



Technische
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Modelle für die Beschreibung der Zustandsänderung bei Alterung von Baustoffen

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Probabilistic Computational Mechanics and Uncertainty Quantification: Rare event simulation and surrogate models

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Intuitively, in science and engineering computational simulations of physical systems are used to help predict and plan for the future. Uncertainty Quantification methods can be used to facilitate engineering reasoning by incorporating probability into simulation models. Probabilistic simulation of physical systems modelled by, for example, Partial Differential Equations present substantial computational difficulties. In particular, sampling based probabilistic methods are challenging when each sample is computationally expensive to generate. This discussion suggests directions for practical numerical techniques.

These abstract considerations are explored via an example. Specifically, a sampling based rare event reliability estimation problem from Civil Engineering is analysed via a probabilistic nonlinear finite element approach. Details of Subset Simulation for rare event Uncertainty Quantification and Markov Chain Monte Carlo in combination with nonlinear finite elements are detailed.

Further, it is demonstrated that Deep Learning can be used to enhance sampling based Uncertainty Quantification of physical systems. Examples are used to show that surrogate models of nonlinear and time dependent finite element problems can be learnt by Artificial Neural Networks. These surrogate models can be used to enhance the efficiency of Monte Carlo Simulation for Uncertainty Quantification for probabilistic Partial Differential Equations.

Kontakt

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