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.


Soutenue le 11 décembre 2015 à 14h en Salle Contensou – ONERA Châtillon – devant le jury composé de :

M. G. BIAU Examinateur Professeur, UPMC
M. P.-M. CONGEDO Rapporteur Chargé de recherche - HDR, INRIA
M. P. LARRIEU Examinateur Chargé méthodes numériques, AIRBUS
M. D. LUCOR Directeur de thèse Directeur de recherche CNRS, LIMSI
M. J. PETER Encadrant Maître de recherche, ONERA
Mme M.-V. SALVETTI Examinateur Professeur, Università di Pisa
M. E. VALERO Examinateur Professeur, Univ. Politecnica de Madrid
M. M. VISONNEAU Rapporteur Directeur de recherche CNRS, ÉCN