mathematical problem	136	302.1781142	137	2.16E+02
726 5	Bai	496	1859	statistical/mathematical problem	496	14328395.76	497	2.51E+06
727 5	Bai	5151	20199	statistical/mathematical problem	5151	2.23E+15	5152	5.37E+14
728 2	Rommes	682	1633	eigenvalue/model reduction problem	682	0.031435468	683	3 22E+00
720 2	Bammaa	529	1217	eigenvalue/model reduction problem	520	0.520006796	520	1.52E.02
729 3	Rommes	328	1317	eigenvalue/model reduction problem	328	0.330090780	329	1.53E-02
730 3	Rommes	1182	2881	eigenvalue/model reduction problem	1182	1.134412766	1183	8.83E+00
731 4	Rommes	1028	2547	eigenvalue/model reduction problem	1028	0.062789646	1029	9.40E-02
732 5	Rommes	2182	5341	eigenvalue/model reduction problem	2182	0.33019982	2183	7.36E+00
733 5	Rommes	2028	5007	eigenvalue/model reduction problem	2028	0.427151083	2029	5 93E 03
733 3	Rommes	2028	3007	eigenvalue/model reduction problem	2028	0.42/131963	2029	5.93E-03
734 3	Rommes	4182	10261	eigenvalue/model reduction problem	4182	0.249477754	4183	8.93E+01
735 5	Rommes	4028	9927	eigenvalue/model reduction problem	4028	20.13406152	4029	2.24E-03
736 3	HB	238	1128	computational fluid dynamics problem	238	0.729924923	239	1.84E-06
737 5	Pajek	3084	10413	directed multigraph	3084	1.65E+19	3085	2 13E+19
739 4	Tujek	170000	059026	circuit circulation multipli	170000	0.002015512	170000	1.87E.01
/38 4	Hamm	170998	958936	circuit simulation problem	170998	0.002015515	170999	1.8/E-01
739 4	JGD_Homology	200200	800800	combinatorial problem	200200	3940	200200	3.93E+03
740 5	HB	1000	22004	computational fluid dynamics problem	1000		1001	
741 2	(	1080	23094		1080	0.153592192	1081	7.56E+01
742 1	HB	5005	20033	computational fluid dynamics problem	1080 4866	0.153592192 8.38E-11	441	7.56E+01 4.09E-11
1 1	HB	5005	20033 3786	computational fluid dynamics problem	1080 4866 150	0.153592192 8.38E-11 9.08E-11	1081 441 116	7.56E+01 4.09E-11 2.21E-11
742 2	HB HB	1080 5005 1104 2312	20033 3786 20702	computational fluid dynamics problem computational fluid dynamics problem	1080 4866 150	0.153592192 8.38E-11 9.08E-11 7.28E-11	1081 441 116 249	7.56E+01 4.09E-11 2.21E-11 2.18E-11
743 2	HB HB HB	1080           5005           1104           3312	20033 3786 20793	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem	1080 4866 150 1966	0.153592192 8.38E-11 9.08E-11 7.28E-11	1081 441 116 249	7.56E+01 4.09E-11 2.21E-11 2.18E-11
743         2           744         4	HB HB HB Shen	1080           5005           1104           3312           3432	20033 3786 20793 25220	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem	1080           4866           150           1966           3432	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615	1081           441           116           249           3433	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00
743         2           744         4           745         2	HB HB HB Shen Shen	1080           5005           1104           3312           3432           18510	20033 3786 20793 25220 145149	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem	1080 4866 150 1966 3432 18510	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351	1081 441 116 249 3433 18511	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15
743         2           744         4           745         2           746         5	HB HB Shen Shen Shen	1080           5005           1104           3312           3432           18510           6136	20033 3786 20793 25220 145149 53329	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem	1080 4866 150 1966 3432 18510 6136	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702	1081 441 116 249 3433 18511 6137	7.56E+01 4.09E-11 2.21E-11 1.64E+00 3.82E+15 9.88E+03
743         2           744         4           745         2           746         5           747         2	HB HB HB Shen Shen HB	1080           5005           1104           3312           3432           18510           6136           663	20033 3786 20793 25220 145149 53329 1687	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem antimization problem sequence	1080 4866 150 1966 3432 18510 6136 663	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736	1081 441 116 249 3433 18511 6137 664	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.16E+01
743         2           744         4           745         2           746         5           747         2           748         3	HB HB Shen Shen Shen HB HB	1080           5005           1104           3312           3432           18510           6136           663	20033 20033 3786 20793 25220 145149 53329 1687 1726	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problems	1080 4866 150 1966 3432 18510 6136 663 663	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76 86519225	1081 441 116 249 3433 18511 6137 664 664	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01
743         2           744         4           745         2           746         5           747         2           748         3           749         -	HB HB Shen Shen Shen HB HB	1080           5005           1104           3312           3432           18510           6136           663           663           663	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem	1080           4866           150           1966           3432           18510           6136           663           663           663           663	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925	1081 441 116 249 3433 18511 6137 664 664 664	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 0.37E-01
743         2           744         4           745         2           746         5           747         2           748         3           749         1	HB HB Shen Shen Shen HB HB HB	1080           5005           1104           3312           3432           18510           6136           663           663           663	20033 3786 20793 25220 145149 53329 1687 1726 1712	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem subsequent optimization problem	1080           4866           150           1966           3432           18510           6136           663           663           663	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657	1081           441           116           249           3433           18511           6137           664           664           664	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	HB HB Shen Shen Shen HB HB HB Shyy	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480	20033 3786 20793 25220 145149 53329 1687 1726 1712 329762	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem subsequent optimization problem computational fluid dynamics problem	1080           4866           150           1966           3432           18510           6136           663           663           76480	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359	1081           441           116           249           3433           18511           6137           664           664           664           76481	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02
$\begin{array}{c cccc} 743 & 2 \\ \hline 744 & 4 \\ \hline 745 & 2 \\ \hline 746 & 5 \\ \hline 747 & 2 \\ \hline 748 & 3 \\ \hline 749 & 1 \\ \hline 750 & 1 \\ \hline 751 & 2 \\ \end{array}$	HB HB Shen Shen Shen HB HB HB Shyy Shyy	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480           4720	2:0033 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042	computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem	1080           4866           150           1966           3432           18510           6136           663           663           663           76480           4720	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361	1081           441           116           249           3433           18511           6137           664           664           664           664           464           76481           4721	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03
$\begin{array}{c cccc} 743 & 2 \\ \hline 744 & 4 \\ \hline 745 & 2 \\ \hline 746 & 5 \\ \hline 747 & 2 \\ \hline 748 & 3 \\ \hline 749 & 1 \\ \hline 750 & 1 \\ \hline 751 & 2 \\ \hline 752 & 5 \\ \hline \end{array}$	HB HB Shen Shen Shen HB HB HB Shyy Shyy MathWorks	1080           5005           1104           3312           3432           18510           6136           663           663           76480           4720           2290	20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem subsequent optimization problem subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem counter-example problem	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818207	1081           441           116           249           3433           18511           6137           664           664           664           76481           4721           2291	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03
$\begin{array}{c cccc} 743 & 2 \\ \hline 744 & 4 \\ \hline 745 & 2 \\ \hline 746 & 5 \\ \hline 747 & 2 \\ \hline 748 & 3 \\ \hline 749 & 1 \\ \hline 750 & 1 \\ \hline 750 & 1 \\ \hline 751 & 2 \\ \hline 752 & 5 \\ \hline 752 & 4 \\ \hline \end{array}$	HB HB Shen Shen Shen HB HB Shyy Shyy MathWorks Uoba	1080           5005           1104           3312           3432           18510           6136           663           663           76480           4720           2290           7500	20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 29092	computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.75554292	1081           441           116           249           3433           18511           6137           664           664           664           664           76481           4721           2291           7501	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01
$\begin{array}{c cccc} 743 & 2 \\ \hline 744 & 4 \\ \hline 745 & 2 \\ \hline 746 & 5 \\ \hline 747 & 2 \\ \hline 748 & 3 \\ \hline 749 & 1 \\ \hline 750 & 1 \\ \hline 751 & 2 \\ \hline 752 & 5 \\ \hline 753 & 4 \\ \hline 754 & 5 \\ \hline 753 & 4 \\ \hline 754 & 5 \\ \hline 754 & 5 \\ \hline 755 & $	HB HB Shen Shen Shen HB HB HB HB Shyy Shyy Shyy MathWorks Hohn	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480           4720           2290           7500           1452	20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 26445	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem counter-example problem materials problem	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 20.76554039	1081           441           116           249           3433           18511           6137           664           664           664           76481           4721           2291           7501	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 9.37E+01 3.77E+03 8.52E+03 2.35E+01 2.35E+01
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB Shen Shen Shen HB HB Shyy Shyy Shyy MathWorks Hohn Hohn	1080           5005           1104           3312           3432           18510           6136           663           663           663           663           76480           4720           2290           7500           11532	2,0033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem materials problem materials problem	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047	1081           441           116           249           3433           18511           6137           664           664           664           76481           4721           2291           7501           11533	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01
$\begin{array}{c cccc} 743 & 2 \\ \hline 744 & 4 \\ 745 & 2 \\ \hline 746 & 5 \\ \hline 747 & 2 \\ \hline 748 & 3 \\ \hline 749 & 1 \\ \hline 750 & 1 \\ \hline 750 & 1 \\ \hline 751 & 2 \\ \hline 752 & 5 \\ \hline 753 & 4 \\ \hline 754 & 5 \\ \hline 755 & 3 \\ \end{array}$	HB HB Shen Shen Shen HB HB HB Shyy Shyy MathWorks Hohn Hohn Hohn	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480           4720           2290           7500           11532           16428	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem counter-example problem materials problem materials problem	1080           4866           150           1966           3432           18510           6136           663           663           663           76480           4720           2290           7500           11532           16428	0.153592192 8.38E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945	1081           441           116           249           3433           18511           6137           664           664           664           4721           2291           7501           11533           16429	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01
$\begin{array}{c cccc} 743 & 2 \\ \hline 744 & 4 \\ \hline 745 & 2 \\ \hline 746 & 5 \\ \hline 747 & 2 \\ \hline 748 & 3 \\ \hline 749 & 1 \\ \hline 750 & 1 \\ \hline 751 & 2 \\ \hline 752 & 5 \\ \hline 753 & 4 \\ \hline 754 & 5 \\ \hline 755 & 3 \\ \hline 756 & 2 \\ \hline \end{array}$	HB HB HB Shen Shen Shen HB HB HB HB Shyy Shyy MathWorks Hohn Hohn Paiek	1080           5005           1104           3312           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059	23094 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem 2D/3D problem subsequent optimization problem subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem counter-example problem materials problem materials problem materials problem	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17	1081           441           116           249           3433           18511           6137           664           664           664           76481           4721           2291           7501           11533           16429           1060	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 2.06E+17
