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Méthode des bases réduites pour des problèmes multi-physiques non-linéaires

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We present an open-source framework for the reduced basis methods implemented in the library Feel++ [3,4] and we consider in particular multi-physics, possibly non-linear, applications [1,2] which require high performance computing. We present how the mathematical methodology and technology scale with respect to complexity and the gain obtained in industrial context [1]. We present also briefly our first developments on low-rank methods within our framework with our colleagues from ECN.

One of the main application presented is developed with the Laboratoire National des Champs Magnétique Intenses (LNCMI), a large french equipment, allowing researchers to do experiments with magnetic fields up to 35T provided by water cooled resistive electro-magnet. Existing technologies (material properties,...) are pushed to the limits and users require now specific magnetic field profiles or homogeneous fields. These constraints and the international race for higher magnetic fields demand conception tools which are reliable and robust. The reduced basis methodology is now part of this tool chain.

Another domain of application we will consider in the talk is fluid flows, both Stokes and Navier-Stokes.

[1] Cécile Daversin, Stéphane Veys, Christophe Trophime, Christophe Prud'Homme
{A Reduced Basis Framework: Application to large scale non-linear multi-physics problems}
http://hal.archives-ouvertes.fr/hal-00786557

[2] Elisa Schenone, Stéphane Veys, Christophe Prud'Homme
{High Performance Computing for the Reduced Basis Method. Application to Natural Convection}
http://hal.archives-ouvertes.fr/hal-00786560

[3] http://www.feelpp.org

[4] C. Prudhomme, V. Chabannes, V. Doyeux, M. Ismail, A. Samake, G. Pena. {Feel++ : A Computational Framework for Galerkin Methods and Advanced Numerical Methods}, ESAIM Proc., Multiscale Coupling of Complex Models in Scientific Computing, 38 (2012), 429–455.