Semester Project / Master’s Thesis

Map Failure Domain in Sample Space within Subset Simulation

Motivation

The flight safety team at the Institute of Flight System Dynamics uses subset simulation based on Metropolis Chain Monte Carlo (MCMC) sampling to quantify low-probability events in airline operations. For instance, we can estimate the probability for a runway overrun event (RO) based on the uncertain distribution of common aircraft parameters at touchdown like speed, altitude, position, etc. Together with a physical model that simulates the aircraft breaking behaviour, those uncertain parameters (sample domain) propagate through the sample-based algorithm into an uncertain indicator, whether the runway is exceeded or not (failure domain).

Currently, the subset simulation tool will find one (virtual) parameter sample and its probability that would result in an accident. The idea for this thesis is to extend the current algorithm, so that once a sample in the failure domain is found, it continues to explore the boundary of the failure domain fully, so that a surrogate model for the global failure domain in sample space can be derived, e.g. a support vector machine, or a model that fits even better.

Fields of Activity

- WP1 Getting started with subset simulation and the runway overrun use case
- WP2 Formulate the sampling problem to map out the failure domain
- WP3 Implement the sampling method from WP2 on a test problem
- WP4 Integrate WP3 in the subset simulation code
- WP5 Apply to the RO case and discuss findings

Requirements

- Prior coding experience with Matlab
- Understanding of aircraft behaviour and control
- Basic statistical knowledge
- Self-organized and independent

Contact

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