Data-based sparse polynomial chaos expansions: applications in dynamics and machine learning

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Abstract

The links between uncertainty quantification and classical machine learning (ML) have tightened in the past few years. On the one hand, uncertainty propagation techniques are nowadays mainly based on the use of *surrogate models* such as polynomial chaos expansions (PCE), Gaussian processes or low-rank tensor representations that are constructed in a non-intrusive manner using a batch of computer experiments and dedicated algorithms. On the other hand, in the context of supervised learning, artificial intelligence algorithms are used to build predictive models from input/output data sets.

In this talk we will emphasize the links between the two fields, and present more specifically recent developments on sparse polynomial chaos expansions that allow one to handle problems with functional output quantities (e.g. trajectories of a dynamical system).

As a second application, sparse PCEs will be used in a purely data-driven approach to handle benchmark data sets that are commonly used in the machine learning community. It is shown that sparse PCEs give as good as, or even better results than the (ad-hoc tuned) ML ones presented in the literature.