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MINI-SYMPOSIUM

EPISTEMIC UNCERTAINTIES IN ENGINEERING – MODELLING, METHODS AND APPLICATIONS

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ABSTRACT

Uncertainties are pervasive in engineering practice due to inherent variability and lack of knowledge. Realistically quantifying uncertainties in analysis and design of engineering systems is crucial. Probabilistic methods have been developed extensively for this purpose and have led to great achievements. Significant research is increasingly devoted to problematic cases, which involve, for example, limited information, human factors, subjectivity and experience, linguistic assessments, imprecise measurements, dubious information, unclear physics, etc. In this context, two pathways have been proposed to account for epistemic uncertainties. First, subjective probabilities are utilized to quantify expert knowledge on an intuitive basis in form of a belief. The most popular implementation of subjective probabilities in engineering is observed in Bayesian approaches. Second, alternative concepts have attracted considerable attention, ranging from imprecise probabilities to interval and fuzzy methods. Imprecise probabilities are most suitable when we have partial information about probabilities, interval methods are most suitable when we only know bounds, fuzzy methods are appropriate when we have expert knowledge formulated in terms of imprecise ("fuzzy") words from natural language. The usefulness of all these concepts has been demonstrated in practical applications. Quantification concepts and numerical methods for processing subjective probabilities as well as fuzzy sets and intervals in engineering analyses have already reached remarkable capabilities.

This mini-symposium aims to bundle and disseminate the latest developments of handling epistemic uncertainties in engineering. Contributions are invited with emphasis on theory, numerical methods and applications of both the non-probabilistic framework and subjective probabilities. These may address specific technical or mathematical details, conceptual developments and solution strategies, individual solutions, and may also provide overviews and comparative studies. Topics may include modelling, quantification, analysis, design, decision-making, monitoring and control in broad engineering areas.