Technische Universität Braunschweig

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Modelle für die Beschreibung der Zustandsänderung bei Alterung von Baustoffen

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Deep networks in uncertainty quantification

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Mühlenpfordtstrasse 23, 8. OG, Raum 812

Recently, it has become feasible to use deep artificial neural networks to solve complicated optimisation problems. The power of these deep networks reaches across several areas of study as they are able to learn functions which encode hierarchical abstractions parametrically. This talk explores the theory and application of deep artificial neural networks and machine learning for Partial Difierential Equation (PDE) uncertainty quantification.
First, the deep network model is demonstrated using a surrogate model example. Specifically, it is demonstrated that deep network techniques can be used to improve the efficiency of Monte Carlo methods for PDE uncertainty quantification by learning to interpolate between known values of a PDE solver function. Deep networks can also be used to enhance parametric statistical modelling methods. Probabilistic numerics frames equation solving as an inference problem.
Following this framework, it is shown that the Expectation-Maximisation algorithm can used to derive an adaptive basis Element Free Galerkin method. Deep networks can be used to find efficient representations of PDE basis functions that can also be tuned to improve their accuracy.
Finally, Variational Bayesian Inference for probabilistic PDE problems are briefly discussed. Distributions representing the outputs from Stochastic PDE problems could benefit from deep network representations. By exploring the intersection of artificial neural networks, numerical methods and statistics it will be possible to improve computational PDE methods for uncertainty quantification in the future.

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