$\begin{array}{c ccccc} 743 & 2 \\ \hline 744 & 4 \\ \hline 745 & 2 \\ \hline 746 & 5 \\ \hline 747 & 2 \\ \hline 748 & 3 \\ \hline 749 & 1 \\ \hline 750 & 1 \\ \hline 750 & 1 \\ \hline 751 & 2 \\ \hline 752 & 5 \\ \hline 753 & 4 \\ \hline 754 & 5 \\ \hline 755 & 3 \\ \hline 755 & 3 \\ \hline 756 & 2 \\ \hline 757 & 3 \\ \hline \end{array}$	HB HB HB Shen Shen HB HB HB Shyy Shyy MathWorks Hohn Hohn Hohn Pajek Pajek	1080 5005 1104 3312 3432 18510 6136 663 663 663 663 663 76480 4720 2290 7500 11532 16428 1059 396	2,0033 3786 20793 25220 145149 53329 1687 1726 329762 20042 14873 283992 551184 948696 4919 994	computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem 2D/3D problem computational problem sequence subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem counter-example problem materials problem materials problem materials problem directed multigraph directed multigraph	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 195E+15	1081           441           116           249           3433           18511           6137           664           664           664           664           76481           4721           2291           7501           11533           16429           1060           397	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 8.71E+01 8.29E+16
$\begin{array}{c ccccc} 743 & 2 \\ \hline 744 & 4 \\ \hline 745 & 2 \\ \hline 746 & 5 \\ \hline 747 & 2 \\ \hline 748 & 3 \\ \hline 749 & 1 \\ \hline 750 & 1 \\ \hline 751 & 2 \\ \hline 752 & 5 \\ \hline 753 & 4 \\ \hline 754 & 5 \\ \hline 755 & 3 \\ \hline 755 & 3 \\ \hline 755 & 3 \\ \hline 756 & 2 \\ \hline 757 & 3 \\ \hline 758 & \cdot \end{array}$	HB HB HB Shen Shen HB HB HB HB Shyy Shyy MathWorks Hohn Hohn Hohn Hohn Pajek Pajek	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480           4720           2290           7500           11532           16428           1059           396           13524	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 974827	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem comter-example problem materials problem materials problem directed multigraph directed multigraph	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           2164	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 0.8E 11	1081           441           116           249           3433           18511           6137           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           2066	7.56E+01 4.09E-11 2.21E-11 2.11E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 2.06E+17 8.29E+16 9.52E-11
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen HB HB HB Shyy Shyy MathWorks Hohn Hohn Hohn Pajek Pajek FEMLAB	$\begin{array}{r} 1080\\ 5005\\ 1104\\ 3312\\ 3432\\ 18510\\ 6136\\ 663\\ 663\\ 663\\ 76480\\ 4720\\ 2290\\ 7500\\ 11532\\ 16428\\ 1059\\ 396\\ 12504 \end{array}$	2,0033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887	computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem materials problem materials problem materials problem directed multigraph directed multigraph structural problem	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754045 4.74E+17 1.95E+15 9.8E-11	1081           441           116           249           3433           18511           6137           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           3066	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 9.37E+01 9.37E+01 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 8.71E+01 9.52E+16 9.52E-11
$\begin{array}{c cccc} 743 & 2 \\ \hline 744 & 4 \\ \hline 745 & 2 \\ \hline 746 & 5 \\ \hline 747 & 2 \\ \hline 748 & 3 \\ \hline 749 & 1 \\ \hline 750 & 1 \\ \hline 750 & 1 \\ \hline 751 & 2 \\ \hline 752 & 5 \\ \hline 753 & 4 \\ \hline 754 & 5 \\ \hline 755 & 3 \\ \hline 756 & 2 \\ \hline 757 & 3 \\ \hline 758 & 1 \\ \hline 759 & 3 \\ \end{array}$	HB HB HB Shen Shen HB HB HB HB Shyy Shyy MathWorks Hohn Hohn Hohn Hohn Pajek Pajek FEMLAB FEMLAB	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480           2290           7500           11532           16428           1059           396           12504           29067	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063	computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem counter-example problem materials problem materials problem directed multigraph directed multigraph structural problem	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164           3737	0.153592192 8.38E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11	1081           441           116           249           3433           18511           6137           664           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           3066           3724	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 8.71E+01 8.71E+01 8.71E+01 8.29E+16 9.52E-11 8.46E-11
$\begin{array}{c cccc} 743 & 2 \\ \hline 744 & 4 \\ \hline 745 & 2 \\ \hline 746 & 5 \\ \hline 747 & 2 \\ \hline 748 & 3 \\ \hline 749 & 1 \\ \hline 750 & 1 \\ \hline 751 & 2 \\ \hline 752 & 5 \\ \hline 753 & 4 \\ \hline 754 & 5 \\ \hline 755 & 3 \\ \hline 755 & 3 \\ \hline 756 & 2 \\ \hline 757 & 3 \\ \hline 758 & 1 \\ \hline 759 & 3 \\ \hline 760 & 5 \\ \end{array}$	HB HB HB Shen Shen Shen HB HB Shyy Shyy Shyy MathWorks Hohn Hohn Pajek Pajek FEMLAB FEMLAB FEMLAB	$\begin{array}{r} 1080\\ 5005\\ 1104\\ 3312\\ 3432\\ 18510\\ 6136\\ 663\\ 663\\ 663\\ 76480\\ 4720\\ 2290\\ 7500\\ 11532\\ 16428\\ 1059\\ 396\\ 12504\\ 12504\\ 29067\\ 42930\\ \end{array}$	23094 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656	computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           2D/3D problem           2D/3D problem           optimization problem sequence           subsequent optimization problem           computational fluid dynamics problem           directed multigraph           directed multigraph           directed multigraph           structural problem           structural problem	1080           4866           150           1966           3432           18510           6136           663           663           76480           4220           2290           7500           11532           16428           1059           396           3164           3737           6546	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11	1081           441           116           249           3433           18511           6137           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           3066           3724           8348	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+01 1.37E+01 8.71E+01 2.06E+17 8.29E+16 9.52E-11 8.46E-11 2.97E-06
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen HB HB HB Shyy Shyy MathWorks Hohn Hohn Hohn Pajek FEMLAB FEMLAB FEMLAB SNAP	1080           5005           1104           3312           3432           18510           6136           663           663           663           663           7500           11532           16428           1059           396           12504           29007           75888	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837	computational fluid dynamics problem           computational fluid dynamics problem           2D/3D problem           optimization problem sequence           subsequent optimization problem           computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           conter-example problem           materials problem           materials problem           directed multigraph           structural problem           structural problem           structural problem	1080           4866           150           1966           3432           18510           6136           663           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164           3737           6546           75888	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754045 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7	1081           441           116           249           3433           18511           6137           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           3066           3724           8348           84	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 9.37E+01 9.37E+01 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 8.29E+16 9.52E-11 8.46E-11 2.97E-06 4.98E+02
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen HB HB HB Shyy Shyy MathWorks Hohn Hohn Hohn Hohn Pajek Pajek FEMLAB FEMLAB FEMLAB SNAP SNAP	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480           4720           2290           7500           11532           16428           1059           396           12504           299067           42930           75888           131929	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 2081063	computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           2D/3D problem           2D/3D problem           2D/3D problem           optimization problem sequence           subsequent optimization problem           computational fluid dynamics problem           materials problem           materials problem           directed multigraph           structural problem           structural problem           structural problem           directed multigraph           structural problem	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164           3737           6546           75888           131870	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 20857.98351 20857.98351 20857.98351 204.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2	1081           441           116           249           3433           18511           6137           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           3066           3724           8348           84           15	7.56E+01 4.09E-11 2.21E-11 2.11E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 2.06E+17 8.29E+16 9.52E-11 8.46E-11 2.97E-06 4.98E-02 1.63E 01
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen HB HB HB Shyy Shyy Shyy MathWorks Hohn Hohn Hohn Pajek Pajek FEMLAB FEMLAB FEMLAB SNAP SNAP	$\begin{array}{r} 1080\\ 5005\\ 1104\\ 3312\\ 3432\\ 18510\\ 6136\\ 663\\ 663\\ 663\\ 76480\\ 4720\\ 2290\\ 7500\\ 11532\\ 16428\\ 1059\\ 396\\ 12504\\ 29067\\ 12504\\ 29067\\ 75888\\ 131828\\ 131828\\ 131828\\ 131828\\ 13757\\ \end{array}$	23094 20033 3786 20793 2520 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 841372 \$15757	computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem computational fluid dynamics problem directed multigraph directed multigraph structural problem structural problem directed graph directed graph directed graph	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164           3737           6546           75888           131828           7357	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754045 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 90.1	1081         441         116         249         3433         18511         6137         664         664         664         664         76481         4721         2291         7501         11533         16429         1060         397         3066         3724         8348         84         15         112	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 9.37E+01 9.37E+01 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 8.71E+01 8.29E+16 9.52E-11 8.46E-11 2.97E-06 4.98E-02 1.63E-01 0.146
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen HB HB HB HB Shyy Shyy MathWorks Hohn Hohn Hohn Pajek FEMLAB FEMLAB FEMLAB FEMLAB SNAP SNAP	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480           4720           2290           7500           11532           16428           1059           396           12504           29067           42930           75888           131828           77357	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 841372 516575	computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           2D/3D problem           2D/3D problem           2D/3D problem           optimization problem sequence           subsequent optimization problem           computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           conter-example problem           materials problem           materials problem           directed multigraph           directed multigraph           structural problem           structural problem           directed eighted graph           directed weighted graph	1080           4866           150           1966           3432           18510           6136           663           663           75480           4720           2290           7500           11532           16428           1059           396           3164           3737           6546           75888           7357	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 99.1	1081           441           116           249           3433           18511           6137           664           664           664           664           2291           7501           11533           16429           1060           397           3066           3724           8348           84           15           112	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 8.71E+01 8.71E+01 8.71E+01 8.71E+01 8.72E-11 8.46E-11 2.97E-06 4.98E-02 1.63E-01 0.146
