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UNCERTAINTY MODELING AND QUANTIFICATION IN COMPUTATIONAL MECHANICS

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ABSTRACT

The rational treatment of uncertainties in computational mechanics receives particularly in recent years increasing attention. Loading and boundary conditions, material properties, geometry and various other parameters show in some cases considerable variations at macro-scale or at micro-scale and more generally, for multi-scale analysis in a multi-physics context. Observations and measurements of physical processes as well as parameters at different scales clearly show their random characteristics. Hence statistical and probabilistic procedures provide a sound framework for a rational basis for processing these uncertainties. In addition to parameter uncertainties, model uncertainties play also a focal role in modern computational mechanics in particular for multi-scale models. In reality neither the true model nor the model parameters are deterministically known. It is for these uncertainties that the assumption that an ever finer discretization at a different scales leads consequently to an increase in accuracy is a myth. In this context the aspects of model validation and verification respectively are also addressed.

In this Mini Symposium, conceptual aspects, uncertainties modeling in computational mechanics and computational aspects of uncertainty processing and assessment will be discussed. Contributions that highlight the interplay between experimental evidence and model-based prediction will also be considered. It is for the highly developed computational means that the traditional intuitive treatment of uncertainties may be placed already in the not too distant future by this rational approach. All the application domains of the computational mechanics are concerned by this mini-symposium: solid and structural mechanics, materials science, fluid mechanics, biomechanics, engineering sciences, etc. Although emphasis will be placed on contributions that are adapted to characterizing and quantifying the predictability of uncertain complex systems, the development of reduced-order models in computational mechanics for particular quantities of interest are also encouraged.