Recent Developments in Stabilization of Gas Flow Under Uncertainty

Abstract:

Boundary stabilization has been studied intensively in the past years. Most results are based on the assumption that model parameters are known exactly. In practice, there are uncertainties that have to be taken into account. For instance, model parameters are uncertain due to noisy measurements. Moreover, epistemic uncertainties arise, since the speed of sound and the friction factor are usually not constant in a pipe, when the pressure decreases. When the underlying model is not known exactly, but is given by a probability law or by statistical moments, the deterministic stabilization concept are extended to the stochastic case. Here, we study the impact of uncertain propagation speeds and friction factors. We represent stochastic perturbations by series of piecewise orthogonal polynomials. This talk introduces a Lyapunov stability analysis for the system of gPC coefficients. The presented approach allows to model random parameters as Gaussian random fields, which are described by their mean and covariance structure. Then, the gPC expansion coincides with the Karhunen–Loeve expansion. However, the orthogonal basis is determined by the correlation of the process such that it is optimal in the sense that it minimizes the total mean squared error.