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen HB HB HB Shyy Shyy MathWorks Hohn Hohn Hohn Hohn Pajek Pajek FEMLAB FEMLAB FEMLAB SNAP SNAP SNAP SNAP	1080           5005           1104           3312           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           12504           29067           42930           75888           131828           131828           131821	23034 20033 3786 20793 2520 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 841372 516575 545671	computational fluid dynamics problem           computational fluid dynamics problem           2D/3D problem           2D/3D problem           2D/3D problem           2D/3D problem           optimization problem sequence           subsequent optimization problem           computational fluid dynamics problem           conter-example problem           materials problem           directed multigraph           directed multigraph           structural problem           structural problem           directed graph           directed weighted graph           directed weighted graph           directed weighted graph	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164           7737           6546           75888           131828           77357           81871	0.153592192 8.38E-11 7.28E-11 17.28E-11 17.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 99.1 133	1081         441         116         249         3433         18511         6137         664         664         664         664         76481         4721         2291         7501         11533         16429         1060         397         3066         3724         8348         84         15         112         98	7.56E+01 4.09E-11 2.21E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+01 1.37E+01 8.71E+01 2.06E+17 8.29E+16 9.52E-11 8.46E-11 2.97E-06 4.98E-02 1.63E-01 0.146 3.09
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen HB HB HB Shyy Shyy MathWorks Hohn Hohn Hohn Pajek FEMLAB FEMLAB FEMLAB FEMLAB SNAP SNAP SNAP SNAP	1080 5005 1104 3312 3432 18510 6136 663 663 663 663 663 663 76480 7500 11532 16428 1059 396 12504 29067 42930 75888 131828 77357 81871 82144	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 841372 516575 545671 549202	computational fluid dynamics problem           computational fluid dynamics problem           2D/3D problem           2D/3D problem           2D/3D problem           2D/3D problem           2D/3D problem           optimization problem sequence           subsequent optimization problem           computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           conter-example problem           materials problem           materials problem           directed multigraph           structural problem           structural problem           directed graph           directed graph           directed weighted graph           directed weighted graph	1080           1080           4866           150           1966           3432           18510           6136           663           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164           3737           6546           75888           131828           77357           81871           82144	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754045 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 99.1 133 51.6	1081           441           116           249           3433           18511           6137           664           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           3066           3724           8348           84           15           112           98	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 9.37E+01 9.37E+01 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 8.29E+16 9.52E-11 8.46E-11 2.97E-06 4.98E-02 1.63E-01 0.146 3.09 89
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen Shen HB HB Shyy Shyy Shyy MathWorks Hohn Hohn Pajek Pajek FEMLAB FEMLAB FEMLAB FEMLAB SNAP SNAP SNAP SNAP SNAP	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480           4720           2290           7500           11532           16428           1059           396           12504           299067           42930           75888           131828           77357           81871           82144           7360	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 841372 5516575 545671 549202 905468	computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           2D/3D problem           2D/3D problem           2D/3D problem           optimization problem sequence           subsequent optimization problem           computational fluid dynamics problem           conter-example problem           materials problem           directed multigraph           directed multigraph           structural problem           structural problem           directed weighted graph	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164           77357           81871           82144           77360	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E-17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 99.1 133 51.6 26.6702652	1081           441           116           249           3433           18511           6137           664           664           664           664           2291           7501           11533           16429           1060           397           3066           3724           8348           84           15           112           98           98           77361	7.56E+01 4.09E-11 2.21E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 2.06E+17 8.29E+16 9.52E-11 8.46E-11 2.97E-06 4.98E-02 1.63E-01 0.146 3.09 89 9.43E+01
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen HB HB HB Shyy Shyy Shyy MathWorks Hohn Hohn Hohn Pajek Pajek FEMLAB FEMLAB FEMLAB FEMLAB SNAP SNAP SNAP SNAP SNAP	1080 5005 1104 3312 3432 18510 6136 663 663 663 76480 4720 2290 7500 11532 16428 1059 396 12504 12504 29067 42930 75888 131828 77357 81871 82144 77360 82149 82 82 82 82 82 82 82 82 82 82	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 841372 516575 545671 549202 905468 94866	computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem 2D/3D problem computation problem sequence subsequent optimization problem computational fluid dynamics problem directed multigraph structural problem structural problem structural problem directed graph directed weighted graph	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164           3737           75888           131828           77357           81871           82144           77360           82169	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.765554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 99.1 133 51.6 26.62702652 1820.92825	1081           441           116           249           3433           18511           6137           664           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           3066           3724           8348           84           15           112           98           98           98           98           98           98           98           98           92160	7.56E+01 4.09E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 9.37E+01 9.37E+01 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 8.71E+01 8.29E+16 9.52E-11 8.46E-11 2.97E-06 4.98E-02 1.63E-01 0.146 3.09 89 9.43E+01 9.96E+01 9.96E+01
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen HB HB HB HB HB HB HB HB HB HB HB HB HB	1080 5005 1104 3312 3432 18510 6136 663 663 663 663 663 76480 4720 2290 7500 11532 16428 1059 396 12504 229067 42930 75888 131828 77357 81871 82144 77360 82168 82168	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 841372 516575 545671 549202 9905468 948464 948464	computational fluid dynamics problem computational fluid dynamics problem 2D/3D problem 2D/3D problem 2D/3D problem 2D/3D problem optimization problem sequence subsequent optimization problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem directed multigraph directed multigraph directed multigraph directed graph directed graph directed weighted graph directed weighted graph directed weighted graph directed weighted graph directed graph directed graph directed graph directed graph	1080           4866           150           1966           3432           18510           6136           663           663           70480           4720           2290           7500           11532           16428           1059           396           3164           3737           6546           7588           7357           81871           82144           77360           82168           20166	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 99.1 133 51.6 26.62702652 1820.929235	1081         441         116         249         3433         18511         6137         664         664         664         76481         4721         2291         7501         11533         16429         1060         397         3066         3724         8348         84         15         112         98         977361         82169         265	7.56E+01 4.09E-11 2.21E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.35E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 2.06E+17 8.20E+16 9.52E-11 8.46E-11 2.97E-06 4.98E+02 1.63E-01 0.146 3.09 89 9.43E+01 9.96E+01 1.50E+01
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen Shen HB HB Shyy Shyy Shyy MathWorks Hohn Hohn Pajek Pajek FEMLAB FEMLAB FEMLAB FEMLAB SNAP SNAP SNAP SNAP SNAP SNAP SNAP SNAP	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480           4720           2290           7500           11532           16428           1059           396           12504           29067           42930           75888           131828           131828           1318214           77360           82168           281903	23034 20033 3786 20793 2520 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 841372 516575 545671 549202 905468 948464 2312497	computational fluid dynamics problem         computational fluid dynamics problem         2D/3D problem         optimization problem sequence         subsequent optimization problem         computational fluid dynamics problem         computational fluid dynamics problem         computational fluid dynamics problem         conter-example problem         materials problem         materials problem         directed multigraph         directed multigraph         structural problem         structural problem         directed graph         directed weighted graph         directed weighted graph         directed weighted graph         directed graph         directed graph         directed graph         directed graph         directed graph         directed graph	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164           77377           6546           75888           131828           77357           81871           82164           27360           82168           281903	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 99.1 133 51.6 26.62702652 1820.929235 557	1081           441           116           249           3433           18511           6137           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           3066           3724           8348           84           15           112           98           98           97           3061           82169           565	7.56E+01 4.09E-11 2.21E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 9.37E+01 9.37E+01 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 2.06E+17 8.29E+16 9.52E-11 8.46E-11 2.97E-06 4.98E-02 1.63E-01 0.146 3.09 89 9.43E+01 9.96E+01 1.20E+00
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen HB HB HB Shyy MathWorks Hohn Hohn Hohn Pajek FEMLAB FEMLAB FEMLAB FEMLAB SNAP SNAP SNAP SNAP SNAP SNAP SNAP SNAP	1080           5005           1104           3312           3432           18510           6136           663           663           663           76480           2290           7500           11532           16428           1059           396           12504           29067           42930           75888           131828           77357           81871           82168           281903           21982	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 841372 516575 545671 549202 905468 948464 2312497 1248213	computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           2D/3D problem           2D/3D problem           2D/3D problem           optimization problem sequence           subsequent optimization problem           computational fluid dynamics problem           conter-example problem           materials problem           materials problem           directed multigraph           directed multigraph           structural problem           structural problem           directed weighted graph           directed weighted graph           directed weighted graph           directed weighted graph           directed graph </td <td>1080           4866           150           1966           3432           18510           6136           663           663           663           75480           4720           2290           7500           11532           16428           1059           396           3164           3737           6546           7588           7357           81871           82144           77360           82168           281903           21982</td> <td>0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 99.1 133 51.6 26.62702652 1820.929235 557</td> <td>1081           441           116           249           3433           18511           6137           664           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           3066           3724           8348           84           15           112           98           977361           82169           565           21983</td> <td>7.56E+01 4.09E-11 2.21E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.35E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.72E+03 2.35E+01 1.37E+01 8.72E+10 8.46E-11 2.97E-06 4.98E-02 1.63E-01 0.146 3.09 89 9.43E+01</td>	1080           4866           150           1966           3432           18510           6136           663           663           663           75480           4720           2290           7500           11532           16428           1059           396           3164           3737           6546           7588           7357           81871           82144           77360           82168           281903           21982	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 99.1 133 51.6 26.62702652 1820.929235 557	1081           441           116           249           3433           18511           6137           664           664           664           664           76481           4721           2291           7501           11533           16429           1060           397           3066           3724           8348           84           15           112           98           977361           82169           565           21983	7.56E+01 4.09E-11 2.21E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.35E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.72E+03 2.35E+01 1.37E+01 8.72E+10 8.46E-11 2.97E-06 4.98E-02 1.63E-01 0.146 3.09 89 9.43E+01
