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Title : Uncertainty analysis and numerical flow simulation

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This research project deals with uncertainty quantification and numerical simulation of high Reynolds number flows. It represents a challenging study demanding accurate and efficient numerical methods. It involves the INRIA team BACCHUS, FRG group from the Department of Aeronautics and Astronautics and the UQ Lab from the Department of Mechanical Engineering at Stanford University. The first topic concerns the simulation of flows when only partial information about the physics or the simulation conditions (initial conditions, boundary conditions) is available. In particular we are interested in developing methods to be used in complex flows where the uncertainties represented as random variables can have arbitrary probability density functions. The second topic focuses on the accurate and efficient simulation of high Reynolds number flows.

In this talk, we will illustrate some recent results obtained in the context of uncertainty quantification and of the Discontinuous Enrichment Method: i) a non-linear multi-resolution framework for uncertainty quantification in Computational Fluid Dynamics, ii) a high-order statistics decomposition and its application to robust design optimization, iii) the Simplex 2 method, that is an innovative technique developed in AQUARIUS for robust design optimization and for treating epistemic uncertainties. Finally, future works and perspectives will be presented.

AQUARIUS Team : Numerical Methods for Uncertainty Quantification and Prediction of high Reynolds number Flows

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