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Efficient numerical methods to deal with imprecise probabilities

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Abstract
Uncertainties are commonly encountered in the context of structural dynamics and in complex systems. Due to the sheer complexity of the underlying physics, the corresponding dynamical loads that act on the system often cannot be described in a crisp way. Stochastic processes provide a rigorous framework to deal with the uncertainties and space/time correlations of uncertain loads by resorting to the well-documented framework of probability theory. However, in practice, the analyst is often confronted with limited, incomplete or conflicting sources of data (i.e., epistemic uncertainty). In this case, the application of a probabilistic framework to take this additional level of uncertainty into account is questionable since in this case, there is simply not enough information to construct an objective probabilistic uncertainty model. In this research seminar, I will talk about how to deal with this challenging problem of modelling uncertainties in space and/or time under limited data. More precisely, I will show how to define and model imprecise stochastic processes that are robust with respect to missing and/or conflicting data, as well as present some efficient methodologies to effectively propagate these processes through numerical simulation models.

About the Speaker
Matthias Faes is a full Professor in Reliability Engineering at TU Dortmund. Before, he was working at the Department of Mechanical Engineering of KU Leuven, and was also affiliated to the Institute for Risk and Reliability at the University of Hannover as Humboldt Fellow. He graduated summa cum laude as Master of Science in Engineering Technology in 2013 and obtained his PhD in Engineering Technology from KU Leuven in 2017. He is a Laureate of the 2017 PhD award of the Belgian National Committee for Applied and Theoretical Mechanics, the 2023 EASD Junior Research Prize, among other awards. He is editor at Mechanical Systems and Signal Processing and Associate Managing Editor of the ASCE-ASME Journal of Risk and Uncertainty in Engineering System parts A and B, among other journals. Matthias Faes is author of more than 70 journal papers and more than 60 conference contributions and he has a Google Scholar H-index of 23 (1900+ citations) since 2016.

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