Fast rounding error estimation for compute-intensive operations using standard floating-point arithmetic

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Résumé

Numerical validation enables one to ensure the reliability of numerical computations that rely on floating-point operations. Discrete Stochastic Arithmetic (DSA) makes it possible to validate the accuracy of floating-point computations using random rounding. However, it may bring a large performance overhead compared with the standard floating-point operations. In this talk, we show that with perturbed data it is possible to use standard floating-point arithmetic instead of DSA for the purpose of numerical validation. For instance, for codes including matrix multiplications, we can directly utilize the matrix multiplication routine (GEMM) of level-3 BLAS that is performed with standard floating-point arithmetic. Consequently, we can achieve a significant performance improvement by avoiding the performance overhead of DSA operations as well as by exploiting the speed of highly-optimized BLAS implementations. Finally, we demonstrate the performance gain using Intel MKL routines compared against the DSA version of BLAS routines.

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