
Interactive
comment

Interactive comment on “rpe v5: An emulator for reduced floating-point precision in large numerical simulations” by Andrew Dawson and Peter Düben

Anonymous Referee #2

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General comments:

This article presents a library (rpe v5) that enables one to change the precision of floating-point variables in Fortran codes. Reducing the precision can improve the code performance and it can be particularly advantageous in a parallel environment because it enables one to reduce the volume of data exchanged. This article recalls the importance of mixed precision simulations. The rpe v5 library seems easy to use in Fortran codes, the Fortran language being widespread for geoscience simulations. However the interest of the library seems limited compared to existing tools. As remarked by the authors, emulated reduced precision may produce different results than the native one. In rpe v5, with reduced precision variables, the exponent range remains the same, except when half-precision variables are emulated. No information is given on the validity of the results produced. Users must perform comparisons with, for instance, the double

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precision results that are supposed to be correct.

Specific comments:

In the introduction two tools that estimate rounding errors are mentioned: CADNA and Verificarlo. In the reference "Scott et al." an author is missing (C. Denis). However another article describes CADNA in more detail: F. Jézéquel, J.-M. Chesneaux, CADNA: a library for estimating round-off error propagation, Computer Physics Communications, 178(12), pages 933-955, 2008.

In my opinion, a state of the art relative to precision reduction is missing.

Introducing errors on floating-point variables in a Fortran code is a functionality of CADNA. The SAM (Stochastic Arithmetic in Multiprecision) library enables one to control rounding errors in arbitrary precision simulations. Furthermore tools exist to auto-tune floating-point precision; some are listed below.

CRAFT HPC M.O. Lam, J.K. Hollingsworth, B.R. de Supinski, M.P. Legendre, Automatically Adapting Programs for Mixed-precision Floating-point Computation, in: Proceedings of the 27th International ACM Conference on International Conference on Supercomputing, ICS '13, ACM, New York, NY, USA, 2013, pp. 369–378. <https://sourceforge.net/projects/crafthpc/>

Precimonious C. Rubio-González, C. Nguyen, H.D. Nguyen, J. Demmel, W. Kahan, K. Sen, D.H. Bailey, C. Iancu, D. Hough, Precimonious: Tuning assistant for floating-point precision, in: Proceedings of the International Conference on High Performance Computing, Networking, Storage and Analysis, SC'13, ACM, New York, NY, USA, 2013, pp. 27:1–27:12. <https://github.com/corvette-berkeley/precimonious>

Blame Analysis C. Nguyen, C. Rubio-González, B. Mehne, K. Sen, J. Demmel, W. Kahan, C. Iancu, W. Lavrijsen, D.H. Bailey, D. Hough, Floating-Point Precision Tuning Using Blame Analysis, Technical Report, LBNL TR, 2015. <https://github.com/corvette-berkeley/shadow-execution>

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PROMISE S. Graillat, F. Jézéquel, R. Picot, F. Févotte, B. Lathuilière. PROMISE: floating-point precision tuning with stochastic arithmetic, 17th international symposium on Scientific Computing, Computer Arithmetic and Validated Numerics (SCAN 2016), Uppsala (Sweden), September 2016. <http://promise.lip6.fr/>

Section 2.2: It would be interesting to have more details on the impact of rounding toward zero on fluid dynamics simulations. What would be the impact of rounding to plus or minus infinity on conservation properties?

As a remark, being not familiar with fluid dynamics simulations, I cannot easily judge the similarity of results displayed in Figure 4. The similarity of results displayed in Figure 5 seems clearer. However it would be interesting to compare them with those obtained with 10-bit significand.

The performance overhead due to the library is mentioned in the conclusion. It would be interesting to have measurements of that overhead.

Technical corrections are proposed below.

p4: The reduced-precision program (Fig. 1b) set → The reduced-precision program (Fig. 1b) sets

p7: Therefore we generally we discourage → Therefore we generally discourage

Interactive comment on Geosci. Model Dev. Discuss., doi:10.5194/gmd-2016-247, 2016.

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