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	HB HB HB Shen Shen Shen HB HB Shyy Shyy MathWorks Hohn Hohn Hohn Pajek Pajek FEMLAB FEMLAB FEMLAB FEMLAB SNAP SNAP SNAP SNAP SNAP SNAP SNAP SNAP	1080           5005           1104           3312           3432           18510           6136           663           663           663           75480           4720           2290           7500           11532           16428           1059           396           12504           29067           42930           75888           131828           77357           81871           82144           77360           821903           21982           21982	23034 20033 3786 20793 25220 145149 53329 1687 1726 1712 329762 20042 14873 283992 551184 948696 4919 994 874887 2081063 3148656 508837 841372 5516575 545671 549202 905468 948464 2312497 1248213	computational fluid dynamics problem           computational fluid dynamics problem           computational fluid dynamics problem           2D/3D problem           2D/3D problem           2D/3D problem           optimization problem sequence           subsequent optimization problem           computational fluid dynamics problem           conter-example problem           materials problem           directed multigraph           directed multigraph           structural problem           structural problem           directed weighted graph           directed weighted graph           directed weighted graph           directed weighted graph           directed graph           <	1080           4866           150           1966           3432           18510           6136           663           663           76480           4720           2290           7500           11532           16428           1059           396           3164           3737           6546           77357           81871           82164           281903           21982	0.153592192 8.38E-11 9.08E-11 7.28E-11 137.7106615 20857.98351 49519.52702 24.05375736 76.86512925 41.3346657 747.1550359 2791.017361 5375818297 20.76554039 247.3507047 47.88754945 4.74E+17 1.95E+15 9.8E-11 9.97E-11 8.32E-11 66.7 64.2 99.1 133 51.6 26.62702652 1820.929235 557 5.78E+12 382429379.5	1081         441         116         249         3433         18511         6137         664         664         664         664         76481         4721         2291         7501         11533         16429         1060         397         3066         3724         8348         84         15         112         98         98         97861         82169         565         21983	7.56E+01 4.09E-11 2.21E-11 2.21E-11 2.18E-11 1.64E+00 3.82E+15 9.88E+03 1.16E+01 1.53E+01 9.37E+01 7.41E+02 3.77E+03 8.52E+03 2.35E+01 1.37E+01 8.71E+01 2.06E+17 8.29E+16 9.52E-11 8.46E-11 2.97E-06 4.98E-02 1.63E-01 0.146 3.09 89 9.43E+01 9.96E+01 1.20E+00 8.70E+12 8.65E+06

//1	1	VanVelzen	21982	1455374	chemical process simulation problem	21982	178588450.6	21983	1.30E+08
772	3	VanVelzen	21982	531826	chemical process simulation problem	21982	2323889.378	21983	4.00E+05
773	4	HB	240	2248	computational fluid dynamics problem	240	0.000112795	22	5.41E-11
774	2	HB	600	5660	computational fluid dynamics problem	109	7.78E-11	9	2.55E-11
775	3	HB	80	314	computational fluid dynamics problem	80	0.000261446	29	8.53E-11
776	4	Norris	213360	3021648	2D/3D problem	387	4.96E-11	297	7.58E-11
777	4	HB	363	2454	optimization problem sequence	363	3.679862761	364	3.77E+00
778	4	HB	363	3068	subsequent optimization problem	363	3.39080356	364	7.57E+00
779	2	HB	363	3157	subsequent optimization problem	363	10.04296909	364	5.97E+00
780	2	HB	363	3279	subsequent optimization problem	363	54.14973037	364	5.09E+00
781	3	Wang	3169	20841	semiconductor device problem sequence	33	8.53E-11	29	6.62E-12
782	4	Wang	3169	20841	subsequent semiconductor device problem	73	7.77E-11	51	2.85E-11
783	5	TKK	9801	87025	structural problem sequence	108	8.98E-11	175	7.99E-11
784	3	TKK	9801	87025	structural problem sequence	108	8.98E-11	175	7.99E-11
785	1	Bindel	10605	424587	thermal problem	10605	958.5242264	10606	3.29E+04
786	2	Bindel	10605	424587	thermal problem	10605	0.000439461	10606	1.63E-03
787	4	Brunetiere	3456	66528	thermal problem	34	4.39E-11	32	4.43E-11
/88	4	Botonakis	204316	2846228	thermal problem	1131	9.94E-11	204316	3.26E+00
/89	2	Pajek	11	29	directed graph	11	7.32E+13	12	6.93E+13
790	3	Pajek	11	36	directed graph	10	1.28E-11	11	2.36E-12
791	4	Pajek	11	41	directed graph	11	55/584140.4	12	3.40E+0/
792	3	Рајек	11	48	directed graph	9	/./0E-11	10	3.08E-11
793	1	Bai	1090	5194	computational fluid dynamics problem	2000	44851.07498	129	9.42E-11
794	1	Dai	2000	2106	computational fluid dynamics problem	2000	45.41940555 2.01E.09	149	4.60E-11
795	5	Dai	340	2190	computational fluid dynamics problem	340	2.91E-06	90	2.36E-11 5.12E-11
707	5	Dal Raj	4000	0/04	computational fluid dynamics problem	4000	24.3/906328 6/E-11	105	J.12E-11 1.40E-11
709	2	MathWorks	500	28726	computer graphics/vision problem	241	8.78E-11	20	1.47E-11 4.33E-11
700	2	Norris	116158	8516500	2D/3D problem	116158	0.0000445	49793	1.51E+00
800	- 1	Norris	115067	1033473	2D/3D problem	68	4 3F-11	47775	3.93E-11
801	3	Norris	259156	4429042	2D/3D problem	353	3.43E-11	135	5.05E-11
802	4	IBM EDA	116835	749800	circuit simulation problem sequence	116835	19482074 46	200	6.45E-11
802	2	IBM EDA	116835	749800	subsequent circuit simulation problem	116835	0.002188497	483	3.79E-11
804	5	Freescale	178866	961368	circuit simulation problem	178866	1 547013788	178867	1.92E-01
805	5	MathWorks	2142	45262	counter-example problem	2142	7855 263515	21/3	6.61E±03
805	2	TSOPE	5374	205399	power network problem	5374	0.281998165	5375	2 90E-01
807	2	TSOPE	15374	610299	power network problem	15374	1 115813805	15375	6.15E-01
808	4	TSOPE	20374	812749	power network problem	20374	0 2784448	20375	4 24F-01
809	4	TSOPE	25626	6761100	power network problem	25626	2099 14038	25627	6.19E+02
810	1	TSOPF	38120	16171169	power network problem	38120	938	38120	2.66E+01
811	4	TSOPF	38120	16171169	power network problem	38120	930	38120	2.89E+01
812	3	TSOPF	14538	1474325	power network problem	14538	4.452667297	14539	3.31E+00
813	2	TSOPF	28338	2943887	power network problem	28338	17.87492511	28339	7.12E+00
814	2			1110110	nower network problem	42120	9 679302948	42139	2 (9E - 01
		TSOPF	42138	44 3449		441.20			2.08E±01
815	2	TSOPF TSOPF	42138 38098	4413449 684206	power network problem	38098	533977915.8	38099	2.08E+01 2.30E+08
815 816	2 2	TSOPF TSOPF TSOPF	42138 38098 60098	4413449 684206 1079986	power network problem power network problem power network problem	42138 38098 60098	533977915.8 126158040.9	38099 60099	2.30E+08 3.36E+07
815 816 817	2 2 2 2	TSOPF TSOPF TSOPF TSOPF	42138 38098 60098 14098	4413449 684206 1079986 252446	power network problem power network problem power network problem	42138 38098 60098 14098	533977915.8 126158040.9 151027266.7	38099 60099 14099	2.08E+01 2.30E+08 3.36E+07 7.71E+08
815 816 817 818	2 2 2 2 2	TSOPF TSOPF TSOPF TSOPF TSOPF	42138 38098 60098 14098 18696	4413449 684206 1079986 252446 4396289	power network problem power network problem power network problem power network problem	42138           38098           60098           14098           18696	533977915.8 126158040.9 151027266.7 11.10527583	38099 60099 14099 18697	2.08E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00
815 816 817 818 819	2 2 2 2 2 2 2 2	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF	42138 38098 60098 14098 18696 35696	4413449 684206 1079986 252446 4396289 8781949	power network problem power network problem power network problem power network problem power network problem	42138           38098           60098           14098           18696           35696	533977915.8           126158040.9           151027266.7           11.10527583           32.84732338	38099 60099 14099 18697 35697	2.08E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01
815 816 817 818 819 820	2 2 2 2 2 2 1	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF	42138 38098 60098 14098 18696 35696 7224	4413449 684206 1079986 252446 4396289 8781949 54082	power network problem power network problem power network problem power network problem power network problem power network problem	42138 38098 60098 14098 18696 35696 7224	533977915.8 126158040.9 151027266.7 11.10527583 32.84732338 2.34E+11	38099 60099 14099 18697 35697 7225	2.08E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14
815 816 817 818 819 820 821	2 2 2 2 2 2 2 1 2	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai	42138 38098 60098 14098 18696 35696 7224 100	4413449 684206 1079986 252446 4396289 8781949 54082 396	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem	42138 38098 60098 14098 18696 35696 7224 100	533977915.8 126158040.9 151027266.7 11.10527583 32.84732338 2.34E+11 0.000208418	38099 60099 14099 18697 35697 7225 101	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08
815           816           817           818           819           820           821           822	3       2       2       2       2       2       1	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai	42138 38098 60098 14098 18696 35696 7224 100 1000	4413449 684206 1079986 252446 4396289 8781949 54082 396 3996	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem	42138 38098 60098 14098 18696 35696 7224 100 1000	533977915.8 126158040.9 151027266.7 11.10527583 32.84732338 2.34E+11 0.000208418 0.019843556	38099 60099 14099 18697 35697 7225 101 1001	2.66E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04
815           816           817           818           819           820           821           822           823	3       2       2       2       2       2       1	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT	42138 38098 60098 14098 18696 35696 7224 100 1000 120750	4413449 684206 1079986 252446 4396289 8781949 54082 396 3996 1206265	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem frequency-domain circuit simulation problem	42136 38098 60098 14098 18696 35696 7224 100 1000 120750	533977915.8 126158040.9 151027266.7 11.10527583 32.84732338 2.34E+11 0.000208418 0.019843556 263.1076275	38099 60099 14099 18697 35697 7225 101 1001 120751	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan
815           816           817           818           819           820           821           822           823           824	3       2       2       2       2       2       1       1       3	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK	42138 38098 60098 14098 18696 35696 7224 100 1000 120750 1700	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem	42136 38098 60098 14098 18696 35696 7224 100 1000 120750 1700	5.0327915.8 126158040.9 151027266.7 11.10527583 22.84732338 2.34E+11 0.000208418 0.019843556 263.1076275 0.000191213	38099 60099 14099 18697 35697 7225 101 1001 120751 1701	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03
815           816           817           818           819           820           821           822           823           824           825	3       2       2       2       2       1       1       3       5	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK	42138 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 300	4413449 684206 1079986 252446 4396289 8781949 54082 396 3996 1206265 21509 3155	power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem	42136           38098           60098           14098           18696           35696           7224           100           1000           120750           1700           300	5.07915.8 533977915.8 126158040.9 151027266.7 11.10527583 32.84732338 2.34E+11 0.000208418 0.019843556 263.1076275 0.000191213 0.0466371975	38099 60099 14099 18697 35697 7225 101 1001 120751 1701 301	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02
