Dear all,

Dr. Camilo Silva from TU Munich will be visiting us between the 10th and 16th of September. On Wednesday 12th at 3pm he will give a talk in the AlteBib in the HF building, about methods for uncertainty quantification, title and description are below. Although Camilo's work applies to thermoacoustics, the methods themselves are very general and widely applicable to any other physical system.

Generalized Chaos Expansion: application to uncertainty quantification in thermoacoustic systems

Uncertainty Quantification (UQ) is mandatory for the robust conception of reliable stable combustors, where the safety margins are established by design. In this work, a novel UQ method in thermoacoustics is presented. This approach, known as generalized Chaos Expansion (gCE), has been widely developed by mathematicians for the last two decades. The intrusive perspective of this method, which is the one investigated in the present work, consists in expanding deterministic variables into stochastic ones. If applied to Partial Differential Equations (PDEs), this method postulates an extended system of PDEs, where the unknowns are (steady or unsteady) fields that are associated with probability density functions of all quantities considered as stochastic in the problem. The intrusive gCE (igCE) method has not been exploited at all in Computational Fluid Dynamics (CFD) of realistic systems in engineering. So far, this approach has been mainly used by mathematicians to study complex PDEs in one or two-dimensional Cartesian domains.

The present work is one of the first steps towards the inclusion of igCE in engineering CFD. A system of one-dimensional PDEs is decomposed in several subsystems and later integrated into a state-space model. Subsequently, the igCE method is applied to this state-space model so that a Stochastic State Space (SSS) model is obtained. Two variants of the problem are found: (a) an extended system of equations that describe the uncertainty propagation of flame dynamics and acoustic boundary uncertainties to uncertainties of the acoustic pressure fluctuations, (b) a multi-parameter eigenvalue problem that provides probability density functions of the growth rate. Note that the two variants (a and b) need only one solution of one system of equations, and, consequently, no sample techniques are needed. The proposed method has shown to be promising since a low computational cost is required and a large amount of information obtained: probability density functions of all quantities of interest at every node of the computational domain.

Hope to see you there!

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