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▶ To cite this version:

HAL Id: lirmm-02091186

https://hal-lirmm.ccsd.cnrs.fr/lirmm-02091186

Submitted on 5 Apr 2019

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Abstract:
Post Moore's era supercomputing will certainly require more hierarchical parallelism and variable precision floating-point arithmetic to satisfy the computing need of exascale numerical simulations. Nevertheless floating-point addition will remain non associative and so parallel computations will still be prone to return results being different from one run to another one. These failures of the numerical reproducibility reduce the simulation reliability and complicate the debugging and the validating steps of large scale software.

We present two case studies to illustrate how to recover this numerical reproducibility without jeopardizing the computing efficiency. Hydrodynamics parallel simulations with the openTelemac code rely on finite element modelization, subdomain decomposition and iterative solvers. Two openTelemac modules have been modified to provide reproducible results for any number of computing units thanks to targeted compensation techniques. We also describe and analyze generic solutions that are also provided by reproducible and accurately rounded BLAS.