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Data-driven and physical-informed methods for structural reliability assessment and design under deep uncertainties

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ABSTRACT

Coping with uncertainty becomes a necessity in almost all practical situations in structural design. In fact, uncertainty appears on the characterization of loadings, material properties, deterioration processes, etc., and may severely affect structural behaviour. Sources of uncertainty may be classified as aleatoric (that is, randomness) or epistemic, due to lack of knowledge or imprecise information. This problem has generated significant developments on generalized approaches for uncertainty quantification with the key question of how to model these deep uncertainties, encompassing randomness and imprecision simultaneously. In many practical cases only ranges or bounds are available for some parameters so that set-theoretical descriptors provide an appropriate model. In combination with probabilistic information, this leads to imprecise probabilities. Nonetheless, practical applications of imprecise probability approaches remain challenging, as they entail considerable additional efforts when compared to their deterministic, semi-probabilistic or probabilistic counterparts. Therefore, this mini-symposium aims at bundling the most recent developments in imprecise probabilities and their application to structural design, including (but not limited to): different variants of imprecise probability analysis, such as interval probabilities, p-box approach, evidence theory, fuzzy probabilities and so forth; numerical approaches for forward and inverse uncertainty quantification; determination of probability bounds, data-driven and grey-box techniques, etc.