NON-DETERMINISTIC AERODYNAMIC SIMULATIONS
WITH RANDOM INPUTS

A. Resmini\textsuperscript{1,2}, D. Lucor\textsuperscript{2,3,*}, E. Savin\textsuperscript{1,4} and J. Peter\textsuperscript{1}

\textsuperscript{1} ONERA - The French Aerospace Lab, 29, av. de la Division Leclerc, 92322 Châtillon, France, andrea.resmini@onera.fr, jacques.peter@onera.fr, eric.savin@onera.fr, www.onera.fr
\textsuperscript{2} UPMC Université Paris 06, UMR 7190, Institut Jean Le Rond d’Alembert, 4, Place Jussieu, 75005 Paris, France, didier.lucor@upmc.fr, www.upmc.fr
\textsuperscript{3} CNRS, UMR 7190, Institut Jean Le Rond d’Alembert, F-75005 Paris, France.
\textsuperscript{4} École Centrale de Paris, Grande Voie des Vignes, 92295 Châtenay-Malabry, France, eric.savin@ecp.fr, www.ecp.fr

Key words: CFD, UQ, 2D, RANS, Polynomial Chaos, Stochastic Collocation, Adaptivity, Geometrical & Operational Uncertainties, Turbulence Models Effect.

The impact of input data lack of knowledge on CFD simulations may be addressed through uncertainty quantification techniques. The identification of realistic uncertainties is the essential requisite. Subsequently, the appropriate stochastic approximation has to be identified. Non-intrusive techniques, taking advantage of (generalized) polynomial chaos and stochastic collocation approximations [1, 2], are preferred in order to avoid costly code modifications of the flow solver. The study of the turbulent flow about 2D profiles at Reynolds number up to 2 million, subsonic Mach number and at attached and detached conditions is addressed. The analysis takes into consideration simultaneously several operational and geometrical uncertainties. Realistic random inputs from wind-tunnels and real flight data are employed. In this probabilistic framework, the impact of different turbulence models on the global aerodynamic functions of interest is assessed. A comparison between (generalized) polynomial chaos and stochastic collocation methods [3] efficiency is given as well. RANS solution reliability is improved with respect to experimental evidence.

REFERENCES
