HISTORY MATCHING USING SUBSET SIMULATION

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The prediction ability of complex computer models (also known as simulators) relies on how well they are calibrated to experimental data. History Matching (HM) is a form of model calibration for computationally expensive numerical models. It sequentially cuts down the input space to find the non-implausible domain that provides a reasonable match between the output and experimental data. A considerable number of simulator runs is required. Hence, HM involves Bayesian emulation to reduce the cost of the original model. Despite this, the generation of samples from the reduced domain at every iteration has remained an open and complex problem: current research has shown that the non-implausible domain can be orders of magnitude smaller than the original input space. Analogously to a failure set in the context of engineering reliability analysis, this work proposes to use Subset Simulation—a widely used technique in engineering reliability computations and rare event simulation—to generate samples on the reduced domain.

Unlike Direct Monte Carlo, Subset Simulation progressively decomposes rare events, which have very small failure probabilities, into sequential less rare nested events. The original Subset Simulation uses a Modified Metropolis algorithm to generate the conditional samples that belong to intermediate less rare failure events. This PhD work also considers different Markov Chain Monte Carlo strategies and compares their performance in the context of expensive model calibration. Numerical examples are provided to show the potential of the embedded Subset Simulation sampling schemes for HM.

SPEAKER BIO: ZITONG GONG

Zitong Gong is a final year PhD. student at the Institute for Risk and Uncertainty, working under supervision of Dr. Francisco Alejandro Diaz De La O and Prof. Michael Beer. The topic of her research is the development of the inner structure of history matching, which is a model calibration strategy suitable for high-dimensional and computationally expensive computer models. She graduated in 2014 as Master of Engineering in Structural Engineering and is since then a full-time PhD. student at Institute for Risk and Uncertainty, University of Liverpool.