

Analyzing Uncertainty in Civil Engineering

M. Oberguggenberger

Institute of Basic Sciences in Engineering Science, University of Innsbruck,
6020 Innsbruck, Austria, michael.oberguggenberger@uibk.ac.at

Keywords: *Uncertainty Modeling; Foundational Issues; Random Sets as Unifying Concept.*

Abstract

This talk is meant as a survey of uncertainty analysis in civil engineering with an emphasis on one of the unifying models: random sets. After a brief historical note about probability in civil engineering, various fundamental questions are addressed:

- sources of uncertainty in engineering;
- measuring uncertainty: models and axioms;
- semantics: from the real world to the model and back;
- aggregation and propagation of uncertainty;
- classification of models.

In this general discussion, a wide range of models will be incorporated: interval analysis, set-valued models, fuzzy sets, probability, imprecise probability, random sets, sets of probability measures, and more.

The second part of the talk will provide a glimpse of the theory of random sets. This theory is of intermediate generality, but it allows one to treat intervals, bounding sets, probability distributions and imprecise probability distributions on the same footing. Special emphasis will be put on correlation modelling and imprecise random fields as well as sensitivity analysis in this setting.

Related survey papers are Beer, Ferson and Kreinovich (2013) and Oberguggenberger (2011). Oberguggenberger (2014) specifically addresses random sets, while Oberguggenberger (2015) is about imprecise random fields.

References

- Beer, M., S. Ferson, and V. Kreinovich. Imprecise probabilities in engineering analyses. *Mechanical Systems and Signal Processing*, 37:4–29, 2013.
- Oberguggenberger, M. Combined methods in nondeterministic mechanics. In I. Elishakoff and C. Soize, editors, *Nondeterministic Mechanics*, pages 263 – 356. Springer-Verlag, CISM International Centre for Mechanical Sciences, Vol. 539, Wien, 2012.
- Oberguggenberger, M. Engineering. In T. Augustin, F. Coolen, G. de Cooman and M. Troffaes, editors, *Introduction to Imprecise Probabilities*, pages 291 – 304. John Wiley & Sons Ltd, Chichester, 2014.
- Oberguggenberger, M. Analysis and computation with hybrid random set stochastic models. *Structural Safety*, 52:233–243, 2015.