2nd International Conference on Multi-scale Computational Methods for Solids and Fluids

June 10-12, 2015
Sarajevo, Bosnia and Herzegovina

MINISYMPOSIUM

Title:
Interacting with uncertain and complex mechanical systems.

Description:
Mechanical systems for which dramatically uncertain evolution is experimentally or numerically observed make investigators foster a sense of inherent complexity in the analyzed system. Significant uncertainty can for instance arise from high sensitivity of the system to initial or boundary conditions or geometrical parameters, small-scale aleatoric fluctuations, uncontrolled modeling errors, or numerous intertwined mechanisms that underlie the overall system response.
Interacting with complex mechanical systems calls for a multidisciplinary/multilevel approach. For instance, multi-scale computational techniques that grasp key mechanisms at the relevant scale need to be mingled with stochastic methods accounting for uncertainties. Besides, nonlinearity, whether due to heterogeneity, turbulence, structure kinematics, or continuum constitutive behavior, is a signature of complexity. Therefore, computational developments in the framework of nonlinear dynamics appear as meaningful to describe the system evolution.
Also, when the goal is to quantify the level of uncertainty in the system, the complexity often emerges from the numerics themselves since the governing equations are now defined in (much) higher dimensional spaces, composed of both the physical space and the space accounting for the representation of the uncertainty (the random space). In this case, the computational effort needs to be kept under control thanks to the development of stochastic model reductions. Finally, stochastic inverse approaches are useful for seeking possible underlying – possibly large-scale – related and correlated mechanisms somehow hidden in system responses initially qualified as complex.
This minisymposium addresses the issue of developing computational models for interacting with such complex systems, that are models either capable of predicting the system response without sacrificing important features of its complexity, or allowing for a better characterization of this complexity. There is no restriction concerning the range of applications (civil engineering, geosciences, material science, computational fluid dynamics, oceanography, climate…): complexity will be regarded as a unifying concept that should elicit interdisciplinary discussions oriented toward tackling common issues raised by interacting with complex mechanical systems.

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