Reproducible Parallel Simulations in HPC
Chemseddine Chohra, Philippe Langlois, Rafife Nheilli, David Parello

To cite this version:
Chemseddine Chohra, Philippe Langlois, Rafife Nheilli, David Parello. Reproducible Parallel Simulations in HPC. CSE: Computational Science and Engineering, Feb 2017, Atlanta, Georgia, United States. lirmm-02091186

HAL Id: lirmm-02091186
https://hal-lirmm.ccsd.cnrs.fr/lirmm-02091186
Submitted on 5 Apr 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Reproducible Parallel Simulations in HPC

Chemseddine Chohra, Philippe Langlois, Rafife Nheilli, David Parello
Univ. Perpignan Via Domitia, Digits, Architectures et Logiciels Informatiques, F-66860, Perpignan. Univ. Montpellier II, Laboratoire d’Informatique Robotique et de Microélectronique de Montpellier, UMR 5506, F-34095, Montpellier. CNRS. France.

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.