English translation of the task sheet

- Master's thesis for Lucas Hermann
- Enrolment number: 4990987
- Field: Computational Acoustics
- Topic: A Statistical Approach for the Fusion of Data and Finite Element Analysis in Vibroacoustics

Because of the increasing availability of sensor data, the data-driven simulation has become an important field of research. The description of data is often done using methods of probability theory, which raises special questions in the context of the Finite Element Method. With the goal of developing a simple and general statistical Finite Element Method, recently an approach based on Gaussian Process Regression was introduced (https://arxiv.org/pdf/1905.06391.pdf). In this framework, the Finite Element solution is conditioned on locally distributed data, simultaneously a quantification of uncertainty is enabled. Based on this approach, first steps with the goal of a statistical Finite Element Method for vibroacoustic models shall be attempted.

During processing of the task, especially the following points shall be considered:

1. Familiarization, especially with Gaussian Process Regression.
2. Implementing and understanding the 1D-static example from the above mentioned preprint.
3. Enhancement of the method for an acoustical tube model (at single frequency points)
   a) Implementation of the 1D Helmholtz equation
   b) First Order Second Moment analysis
   c) Conditioning with Gaussian Processes and synthetic data
4. Conditioning with real measurement data
   a) Determination and modeling of the measurement deviations
   b) Application of the methodology and discussion of the results regarding the physical context
5. Optional: Enhancement of the method to approach frequency responses
6. Documentation of the thesis

- First examiner: Prof. Dr.-Ing. Sabine C. Langer
- Second examiner: Prof. Dr.-Ing. Ulrich Römer
- Working time: 6 months
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