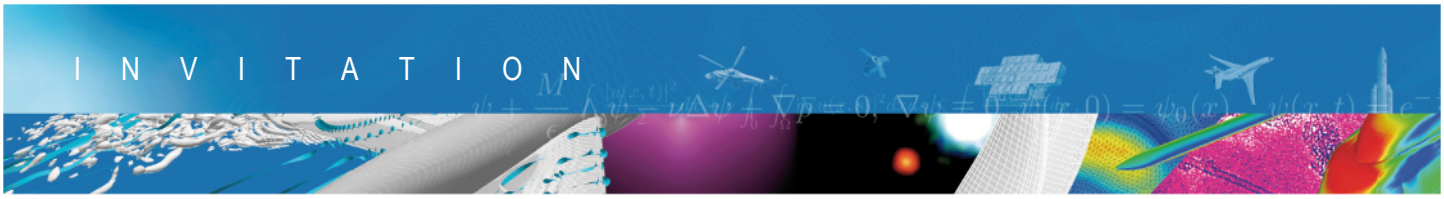

Thèse de doctorat de l'Université Pierre et Marie Curie

Sensitivity analysis for numerical simulation of compressible flows in external aerodynamics

Présentée par
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Sensitivity analysis for the numerical simulation of external aerodynamics compressible flows with respect to the mesh discretization and to the model input parametric uncertainty has been addressed respectively 1- through adjoint-based gradient computation techniques and 2- through non-intrusive stochastic approximation methods based on sparse grids [a]. 1- An enhanced goal-oriented mesh adaptation method based on aerodynamic functional total derivatives with respect to mesh coordinates in a RANS finite-volume mono-block and non-matching multi-block structured grid framework is introduced. Applications to 2D RANS flow about an airfoil in transonic and detached subsonic conditions for the drag coefficient estimation are presented. The asset of the proposed method is patent. 2- The generalized Polynomial Chaos in its sparse pseudospectral form and stochastic collocation methods based on both isotropic and dimension-adapted sparse grids obtained through an improved dimension-adaptivity method driven by global sensitivity analysis are considered. The stochastic approximations efficiency is assessed on multi-variate test functions and airfoil viscous aerodynamics simulation in the presence of geometrical and operational uncertainties. Integration of achievements 1- and 2- into a coupled approach in future work will pave the way for a well-balanced goal-oriented deterministic/stochastic error control.

[a] A. Resmini, J. Peter, D. Lucor. *Sparse grids-based stochastic approximations with applications to aerodynamics sensitivity analysis.* Int. J. Numer. Meth. Engng, 2015.

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