STATIK DYNAMIK

RUB

EFFICIENT AND ROBUST OPTIMIZATION APPROACHES FOR STRUCTURAL DESIGN UNDER CONSIDERATION OF UNCERTAINTIES

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As part of the design process of engineering structures, the load-bearing capacity and serviceability are generally verified using the semi-probabilistic safety concept. Besides, the current guidelines also allow the use of probabilistic safety concepts. The failure probability in the load-bearing capacity and serviceability limit states is determined and compared with an accepted failure probability. Uncertain structural parameters are quantified using stochastic models and in addition, in this work, epistemic uncertain parameters are also considered by intervals.

During the design process, optimization-based numerical methods can be used to determine the most efficient structures in terms of used material and durability. By combining optimization algorithms and probabilistic safety concepts, the aleatory and epistemic uncertainties are analyzed in several sequential sub loops within the global optimization loop. This leads to a high computational effort and to numerical errors.

The focus of this thesis is on the development of efficient and robust methods for combining numerical optimization methods and probabilistic safety concepts. The particle swarm optimization is combined with surrogate model approaches in order to reduce the computational effort. To reduce the numerical errors, the global optimization loop and the sequential sub loops for analyzing the uncertainty are merged. The efficiency and robustness of the developed methods are verified and analyzed by analytical problem-specific benchmark functions and by optimizing a wooden bridge structure under consideration of uncertainties.

The results show that, on the one hand, the occurring numerical errors are within an acceptable tolerance range and, on the other hand, the computational effort is drastically reduced.

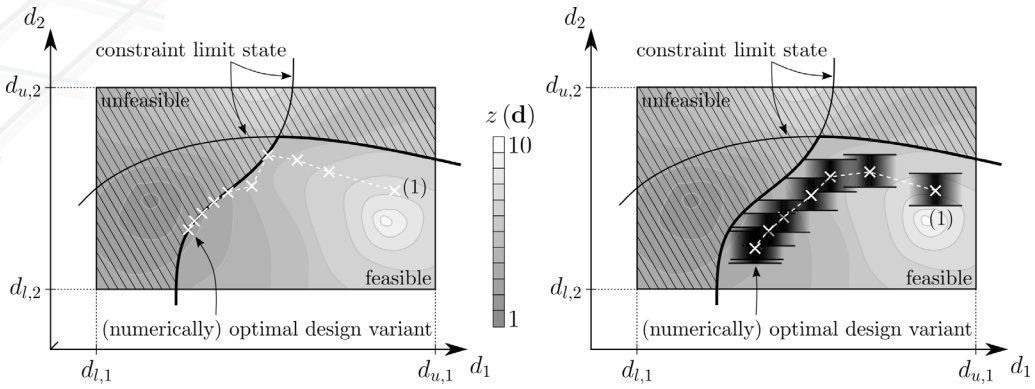

Fig.: Optimization-based structural design process considering deterministic design parameters (left) and considering one aleatory uncertain design parameter and one epistemic uncertain design parameter (right).

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