Bayesian Estimation of Material Properties in Case of Correlated and Insufficient Data
Master of Science Thesis Defense

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Abstract

Identification of material properties has been highly discussed in recent times thanks to a better technology availability and its application to the field of experimental mechanics. Bayesian approaches as Markov-chain Monte Carlo (MCMC) methods demonstrated to be reliable and suitable tools to process data, describing probability distributions and uncertainty bounds for investigated parameters in absence of explicit inverse analytical expressions.

Though it is necessary to repeat experiments multiple times for good estimations, this might be not always feasible due to possible incurring limitations: the thesis addresses the problem of material properties estimation in presence of correlated and insufficient data, resulting in multivariate error modeling and high sample covariance matrix instability.

To recover from the lack of information about the true covariance we analyze two different methodologies: first the hierarchical covariance modeling is investigated, then a method based on covariance shrinkage is proposed. A numerical study comparing both approaches and employing finite element analysis within MCMC iterations will be presented, showing how the method based on covariance shrinkage is more suitable to post-process data for the range of problems under investigation.

Matteo Giugno is an MS candidate in the Aerospace Engineering Department working under the supervision of Professor Theofanis Strouboulis. His research interests are in the areas of computational mechanics, structural analysis and uncertainty quantification. He will join the Materials & Processes Division at Airbus in Toulouse (France).