Performance Evaluation of Multiple Precision Iterative Methods for the Solution of Complex Symmetric Systems of Electromagnetic Analysis

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ABSTRACT

There are great demands for an efficient iterative method for the electromagnetic analysis. By taking Maxwell equations including displacement current for instance, the finite element method (FEM) with the formulation of the electric field leads a complex symmetric system. To solve such system of the linear equation, the conjugate orthogonal conjugate gradient (COCG) method [1] has been widely used, and the conjugate orthogonal conjugate residual (COCR) method [2] has been becoming more known. However, large-scale problems suffer from slow convergence rate and oscillating residual norm behaviour. On the other hand, the MINRES-like_CS method [3] based on iterative procedures of the minimal residual method [4] is expected to show a stable convergence compared to the COCG method and the COCR method.

Besides, the multiple precision computation has a variety of application areas, and many arbitrary precision algorithms and libraries have been developed using the fixed precision arithmetic [5]. Moreover, GCC Version 4.6 or later provide __float128 type as a system software support, and the IBM POWER9 have hardware support of 128-bit quad-precision floating-point operations. Because of these, we expect efficient implementation and easy-to-use of the multiple precision computation in near future.

In this paper, we implement the iterative solver using the multiple precision computation, and demonstrate the performance of the iterative methods in solving complex symmetric system.

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