815           816           817           818           819           820           821           822           823           824           825           826	3       2       2       2       2       1       1       3       5	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK	42138 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 300 3060	4413449 684206 1079986 252446 4396289 8781949 54082 396 3996 1206265 21509 3155 42211	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem	42136           38098           60098           14098           18696           35696           7224           100           120750           1700           300           3060	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.019843556           263.1076275           0.000191213           0.466371975           0.000000334	38099 60099 14099 18697 35697 7225 101 1001 120751 1701 301 3061	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01
815           816           817           818           819           820           821           822           823           824           825           826           827	3       2       2       2       2       2       1       1       3       5       2       4	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK	42138 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 300 3060 5940	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem	42136 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 3000 3060 5940	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.00208418           0.019843556           263.1076275           0.00191213           0.466371975           0.00000334           0.001579934	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01
815           816           817           818           819           820           821           822           823           824           825           826           827           828	2 2 2 2 2 2 2 2 1 2 2 1 1 2 2 1 1 3 5 2 4 3	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon	42138 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 3000 3000 3060 5940 62424	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717792	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem sequence	42136 38098 60098 14098 18696 35696 7224 1000 120750 120750 120750 120750 120750 3060 5940 34186	5.0327915.8 533977915.8 126158040.9 151027266.7 11.10527583 32.84732338 2.34E+11 0.009843556 263.1076275 0.0000191213 0.466371975 0.000000334 0.001579934 9.38E-11	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 6.82E-11
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829	2 2 2 2 2 2 2 1 2 2 1 2 2 1 2 2 1 1 2 2 1 3 5 2 2 4 3 1	TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon	42138 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 300 3060 3060 5940 62424 62424	4413449 684206 1079986 252446 4396289 8781949 54082 396 3996 1206265 21509 3155 42211 83842 1717792 1717763	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem	42136 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 300 3000 3060 5940 34186 62424	33977915.8 126158040.9 151027266.7 11.10527583 32.84732338 2.34E+11 0.000208418 0.000208418 0.001943556 263.1076275 0.0000191213 0.466371975 0.000000334 0.001579934 9.38E-11 0.02174914	38099 60099 14099 18697 35697 7225 101 1001 1001 1001 1701 301 3061 5941 232 62425	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 6.82E-11 1.21E+07
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           830	2 2 2 2 2 2 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 3 5 2 2 4 3 1 1 4 4 3	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon	42138 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 300 3060 5940 62424 62424 62424	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717763 17177763	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem subsequent computational fluid dynamics problem	42136 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 3000 3060 5940 34186 62424 62424 62424	333977915.8 126158040.9 151027266.7 11.10527583 32.84732338 2.34E+11 0.000208418 0.019843556 263.1076275 0.000191213 0.466371975 0.00000334 0.001579934 9.38E-11 0.02174914 0.491070557	38099 60099 14099 18697 35697 7225 101 1001 120751 1701 301 3061 5941 232 62425 62425 62425	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.34E-01 1.98E-01 1.21E+07 9.46E+09 2.66E+09 2.66E+09 2.66E+05 2
815           816           817           818           819           820           821           822           823           824           825           826           827           828           830           831	2 2 2 2 2 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 2 2 1 3 5 5 2 4 4 3 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Quaglino	42138 38098 60098 14098 14098 18696 33696 7224 100 1000 120750 1700 3000 5940 62424 62424 62424 4336 62424	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717792 1717763 1717777 61166 21425	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem subsequent computational fluid dynamics problem materials problem	42136 38098 60098 14098 18696 35696 7224 100 120750 1700 120750 1700 3060 5940 34186 62424 62424 492 492	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.00208418           0.019843556           263.1076275           0.00191213           0.466371975           0.00000334           0.0001579934           9.38E-11           0.491070557           6.37E-11           0.491070557	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           322           (12)	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 6.82E-11 1.21E+07 9.46E+09 7.99E-11 0.04E+11
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           830           831           832	2 2 2 2 2 2 1 2 2 1 2 1 2 1 2 1 3 5 2 4 3 1 4 4 1 3 2 2 4 3 1 4 4 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Quaglino Quaglino Quaglino Quaglino	42138 38098 60098 14098 18696 35696 35696 7224 100 1000 120750 1700 3000 3060 5940 5940 62424 62426 62426 7250 726 726 726 726 726 727 726 727 727 720 720 720 720 720 720 720 720	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 21509 3155 42211 83842 1717792 1717777 61166 381326	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem subsequent computational fluid dynamics problem materials problem	42136 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 3000 3060 5940 34186 62424 62424 62424 492 931 23762	5.03297915.8 126158040.9 151027266.7 11.10527268.3 22.84732338 2.34E+11 0.00208418 0.019843556 263.1076275 0.000191213 0.466371975 0.00000334 0.001579934 9.38E-11 0.02174914 0.491070557 6.57E-11 9.96E-11 9.96E-11 9.96E-11	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           322           612           37262	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 6.82E-11 1.21E+07 9.46E+09 7.99E-11 9.04E-11 2.74E-01
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           830           831           832           833	2 2 2 2 2 2 2 2 2 1 2 2 1 2 2 1 2 2 1 3 5 2 4 4 3 1 1 4 4 1 3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Quaglino Quaglino Quaglino	42138 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 300 3000 3060 5940 62424 62424 62424 62424 62424 32769 37762	4413449 684206 1079986 252446 4396289 8781949 54082 396 3996 1206265 21509 3155 42211 83842 1717763 17177763 17177763 17177763 171777763 171777763 171777763 171777763 171777763 171777763 171777763 171777763 171777763 171777763 171777763 171777763 17177777 61166 381326	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem materials problem materials problem	4/136 38098 60098 14098 18696 35696 7224 1000 120750 1700 3000 3060 5940 34186 62424 62424 62424 62424 931 37762	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.019843556           263.1076275           0.000191213           0.466371975           0.00000334           0.001579934           9.38E-11           0.42174914           0.491070557           6.57E-11           9.96E-11           0.000000698	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           301           3061           5941           232           62425           62425           62425           612           37763	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.21E+07 9.46E+09 7.99E-11 3.74E-01 3
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           830           831           832           833           834	3       2       2       2       2       1       2       1       3       5       2       4       1       3       2       4       1       3       2       4       1       3       2       4       2       4	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Quaglino Quaglino Mancktelow Wang	42138 38098 60098 14098 14098 18696 33696 7224 100 120750 1700 120750 1700 3060 5940 62424 62424 62424 62424 4326 32769 37762 2903 37762	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717763 1717776 1717777 61166 381326 1133641 19093	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem subsequent computational fluid dynamics problem materials problem materials problem semiconductor device problem sequence	4/136 38098 60098 14098 18696 35696 7224 1000 120750 1700 120750 1700 3000 3060 5940 34186 62424 62424 62424 492 931 37762 446	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.00208418           0.019843556           263.1076275           0.00191213           0.466371975           0.00000334           0.001579934           9.38E-11           0.02174914           0.491070557           6.57E-11           9.066E-11           0.00000698           5.07E-11	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           301           3061           5941           232           62425           62425           62425           322           612           37763           191	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.34E-01 1.21E+07 9.46E+09 7.99E-11 9.04E-11 3.74E-01 3.74E-01 3.19E-11 0.44E-11 0
815           816           817           818           819           820           821           822           823           824           825           826           827           830           831           832           833           834           835	3       2       2       2       2       2       1       3       5       2       4       3       1       3       1       2       4       3       2       4       3       2       4       3       2       4       3       2       4       3	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Simon Quaglino Quaglino Quaglino Mancktelow Wang Wang	42138 38098 60098 14098 14098 18696 35696 7224 100 1000 120750 1700 3060 5940 62424 62424 4326 32769 37762 2903 2903	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717792 1717763 1717777 61166 381326 1133641 19093 19093	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem materials problem materials problem materials problem semiconductor device problem sequence subsequent computational fluid dynamics problem materials problem	4/136 38098 60098 14098 18696 35696 7224 100 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 120050 120750 120050 120750 120050 120750 120050 120050 120050 120050 120050 120050 100000	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.00208418           0.019843556           263.1076275           0.00191213           0.466371975           0.00000334           0.000197213           0.466371975           0.00000334           0.001579934           9.38E-11           0.491070557           6.57E-11           9.96E-11           0.000000698           5.07E-11           7.44E-11           0.4774E-11	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           322           612           37763           191           194           250	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E+03 3.89E+02 1.34E+01 1.98E+01 6.82E+11 1.21E+07 9.46E+09 7.99E+11 9.04E+11 3.74E+01 3.19E+11 8.11E+11 7.11E+11
815           816           817           818           819           820           821           822           823           824           825           826           827           831           832           833           834           835           835	3       2       2       2       2       2       1       3       5       2       4       3       1       3       2       4       3       1       3       2       4       3       1       3       2       4       3       1       3       1       3       1	TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Quaglino Quaglino Quaglino Quaglino Wang Wang Wang	42138 38098 60098 14098 18696 35696 35696 120750 1700 120750 1700 3000 3060 5940 62424 62424 62424 62424 62424 62424 32769 37762 2903 26064	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717792 1717763 1717777 61166 381326 1133641 19093 177168	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem materials problem materials problem electromagnetics problem semiconductor device problem sequence subsequent semiconductor device problem semiconductor device problem	42136 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 3000 3060 5940 34186 62424 62424 62424 62424 62424 931 37762 446 4455 367	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.0019843556           263.1076275           0.000000341           0.00191213           0.466371975           0.000191213           0.466371975           0.0001579934           9.38E-11           0.02174914           0.457E-11           9.96E-11           0.00000698           5.07E-11           7.44E-11           9.67E-11           9.74E-11	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           301           3061           5941           232           62425           62425           322           612           37763           191           194           269           305	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 6.82E-11 1.21E+07 9.46E+09 7.99E-11 9.04E-11 3.19E-11 8.11E-11 7.11E-11 9.50E 11
