

Chapter 7

Conclusions and Future Work

7.1 Conclusions

In this thesis, a new companion matrix was proposed to calculate the zeros of polynomials which have multiple or cluster of zeros. The companion matrix has only simple eigenvalues which are the distinct zeros of the original polynomial. We then proposed a new method to calculate the companion matrix using multiple precision arithmetic. The method used a recursive formula based on Euclid's algorithm to compute the values of the polynomial with arithmetic operations of $O(n^2)$, where n is the degree of the polynomial. These methods are efficient in computing multiple zeros or center of the cluster of zeros of polynomials, and are also efficient in computing the multiplicities of the multiple zeros or the number of zeros in the cluster.

we presented a verified method to calculate the maximum value of $|f(z)|$ on the boundary of a disk and then performed a validated computation of the Taylor coefficient of $f(z)$ using circular complex arithmetic. Based on these results, a factorization method was used to calculate a verified polynomial factor of $f(z)$. Moreover, a verified method was proposed to calculate the number of zeros in the cluster of $f(z)$ and compute a disk containing the cluster.

The efficiency of the methods presented in this thesis has been illustrated by a number of numerical examples.

7.2 Future Work

In this thesis, the determination of analyticity of functions is performed by Cdomain system which is based on INTLAB interval arithmetic package. In order to improve the efficiency of the computation, In the future, we focus on the design and implementation of an interactive circular complex arithmetic system with Scilab or C++ programming language. With this system we can perform circular complex arithmetic computations and determine the analyticity of functions in the computation.