Numerical simulations with polymorphic uncertain data

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ABSTRACT

Numerical simulations (analysis and design) of structures or systems are currently often characterised by deterministic methods. Deterministic modelling of the reality indicates preciseness and safety, while, on contrary all available data and information are characterized by various types of uncertainty (variability, imprecision, incompleteness), which cannot be neglected.

The main focus is the presentation of methods for the numerical simulation of structures under consideration of polymorphic data uncertainty. With the help of the mini-symposium, the opportunities of inter- and transdisciplinary shall be used for the generation of synergies between mathematics and engineering sciences.

Engineering solutions are characterized by inherent robustness and flexibility as essential features for a faultless life of structures and systems under uncertain and changing conditions. An implementation of these features in a structure or system requires a comprehensive consideration of uncertainty in the model parameters and environmental and man imposed loads as well as other types of intrinsic and epistemic uncertainties. Numerical design of structures should be robust with respect to (spatial and time dependent) uncertainties inherently present in resistance of materials, boundary conditions etc. This requires in turn the availability of a reliable numerical analysis, assessment and prediction of the lifecycle of a structure taking explicitly into account the effect of the unavoidable uncertainties.

Challenges in this context involve, for example, limited information, human factors, subjectivity and experience, linguistic assessments, imprecise measurements, dubious information, unclear physics etc. Due to the polymorphic nature and characteristic of the available information both probabilistic and set-theoretical approaches as well as newly developed joint approaches are relevant for solutions.

This mini-symposium aims at bringing together researchers, academics and practicing engineers concerned with the various forms of advanced engineering designs. Recent developments of numerical methods in the field of engineering design which include a comprehensive consideration of uncertainty and associated efficient analysis techniques, such as advanced Monte Carlo simulation, meta-model approximations, and High Performance Computing strategies are explicitly invited. These may involve imprecise probabilities, interval methods, Fuzzy methods, and further concepts.

Furthermore, methods for interacting and interdependent uncertain variables as well as uncertainty models for spatial and temporal dependent quantities are addressed. The contributions may address specific technical or mathematical details, conceptual developments and solution strategies, individual solutions, and may also provide overviews and comparative studies.

Particular attention should be paid to practical applicability in engineering. Besides the applications of the involved engineering sciences, "real world" scenarios should be presented.