Modelling Uncertainties in Limit State Functions, Approaches Using Sets of Probability Measures

Th. Fetz

Unit for Engineering Mathematics,
University of Innsbruck, 6020 Innsbruck, Austria,
Thomas.Fetz@uibk.ac.at

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Abstract

In Fetz (2011) limit state functions $g_z(x)$ parameterized by variables z and depending on basic variables x (material properties, loads, etc.) are used to deal with model uncertainty. The uncertainty of x and z are described in a first step by parameterized probability density functions f_a^X and f_b^Z. In a second step the parameters a and b are assumed to be uncertain too. Using sets or random sets to model their uncertainty leads to sets of probability measures for x and z, see Fetz (2007), and results in upper probabilities $\overline{p}_f$ of failure.

While in Fetz (2011) it is focused on the parameterization of the limit state function by additional variables z we will discuss here alternative approaches. In one approach we will directly model the uncertain output y of a limit state function by parameterized density functions f_c^Y with uncertain parameters c. In a second approach we will start with an imprecise failure region described by a function $q : \mathcal{X} \to [0, 1]$ of the basic variables $x \in \mathcal{X}$ as arising in Fetz (2011) or by a fuzzy failure region, cf. Möller and Beer (2004). In both cases the uncertainty of the basic variables x is again specified by density functions f_a^X using sets or random sets for the parameters a. Further we will show that these alternative approaches are more flexible in certain cases, give computational formulas and present a simple engineering problem to exemplify the different methods.

References

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