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Development of Multiple-Precision Arithmetic on MATLAB for Numerical Computations of Ill-Posed Problems

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Abstract

In this talk we will introduce a new multiple-precision arithmetic environment on MATLAB which is widely used for scientific and engineering computing. It enables us to approximate real numbers and their arithmetic with an arbitrary accuracy, and to realize reliable computations for numerically unstable schemes arising from ill-posed problems [1, 2].

In the standard computing environments, the double precision arithmetic [4] which has approximately 16 decimal digits precision is commonly used. In numerically unstable processes, the rounding errors grow rapidly and the standard double precision is not enough for reliable computations. Although regularization schemes are applied to relax instabilities, some important information such as discontinuities of the solutions are not recovered [3].

Exflib [5] is a multiple-precision arithmetic package for fast scientific computations in the programming language C++ and FORTRAN90, and it is effective to treat numerically unstable schemes directly. The proposed multiple-precision environment leverages exflib with MEX (MATLAB Executable) files, and it runs on MATLAB (2015a) on 64-bit Linux or MacOSX at present. Comparisons between VPA (variable precision arithmetic) in MATLAB Symbolic Math Toolbox will be presented, and demonstrations on MacOSX will be also exhibited.

References

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[3] H. Fujiwara and N. Higashimori, Numerical real inversion of the Laplace transform by using multiple-precision arithmetic, *Lib. Math. (N.S.)*, Vol. 34 (2014), pp. 5–21.

[4] IEEE754 standard for binary floating-point arithmetic, IEEE std 754-1985 (1985).

[5] `http://www-an.acs.i.kyoto-u.ac.jp/~fujiwara/exflib/`