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ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems

Call For Papers:

ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems:
Part B. Mechanical Engineering

Non-probabilistic and hybrid approaches for uncertainty quantification and reliability analysis (SI 042B)

Background: Computational models have played a crucial role in the transition of a traditional experiment-centered engineering practice towards a virtual design context where the performance of designed components is assessed long before the first prototype is built. Recent advances in numerical approaches enable in this context the application of hyper-resolution, high-fidelity and first principle-based computer simulations which provide an analyst with a plethora of information on the design at hand. However, in most realistic engineering cases, the designer is faced with a multitude of sources of uncertainty on both the actual model form (i.e., the equations that have to be solved) as on the physical quantities that are used to parametrize these models. Such uncertainty stems either from the apparently pure random nature of some physical quantities (e.g., earthquake or wind loadings on a structure or the mechanical behavior of complex materials such as soil or parts produced with Additive Manufacturing), incomplete knowledge on the actual value of these quantities (e.g., stemming from incomplete or too scarce data or future design decisions that yet have to be made), or a combination of both. When uncertainty stemming from incomplete knowledge is involved in the design process, non-probabilistic and hybrid (also referred to as polymorphic) approaches are gaining momentum for the assessment of the (bounds on the) reliability of designed structures and components, and the quantification of the underlying model response uncertainty. In this context, powerful techniques based on e.g., the framework of interval or fuzzy calculus, p-box formulations, information theory, Dempster-Shafer belief functions or game theoretical foundations have been introduced in the last two decades. However, their application towards realistic engineering applications requires further developments both on a theoretical as well as a numerical/algorithmic level.

Scope: This special issue is aimed at gathering contributions that discuss new theoretical developments and advanced applications of non-probabilistic and hybrid approaches towards uncertainty quantification and reliability analysis. More specifically, papers discussing theoretical developments in the framework of non-probabilistic, hybrid or polymorphic uncertainty and efficient numerical or (semi-)analytical propagation schemes for forward and inverse analysis with such uncertainty models are of particular interest for this special issue. In view of assisting the translation of these novel methods towards application, also papers that apply these methods to challenging and realistic engineering cases in general are welcomed, especially if the non-probabilistic or hybrid models for the uncertainty are based on real data.

Indicative Topics:
- New theoretical developments in the modelling of, and simulation with non-probabilistic or hybrid representations of uncertainty such as intervals, fuzzy sets, set-valued approaches, interval probabilities, credal sets, Dempster-Shafer belief functions, interval fields or imprecise random fields.
- Efficient propagation schemes for such notn-probabilistic or hybrid representations, including new algorithmic developments, surrogate models, model order reduction or low-rank representations.

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