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           830           831           832           833           834           835           836           837	3       2       2       2       2       2       1       3       5       2       4       1       3       1       3       1       3       1       3       1       3       1       2       4       3       1       2       4       3       1       2	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Quaglino Quaglino Quaglino Mancktelow Wang Wang Wang	42138 38098 60098 14098 14098 18696 33696 7224 100 120750 1700 120750 1700 120750 1700 3060 5940 62424 62426 82766 7276 7276 7276 7276 7276 72777 7277 7277777777	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717763 1717776 17166 173641 19093 19093 19093	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem subsequent computational fluid dynamics problem subsequent computational fluid dynamics problem materials problem materials problem esemiconductor device problem sequence subsequent semiconductor device problem semiconductor device problem semiconductor device problem	4/136 38098 60098 14098 14098 18696 35696 7224 1000 120750 1700 3000 3060 5940 34186 62424 62424 62424 62424 62424 931 37762 446 455 367 590	333977915.8 126158040.9 151027266.7 11.10527583 32.84732338 2.34E+11 0.000208418 0.019843556 263.1076275 0.0000191213 0.466371975 0.000000334 0.001579934 9.38E-11 0.02174914 0.491070557 6.57E-11 9.96E-11 0.00000698 5.07E-11 7.44E-11 9.67E-11 4.77E-11 0.655 11	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           612           37763           191           194           269           305           629	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.21E+07 9.46E+09 7.99E-11 3.74E-01 3.19E-11 8.11E-11 7.11E-11 8.00E-11 9.42E-11 9.42E-11 1.11E-11 1
815           816           817           818           819           820           821           822           823           824           825           826           827           828           830           831           832           833           834           835           836           837           838	3       2       2       2       2       2       1       3       5       2       4       3       2       4       3       2       4       3       1       4       1       2       1       2       1       2       1       2       1       2	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Simon Quaglino Quaglino Quaglino Quaglino Quaglino Wang Wang Wang Wang	42138 38098 60098 14098 14098 18696 35696 7224 100 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 2424 62424 62424 62424 4326 62424 4326 52424 62424 4326 52424 62665 7760 7760 7760 7760 7760 7760 7760 7	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717763 1717776 1717776 17177776 1133641 19093 19093 19093 177168 177196 2035281	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem materials problem materials problem semiconductor device problem sequence subsequent semiconductor device problem semiconductor device problem semiconductor device problem semiconductor device problem semiconductor device problem semiconductor device problem	4/136 38098 60098 14098 18696 35696 7224 100 120750 1700 120750 1700 3060 3060 5940 34186 62424 62424 62424 62424 62424 492 931 37762 446 4455 367 590 28521 95	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.019843556           263.1076275           0.00191213           0.466371975           0.00000334           0.001579934           9.38E-11           0.02174914           0.491070557           6.57E-11           9.66E-11           0.00000698           5.07E-11           9.67E-11           4.77E-11           9.56E-11           0.67E-11           9.56E-11           9.56E-11           9.56E-11	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           62425           37763           191           194           269           305           5030           174	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.21E+07 9.46E+09 7.99E-11 9.04E-11 3.74E-01 3
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           831           832           833           834           835           836           837	$     \begin{array}{c}       3 \\       2 \\       2 \\       2 \\       2 \\       2 \\       2 \\       2 \\       2 \\       2 \\       2 \\       1 \\       1 \\       3 \\       5 \\       2 \\       4 \\       3 \\       1 \\       1 \\       3 \\       2 \\       4 \\       3 \\       1 \\       1 \\       2 \\       3 \\       5 \\       2 \\       4 \\       3 \\       1 \\       1 \\       2 \\       3 \\       5 \\       2 \\       4 \\       3 \\       1 \\       2 \\       3 \\       5 \\       2 \\       4 \\       3 \\       1 \\       2 \\       3 \\       5 \\       2 \\       4 \\       3 \\       2 \\       3 \\       5 \\       5 \\       2 \\       4 \\       3 \\       3 \\       1 \\       1 \\       2 \\       3 \\       5 \\       5 \\       5 \\       2 \\       4 \\       3 \\       5 \\       5 \\       7 \\     $	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Quaglino Quaglino Quaglino Quaglino Wang Wang Wang Wang Rudnyi HB	42138 38098 60098 14098 14098 18696 35696 7224 100 120750 1700 3060 5940 62424 62424 62424 62424 4326 32769 37762 2903 2903 2903 2903 20064 2903	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717792 1717763 1717777 61166 381326 1133641 19093 19093 177168 177196 2035281 11360	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem subsequent computational fluid dynamics problem materials problem materials problem semiconductor device problem sequence subsequent semiconductor device problem semiconductor device problem computational fluid dynamics problem semiconductor device problem computational fluid dynamics problem semiconductor device problem semiconductor device problem computational fluid dynamics problem computational fluid dynamics problem	4/136 38098 60098 14098 18696 35696 7224 100 120750	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.00208418           0.019843556           263.1076275           0.00191213           0.466371975           0.00000334           0.000191213           0.00000334           0.0001579934           9.38E-11           0.02174914           0.491070557           6.57E-11           9.96E-11           7.44E-11           9.67E-11           9.66E-11           9.66E-11           9.66E-11           9.66E-11           9.66E-11           9.66E-11           9.66E-11           9.66E-11	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           322           612           37763           191           194           269           305           5030           174           244	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E+03 3.89E+02 1.34E+01 1
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           830           831           832           833           834           835           836           837           838           839           840	3       2       2       2       2       2       1       3       5       2       4       1       3       2       4       1       3       1       2       4       1       3       1       2       3       1       2       3       5       2       3       5	TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Quaglino Quaglino Quaglino Quaglino Quaglino Wang Wang Wang Wang Wang Rudnyi HB HB	42138 38098 60098 14098 18696 35696 7224 100 1000 120750 1700 3000 3060 5940 62424 62424 62424 62424 62424 62424 62424 62424 32769 37762 2903 26064 2003 26064 1856 1855	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717792 1717763 1717777 61166 381326 1133641 19093 177168 177196 2035281 11360	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem requency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem materials problem materials problem materials problem subsequent computational fluid dynamics problem subsequent semiconductor device problem subsequent semiconductor device problem semiconductor device problem semiconductor device problem computational fluid dynamics problem	4/136 38098 60098 14098 18696 35696 7224 1000 120750 1700 3000 3060 5940 34186 62424 62424 62424 62424 62424 62424 931 37762 4446 4455 367 590 28521 95 515 9014	33977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.0019843556           263.1076275           0.000191213           0.466371975           0.00000334           0.001579934           9.38E-11           0.02174914           0.46174914           0.4714914           0.4714914           0.40000698           5.07E-11           9.96E-11           9.67E-11           4.77E-11           9.6E-11           9.56E-11           9.56E-51           9.56E-51           9.56E-51           9.56E-51           9.56E-51           9.56E-51           9.56E-51           9	38099 60099 14099 18697 35697 7225 101 1001 120751 1701 301 3061 5941 232 62425 62425 62425 62425 62425 612 37763 191 194 269 305 5030 174 344 2055	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.21E+07 9.46E+09 7.99E-11 3.74E-01 3
815           816           817           818           819           822           823           824           825           826           827           828           829           830           831           832           833           834           835           836           837           838           839           840           841	3         2         2         2         2         1         3         5         3         1         3         5         3         1         3         5         3         5         3         2         3         5         3         2         3         5         3         2	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Quaglino Quaglino Quaglino Quaglino Wang Wang Wang Wang Wang Wang Wang Wang	42138 38098 60098 14098 14098 18696 33696 7224 100 120750 1700 120750 1700 3000 5940 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 837762 2903 2903 2903 29064 26068 60740 1856 9914	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717763 1717776 1717776 1717777 61166 381326 1717763 1717776 1133641 19093 19093 19093 1771168 177196 177196 11550 36854 1403124	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem materials problem materials problem semiconductor device problem sequence subsequent semiconductor device problem semiconductor device problem semiconductor device problem semiconductor device problem computational fluid dynamics problem directed graph directed mergh	4/136 38098 60098 14098 18696 35696 7224 100 120750 1700 120750 1700 300 3060 5940 34186 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 531 37762 446 455 367 590 28521 95 515 515 9914 235720	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.019843556           263.1076275           0.000191213           0.00000334           0.001579934           9.38E-11           0.02174914           0.491070557           6.57E-11           9.96E-11           9.67E-11           4.77E-11           9.56E-11           1350000	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           612           37763           191           194           269           305           5030           174           344           9915           2325	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.34E-01 1.34E-01 1.21E+07 9.46E+09 7.99E-11 3.74E-01 3
815           816           817           818           819           820           821           822           823           824           825           826           827           828           830           831           832           833           834           835           836           837           838           839           840           841           842	3         2         2         2         2         2         1         2         1         3         5         2         4         3         2         4         3         2         4         3         2         4         3         2         4         3         1         2         3         5         3         5         3         3         3         3         3         3         3         3         5         3         5	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Simon Quaglino Quaglino Quaglino Quaglino Quaglino Wang Wang Wang Wang Wang Wang Rudnyi HB HB Gleich SNAP SNAP	42138 38098 60098 14098 14098 18696 33696 7224 100 1000 120750 1700 120750 1700 3000 5940 62424 62424 62424 62424 4336 5940 62424 4336 5940 62424 62424 62424 62424 62424 62424 62424 83769 37762 2903 2903 26068 60740 1856 1856 1856 9914 325729 28100 28100 281000000000000000000000000	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717792 1717763 1717777 61166 381326 1133641 19093 177168 1771768 1771768 1771768 1771768 1771768 1771768 1771768 1771768 1771796 2035281 11360 11550 36854 1497134 149714 149714 149714 149714 149714 149714 149714 14	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem subsequent computational fluid dynamics problem materials problem materials problem semiconductor device problem sequence subsequent semiconductor device problem semiconductor device problem semiconductor device problem computational fluid dynamics problem directed graph directed graph	4/136 38098 60098 14098 18696 35696 7224 100 120750 1700 120750 1700 3060 5940 34186 62424 62424 492 931 37762 446 455 367 590 28521 95 515 9914 325729 28102	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.019843556           263.1076275           0.00191213           0.466371975           0.0000334           0.000191213           0.0000334           0.0001579934           9.38E-11           0.02174914           0.491070557           6.57E-11           9.66E-11           0.00000698           5.07E-11           9.67E-11           9.67E-11           9.56E-11           9.56E-11           9.56E-11           9.56E-11           9.56E-11           23.85757551           1250000	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           62425           301           37763           191           194           269           305           5030           174           344           9915           325729	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.34E-01 1.98E-01 1.21E+07 9.46E+09 7.99E-11 9.04E-11 3.19E-11 8.50E-11 9.62E-11 9.62E-11 9.29E-11 6.25E+02 1.25E+02 1.25E+02 1.25E+00 2.26E+00 2
