Postdoctoral position

Augmented Computational AeroAcoustics:
Uncertainty Quantification and Data Assimilation for engineering

Motivations

Noise control and reduction is presently a very important issues in several engineering fields, such as aerospace engineering, wind and civil engineering or ground transport. Among the different noise source, one may identify aeroacoustic sources, which correspond to the noise emitted by an unsteady flow. These sources are the most important in many important applications, like aircraft landing. A huge amout of work has been devoted to these mechanisms and many heursitic or semi-empirical models have been proposed, along with theoretical models based on physical assumptions (e.g. Lighthill's theory and sequels). Thanks to the rapid growth of supercomputing facilities, direct noise computation (Computational AeroAcoustics - CAA) via brute force computation of unsteady aerodynamic flow has emerged as a powerful technique to predict radiated noise.

Existing CAA tools deal with deterministic problems in which all flow parameters, including boundary conditions, are exactly known and perfecty prescribed in the simulation. Unfortunately, in real physical systems, the complexity is so high that all parameters are not exactly known, leading to the existence of uncertainties. To account for this lack of knowledge about the system, one must handle uncertainties in the numerical model. This is the aim of the Uncertainty Quantification (UQ) theory, which allows for a description of the response surface of the system spanned by possible variations of uncertain parameters. Therefore, classical fully known deterministic solutions are replaced by stochastic ones. The uncertainty can be reduced by incorporating existing data coming from experiments into the simulation, thanks to Data Assimilation (DA) techniques. While UQ is a direct problem, DA relies on an inverse problem.

The goal of the present project is to couple UQ and DA to Computational AeroAcoustics, in order to develop a relevant tool to describe noise generated by flows in complex systems.

Research program

The research program will be focused on the following items:

- Phase 1: Noise emitted by a flow with uncertain parameters. The goal will be a get a description of the far field acoustic field radiated by a flow with uncertain parameters. The emphasis will be put on 2D flows and the development of an efficient UQ method based on hybridization of ANOVA, Proper Orthogonal Decompostion and Kriging

- Phase 2: Reduction of the uncertainty via Data Assimilation. Here, available data dealing with both aerodynamic and acoustic field will be used to tune some uncertain parameters in an optimal way. Ensemble-based Variational methods will be used and extended for that purpose.
- Phase 3: Application to a relevant engineering problem.

The work will be performed in close collaboration with D'Alembert Institute (Paris, France), CERFACS (Toulouse, France), LMA (Marseille, France), Airbus and Renault.

Candidate profile

Candidates should have a significant experience Computational Fluid Dynamics and/or Computational AeroAcoustics. They should be higly skilled in applied mathematics. An experience in the field of Uncertainty Quantification and/or Data Assimilation would be greatly appreciated.

Contact & informations

Location: M2P2 Laboratory, Marseille, France

Duration: 12 - 24 months

Net monthly salary: 1960€ (< 3 years after PhD) or 2300€ (>3 years after PhD)

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