CWI-Inria
INTERNATIONAL LAB

CWI

Inria
inventeurs du monde numérique

Workshop 2019
September 17-18, 2019, Amsterdam

Nassim RAZAALY **(Inria - DEFI Team)**
COMMUNES Associate team

Title: « An efficient Reliability Analysis tool, for the computation of Low Tail Probabilities and extreme quantiles characterized by Multiple Failure Regions »

Abstract:

Calculation of tail probabilities and small quantiles is of fundamental importance in several domains, such as for example risk assessment or optimization. One major challenge consists in their computation when characterized by multiple-failure regions and rare event, say an occurrence probability smaller than 1e-7.

Here, we focus on cases where the function of interest is the output of an computationally expensive code such as CFD or structural analysis.

We propose a novel algorithm permitting to build an accurate Kriging metamodel, and exploit it using Importance Sampling techniques in order to estimate the required statistics (either quantile or tail probability). In fact, it relies on a novel metamodel building strategy, which aims to refine the limit-state region in all the branches ”equally”, even in the case of multiple failure regions, with a robust stopping building criterion.

Due to Kriging limitations, the method is suitable for low stochastic dimension (say less than 10).

This refinement step is formulated in such a way that the computation of both small probabilities of failure and extreme quantiles is unified. Parallel strategies are proposed.

Several numerical examples are carried out, showing the very good performances of the proposed method with respect to the state-of-the-art in terms of accuracy and computational cost, namely the number of calls of the original function of interest.