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           830           831           832           833           834           835           836           837           840           841           842           843           844	3         2         2         2         2         2         1         3         5         2         4         3         1         3         1         3         1         2         3         1         2         3         1         2         3         5         3         5         3         5         3         5         3         5         3         5         3         5	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Quaglino Quaglino Quaglino Quaglino Quaglino Wang Wang Wang Wang Wang Rudnyi HB HB HB HB HB HB HB HB HB HB HB	42138 38098 60098 14098 14098 18696 35696 7224 100 1000 120750 1700 3060 5940 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 62424 83769 37762 2903 26064 26076 2729 281903 26729 281903 67	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717792 1717763 1717777 61166 381326 1133641 19093 19093 197196 2035281 11360 11550 36854 1497134 2312497 204	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem materials problem materials problem semiconductor device problem sequence subsequent semiconductor device problem semiconductor device problem semiconductor device problem computational fluid dynamics problem materials problem materials problem semiconductor device problem semiconductor device problem computational fluid dynamics problem dureted graph directed graph directed graph	4/136 38098 60098 14098 18696 35696 7224 100 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 120750 2340 34186 62424 455 367 62424 446 455 590 28521 95 515 515 515 515 515 515 515 515 515	333977915.8 126158040.9 151027266.7 11.10527583 32.84732338 2.34E+11 0.000208418 0.000208418 0.0019843556 263.1076275 0.0000191213 0.466371975 0.000000334 0.001579934 9.38E-11 0.02174914 0.02174914 0.0417757 1.2500000698 5.07E-11 9.56E-	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           301           3061           5941           232           62425           62425           322           612           37763           191           194           269           305           5030           174           344           9915           325729           7           62	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E+03 3.89E+02 1.34E+01 1.34E+01 1.34E+01 1.34E+01 1.34E+01 1.34E+09 7.99E+11 9.46E+09 7.99E+11 8.11E+11 7.11E+11 8.50E+11 9.62E+11 8.52E+11 9.62E+11 8.52E+11 9.62E+11 8.52E+11 9.62E+11 8.52E+11 9.62E+11 8.52E+10 1.25E+00 1
815           816           817           818           819           820           821           822           823           824           825           826           827           830           831           832           833           834           835           836           837           838           839           840           841           842           843           8443           844	3         2         2         2         2         1         3         5         2         4         1         3         1         3         1         3         1         2         4         3         1         2         3         1         2         3         3         3         5         3         5         2	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Simon Quaglino Mancktelow Wang Wang Wang Wang Wang Wang Wang Simon Simo	42138 38098 60098 14098 14098 18696 33696 7224 100 120750 1700 120750 1700 3060 5940 62424 7250 7250 7250 7250 7250 7250 7250 7250	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717763 17177763 17177763 17177763 17177763 17177763 17177763 17177763 17177763 17177763 1717763 1717763 171768 177168 177196 10993 19093 19093 19093 19093 19093 19093 19093 19093 197168 177196 17550 36854 1497134 2312497 294 412	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem materials problem materials problem materials problem subsequent computational fluid dynamics problem subsequent computational fluid dynamics problem subsequent computational fluid dynamics problem materials problem materials problem semiconductor device problem sequence subsequent semiconductor device problem semiconductor device problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem directed graph directed graph chemical process simulation problem	42136           38098           60098           14098           18696           35696           7224           100           1000           120750           1700           300           3060           5940           34186           62424           492           931           37762           446           455           515           991           325729           281903           67           123	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.019843556           263.1076275           0.000191213           0.466371975           0.00000334           0.001579934           9.38E-11           0.02174914           0.4671975           9.36E-11           9.062-11           7.44E-11           9.67E-11           7.52E-11           23.8575751           12.38557551           12.50000           662000           1.854440775	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           612           37763           191           194           269           305           5030           174           344           9915           325729           7           68	2.36E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.21E+07 9.46E+09 9.46E+00 9.46E+00 9.04E+11 3.74E-01 3.19E-11 8.11E-11 7.11E-11 8.50E-11 9.62E+10 9.62E+10 9
815           816           817           818           819           820           821           822           823           824           825           826           827           828           830           831           833           833           833           833           834           835           836           837           838           839           840           841           843           844           845	3         2         2         2         2         1         2         1         3         5         1         3         2         4         3         2         4         3         2         3         5         3         5         3         5         3         5         3         5         3         5         3         5         2         3         5         2         3         5         2         3         5         2         3         2         3         5         2         3         5         2         3         5         3         3         5 <td< td=""><td>TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Quaglino Quaglino Quaglino Quaglino Quaglino Wang Wang Wang Wang Wang Wang Wang Wang</td><td>42138 38098 60098 14098 14098 18696 35696 7224 100 120750 1700 120750 1700 120750 1700 3060 5940 62424 62424 4326 62424 4326 2412 2903 2903 2903 26064 26068 60740 1856 1856 9914 325729 281903 67 132 281903 155</td><td>4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717763 171777 61166 381326 173641 19093 19093 19093 19093 177168 177196 2035281 11360 11550 36854 1497134 2312497 294 413 262</td><td>power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem 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0.02174914           0.491070557           6.57E-11           9.96E-11           9.67E-11           4.77E-11           9.66E-11           7.52E-11           23.85757551           1250000           662000           1.854440775           0.4027277</td><td>38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           62425           62425           62425           62425           6269           305           5030           174           344           9915           325729           7           68           133           157</td><td>2.30E+00 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.34E-01 1.98E-01 1.34E-01 1.21E+07 9.46E+09 7.99E-11 9.04E-11 3.74E-00 3.74E-00 3</td></td<>	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Quaglino Quaglino Quaglino Quaglino Quaglino Wang Wang Wang Wang Wang Wang Wang Wang	42138 38098 60098 14098 14098 18696 35696 7224 100 120750 1700 120750 1700 120750 1700 3060 5940 62424 62424 4326 62424 4326 2412 2903 2903 2903 26064 26068 60740 1856 1856 9914 325729 281903 67 132 281903 155	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717763 171777 61166 381326 173641 19093 19093 19093 19093 177168 177196 2035281 11360 11550 36854 1497134 2312497 294 413 262	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem sequence subsequent computational fluid dynamics problem subsequent computational fluid 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4.77E-11           9.66E-11           7.52E-11           23.85757551           1250000           662000           1.854440775           0.4027277	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           62425           62425           62425           62425           6269           305           5030           174           344           9915           325729           7           68           133           157	2.30E+00 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.34E-01 1.98E-01 1.34E-01 1.21E+07 9.46E+09 7.99E-11 9.04E-11 3.74E-00 3.74E-00 3
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           830           831           832           833           834           835           836           837           838           839           841           842           843           844           845           844	3         2         2         2         2         2         1         3         5         2         4         3         1         3         1         3         1         3         1         2         3         1         2         3         5         3         5         2         3         5         2         3 <td< td=""><td>TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Quaglino Quaglino Quaglino Quaglino Quaglino Mancktelow Wang Wang Wang Wang Rudnyi HB HB HB HB HB HB HB HB</td><td>42138 38098 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     7.44E-11           9.56E-11           1.554440775           &lt;</td><td>38099           60099           14099           18697           35697           7225           101           1001           120751           1701           301           3061           5941           232           62425           322           612           37763           191           194           269           305           5030           174           344           9915           325729           7           68           133           157           168</td><td>2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 6.82E-11 9.46E+09 7.99E-11 9.04E-10 3.74E-01 3.19E-11 8.50E-11 9.62E-11 8.50E-11 9.62E-11 8.52E+10 1.25E+00 1</td></td<>	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Simon Quaglino Quaglino Quaglino Quaglino Quaglino Mancktelow Wang Wang Wang Wang Rudnyi HB 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7.44E-11           9.56E-11           1.554440775           <	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           301           3061           5941           232           62425           322           612           37763           191           194           269           305           5030           174           344           9915           325729           7           68           133           157           168	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 6.82E-11 9.46E+09 7.99E-11 9.04E-10 3.74E-01 3.19E-11 8.50E-11 9.62E-11 8.50E-11 9.62E-11 8.52E+10 1.25E+00 1
