ABSTRACT

Eliška Janouchová
Department of Mechanics, Faculty of Civil Engineering, CTU in Prague

My research activity is centered on efficient methods for stochastic modelling. With respect to my branch of study I deal with applying these methods for numerical models of constructions and materials to evaluate the structural reliability requiring to take account all the relevant uncertainties. In particular, I focused on quantification of uncertainties in model response as well as in model input parameters whose accuracy can increase on the basis of information from experimental measurements.

In order to accelerate probabilistic calculations is appropriate to create a surrogate model replacing the time-consuming full numerical model. Specifically, I concentrate on polynomial chaos expansion used for approximation of the model response in the stochastic space. In my diploma thesis, which I defended in January this year, I compared different methods for construction of this surrogate model in terms of the computational requirements and its resulting accuracy. Surrogate models are closely associated with the selection of a set of simulations used for their construction. Set of the simulation input parameters is called design of experiments, particular samples are points in the design space of a dimension equal to the number of parameters. There are several different methods for generating the appropriate positions of design points according to the specific purpose. In my bachelor's thesis I focused on available optimisation criteria determining the design of experiments suitable for sampling-based sensitivity analysis. According to sensitivity the insignificant parameters can be excluded resulting in reduction of the design space and the difficulty of the problem. Global sensitivity analysis represents a principal tool for investigating properties of complex systems which is an essential part of inverse procedures and uncertainty analysis. These results of my work were published in the international journal *Computers & Structures*

The referred numerical tools enable uncertainty propagation through complex models. The methods and approaches are highly topical because thanks to the growth of powerful computing resources and technology, recently developed procedures in the field of stochastic mechanics have become applicable to realistic engineering systems. Parameter identification is done via Bayesian approach which allows to process data considering measurement errors. In this inverse procedure the initial uncertainty in the parameters is reduced by the experimental data. Sensitivity analysis provides the appropriate experimental data for the identification process.

At present I am dealing with reformulation of the identification method for use in heterogeneous materials. In this case the probabilistic description of the parameters does not reflect the uncertainty in their values, as it is in the classical Bayesian approach, but the actual probability distribution of the parameters in these materials. The developed method will be applied to assess the reliability and determine the durability of the rocket thrust chamber. I am solving this task with our team with the cooperation of Airbus Defense and Space in the framework of a commercial project RALP (Reliability Analysis and Life Prediction with Probabilistic Methods) which is a part of the Future Launchers Preparatory Programme (FLPP) of the European Space Agency (ESA).