Institute of
Flight System Dynamics

Technische Universität München

Master Thesis

Error Quantification in Surrogate-Accelerated Subset Simulation

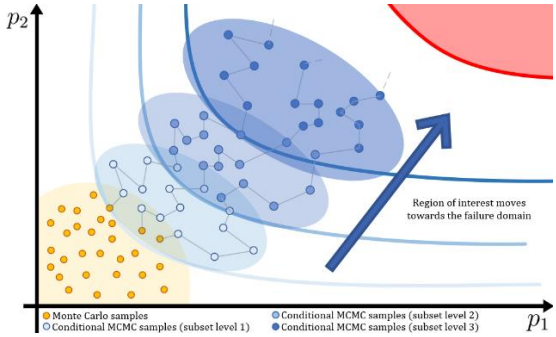

Figure 1: Illustration of the Subset Simulation Algorithm in two dimensions.

Description:

At FSD, we develop a Subset Simulation (SuS) algorithm for use in all of our flight control law (FCL) design projects. The idea is to quantify the (usually remote) failure probability of a requirement in the face of many uncertain parameters. The toolbox can with all public features can be found here.

Internally, we work with an additional unpublished feature: the use of surrogate models. The idea is simple: We try to use surrogate models as a computationally cheap proxy to the (computationally costly) true model. As a result, we can accelerate SuS significantly! However, these models evidently introduce small quantification errors, that will result in classification errors in each subset level of SuS. So far, we use adaptive learning strategies to minimize this error, but we still need to quantify upper bounds for the surrogate errors.

If we can prove the limits hold, we can use surrogate-accelerated SuS for testing and validation. At the very least, this advance would warrant a paper at an aerospace conference! (with you among the Co-Authors)

We are looking for a capable Masters student, who is interested in joining this active research!

Work Packages:

- Literature research (subset simulation, surrogate modelling, error quantification/propagation)
- Familiarization with (surrogate-accelerated) subset simulation
- Active participation in the development and implementation of an error quantification method
- Demonstration of the method on multiple numeric examples

Prerequisites:

- Being familiar with MATLAB (ideally, previous work experience)
- Sound knowledge in uncertainty quantification & probability theory
  (or at least willingness to dive deep into these topics)

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