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           830           831           832           833           834           835           836           837           838           839           840           841           845           846           847           846           847	3         2         2         2         2         1         3         5         2         4         1         3         1         3         5         3         1         2         4         3         5         3         5         3         5         3         5         3         5         3         3         5         3         3         3         3         3         3         3         3         3         3         3         4         3         3         3         3         3         3         3         4         3         3         3         3 <td< td=""><td>TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Quaglino Quaglino Quaglino Quaglino Quaglino Quaglino Quaglino Quaglino Rudnyi HB HB HB HB HB HB HB HB HB HB</td><td>42138 38098 60098 14098 14098 14098 18696 35696 7224 100 120750 1700 3000 3060 5940 5940 62424 60740 1856 60740 1856 60740 1856 1856 1856 1856 1325 132 132 132 136 132 132 132 136 132 132 132 132 132 132 132 132</td><td>4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717792 171776 1166 381326 1133641 19093 19093 177168 177196 2035281 11360 11550 36854 1497134 2312497 294 413 362 506</td><td>power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem electromagnetics problem electromagnetics problem electromagnetics problem 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       281903           67           132           156           167           381</td><td>333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.0019843556           263.1076275           0.000191213           0.466371975           0.00000334           0.001579934           9.38E-11           0.02174914           0.466371975           9.36E-11           9.0274914           0.400000698           5.07E-11           9.56E-11           0.435518857           0.019724277           147.3683172           2.40264016</td><td>38099           60099           14099           18697           35697           7225           101           1001           120751           1701           301           3061           5941           232           62425           62425           62425           62425           612           37763           191           194           269           305           5030           174           344           9915           325729           7           68           133           157           168           133</td><td>2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.34E-01 1.21E+07 9.46E+09 7.99E-11 3.74E-00 3.74E-01 3.74E-01 3.74E-00 3.74E-01 3.74E-01 3.74E-00 3</td></td<>	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Quaglino Quaglino Quaglino Quaglino Quaglino Quaglino Quaglino Quaglino Rudnyi HB HB HB HB HB HB HB HB HB HB	42138 38098 60098 14098 14098 14098 18696 35696 7224 100 120750 1700 3000 3060 5940 5940 62424 60740 1856 60740 1856 60740 1856 1856 1856 1856 1325 132 132 132 136 132 132 132 136 132 132 132 132 132 132 132 132	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717792 171776 1166 381326 1133641 19093 19093 177168 177196 2035281 11360 11550 36854 1497134 2312497 294 413 362 506	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem computational fluid dynamics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem materials problem materials problem materials problem subsequent computational fluid dynamics problem subsequent computational fluid dynamics problem materials problem materials problem semiconductor device problem sequence subsequent semiconductor device problem semiconductor device problem computational fluid dynamics problem semiconductor device problem computational fluid dynamics problem directed graph directed graph chemical process simulation problem chemical process simulation problem	42136           38098           60098           14098           18696           35696           7224           100           1000           120750           1700           3000           3060           5940           34186           62424           62424           931           37762           446           4455           367           590           28521           95           515           9914           325729           281903           67           132           156           167           381	333977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.0019843556           263.1076275           0.000191213           0.466371975           0.00000334           0.001579934           9.38E-11           0.02174914           0.466371975           9.36E-11           9.0274914           0.400000698           5.07E-11           9.56E-11           0.435518857           0.019724277           147.3683172           2.40264016	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           301           3061           5941           232           62425           62425           62425           62425           612           37763           191           194           269           305           5030           174           344           9915           325729           7           68           133           157           168           133	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.98E-01 1.34E-01 1.21E+07 9.46E+09 7.99E-11 3.74E-00 3.74E-01 3.74E-01 3.74E-00 3.74E-01 3.74E-01 3.74E-00 3
815           816           817           818           819           820           821           822           823           824           825           826           827           828           829           830           831           832           833           834           835           836           837           838           839           840           844           845           846           847           848           847           848           847           848           846           847           848           846           847           848           840	3         2         2         2         2         1         2         1         3         5         3         1         2         4         3         1         3         5         3         5         3         5         3         5         3         5         3         4         1         2         3         3         4         1         2         3         3         4         1         2         3         3         4         1         5         3         4         1         5         3         4         5          5          3          4          5 <td>TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Quaglino Quaglino Quaglino Quaglino Wang Wang Wang Wang Wang Wang Wang Wang</td> <td>42138 38098 60098 14098 14098 18696 35696 7224 100 120750 1700 120750 1700 120750 1700 120750 1700 5940 62424 83766 9914 325762 281903 67 132 1356 1352 156 167 381 479</td> <td>4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717763 1717776 1717776 1717776 1717776 1717776 1717776 17166 173641 19093 19093 19093 19093 177168 177196 177198 177196</td> <td>power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem subsequent computational fluid dynamics problem materials problem materials problem semiconductor device problem sequence subsequent computational fluid dynamics problem semiconductor device problem semiconductor device problem semiconductor device problem computational fluid dynamics problem semiconductor device problem computational fluid dynamics problem computational fluid process simulation problem chemical process simulation problem chemical process simulation problem chemical process simulation problem</td> <td>4/136 38098 60098 14098 18696 35696 7224 100 120750 1700 3000 3000 3000 3060 5940 34186 62424 62521 95 515 911 95 515 911 95 515 911 95 515 911 95 515 911 95 515 911 95 515 911 95 515 911 95 515 911 92 815 92 92 816 92 93 81 93 81 95 95 515 911 92 81 93 81 92 93 81 92 93 81 93 67 722 93 81 93 7762 72 93 81 95 515 92 914 722 93 81 93 67 72 93 81 93 67 72 93 81 93 82 72 93 81 93 81 95 55 72 91 81 92 81 93 81 92 81 93 93 93 93 93 93 93 93 93 93 93 93 93</td> <td>3.33977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.019843556           263.1076275           0.000191213           0.466371975           0.00000334           0.001579934           9.38E-11           0.001579934           9.38E-11           0.00177914           0.491070557           6.57E-11           9.96E-11           9.67E-11           9.57E-11           9.57551           123.85757551           123.8575551           1250000           662000           1.854440775           0.031518857           0.0324277           147.3683172           3.24293016</td> <td>38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           62425           612           37763           191           194           269           305           5030           174           344           9915           325729           7           68           133           157           168           382           480</td> <td>2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.34E-01 1.34E-01 1.21E+07 9.04E+11 3.74E-01 3.19E-11 8.11E-11 8.50E-11 9.04E+11 8.50E-11 9.04E+11 8.50E-11 9.29E-11 6.25E+02 1.25E+06 3.26E+00 4.32E+00 9.29E-01 1.34E-03 1.34E-03 1.36E+02 4.59E+00 1.27E+01 1</td>	TSOPF TSOPF TSOPF TSOPF TSOPF TSOPF Bai Bai ATandT TOKAMAK TOKAMAK TOKAMAK TOKAMAK TOKAMAK Simon Simon Quaglino Quaglino Quaglino Quaglino Wang Wang Wang Wang Wang Wang Wang Wang	42138 38098 60098 14098 14098 18696 35696 7224 100 120750 1700 120750 1700 120750 1700 120750 1700 5940 62424 83766 9914 325762 281903 67 132 1356 1352 156 167 381 479	4413449 684206 1079986 252446 4396289 8781949 54082 3996 1206265 21509 3155 42211 83842 1717763 1717776 1717776 1717776 1717776 1717776 1717776 17166 173641 19093 19093 19093 19093 177168 177196 177198 177196	power network problem power network problem power network problem power network problem power network problem power network problem computational fluid dynamics problem computational fluid dynamics problem frequency-domain circuit simulation problem electromagnetics problem electromagnetics problem electromagnetics problem electromagnetics problem computational fluid dynamics problem subsequent computational fluid dynamics problem materials problem materials problem semiconductor device problem sequence subsequent computational fluid dynamics problem semiconductor device problem semiconductor device problem semiconductor device problem computational fluid dynamics problem semiconductor device problem computational fluid dynamics problem computational fluid process simulation problem chemical process simulation problem chemical process simulation problem chemical process simulation problem	4/136 38098 60098 14098 18696 35696 7224 100 120750 1700 3000 3000 3000 3060 5940 34186 62424 62521 95 515 911 95 515 911 95 515 911 95 515 911 95 515 911 95 515 911 95 515 911 95 515 911 95 515 911 92 815 92 92 816 92 93 81 93 81 95 95 515 911 92 81 93 81 92 93 81 92 93 81 93 67 722 93 81 93 7762 72 93 81 95 515 92 914 722 93 81 93 67 72 93 81 93 67 72 93 81 93 82 72 93 81 93 81 95 55 72 91 81 92 81 93 81 92 81 93 93 93 93 93 93 93 93 93 93 93 93 93	3.33977915.8           126158040.9           151027266.7           11.10527583           32.84732338           2.34E+11           0.000208418           0.019843556           263.1076275           0.000191213           0.466371975           0.00000334           0.001579934           9.38E-11           0.001579934           9.38E-11           0.00177914           0.491070557           6.57E-11           9.96E-11           9.67E-11           9.57E-11           9.57551           123.85757551           123.8575551           1250000           662000           1.854440775           0.031518857           0.0324277           147.3683172           3.24293016	38099           60099           14099           18697           35697           7225           101           1001           120751           1701           3061           5941           232           62425           62425           62425           612           37763           191           194           269           305           5030           174           344           9915           325729           7           68           133           157           168           382           480	2.30E+01 2.30E+08 3.36E+07 7.71E+08 1.58E+00 2.04E+01 1.12E+14 1.48E-08 1.11E-04 nan 1.97E-03 3.89E-02 1.34E-01 1.34E-01 1.34E-01 1.21E+07 9.04E+11 3.74E-01 3.19E-11 8.11E-11 8.50E-11 9.04E+11 8.50E-11 9.04E+11 8.50E-11 9.29E-11 6.25E+02 1.25E+06 3.26E+00 4.32E+00 9.29E-01 1.34E-03 1.34E-03 1.36E+02 4.59E+00 1.27E+01 1

850	2	HB	497	1721	chemical process simulation problem	497	107.6817765	498	2.81E+01
851	5	HB	655	2808	chemical process simulation problem	655	4.29075646	656	4.01E+00
852	1	HB	989	3518	chemical process simulation problem	989	71.10327393	990	2.62E+02
853	3	HB	1505	5414	chemical process simulation problem	1505	871.6797716	1506	2.21E+02
854	2	HB	2021	7310	chemical process simulation problem	2021	26557.61639	2022	3.81E+04
855	3	SNAP	8297	103689	directed graph	8297	14.76055306	2729	1.68E+00
856	4	HB	199	701	structural problem	199	2.122543261	200	2.95E+00
857	2	HB	57	281	semiconductor device problem	57	2160.239451	58	2.44E+03
858	2	Pajek	82670	132964	directed weighted graph	82670	567000	327	4.77E+08
859	2	Rommes	66	1194	eigenvalue/model reduction problem	66	0.001330607	67	1.95E-04
860	2	Rommes	13251	48737	eigenvalue/model reduction problem	13251	0.00000867	13252	1.15E+08
861	4	Ronis	48600	1181120	materials problem	1264	9.98E-11	1603	6.18E-11
862	5	Ronis	157464	3866688	materials problem	1444	9.71E-11	1901	5.66E-11
863	4	Rommes	13250	48735	eigenvalue/model reduction problem	13250	6728465.533	33	6.71E-11
864	1	Rommes	20944	74386	eigenvalue/model reduction problem	20944	0.00005	20945	1.75E+01
865	5	HB	841	3988	acoustics problem	701	8.83E-11	842	1.10E-08
866	2	VanVelzen	22835	1642407	chemical process simulation problem	22835	237289756.4	22836	3.15E+09
867	1	VanVelzen	22835	676439	chemical process simulation problem	22835	1201785583	22836	1.04E+04
868	2	VanVelzen	22835	1915726	chemical process simulation problem	22835	340594917.9	22836	4.13E+09
869	5	VanVelzen	22835	713907	chemical process simulation problem	22835	1036.541525	22836	2.98E+03
870	1	VanVelzen	22835	1711557	chemical process simulation problem	22835	360156085	22836	4.71E+07
871	1	VanVelzen	22835	663643	chemical process simulation problem	22835	29284.84715	22836	4.24E+02
872	1	Rommes	13296	48827	eigenvalue/model reduction problem	13296	25394300.15	33	6.71E-11
873	2	Pajek	6752	54233	directed multigraph	6752	9.02E+19	6753	2.56E+20
874	4	Zhao	33861	166453	electromagnetics problem	46	8.84E-11	55	2.47E-11
875	1	Zhao	33861	166453	electromagnetics problem	1734	6.18E-11	7702	7.48E-11