Robustness analysis in uncertainty propagation of numerical models

Bertrand Iooss*[1]

[1]EDF lab – EDF Recherche et Développement – France

Abstract

In nuclear accident management analysis, best-estimate computer codes are increasingly used to estimate safety margins instead of conservative procedures. In this context, it is essential to evaluate the accuracy of the numerical model results, whose uncertainties come mainly from the lack of knowledge of the underlying physics and the model input parameters. One of the most critical hypothesis in such uncertainty propagation studies is the choice of the distributions of uncertain input variables which are propagated through a computational model. In general, such probability distributions come from various sources (statistical inference, design or operation rules, expert judgment, etc). In all cases, the probabilistic models for these variables are established with a certain level of accuracy or confidence. Hence, bringing stringent justifications to the overall approach requires quantifying the impact of the assumptions made on the input laws on the output criterion.

In this talk, we will focus on Perturbed Law based Indices (PLI) which allow to perform such a robustness analysis, different from the standard sensitivity analysis methods. The principle is to assess the influence of a perturbation on a parameter of the input distribution, on some output quantity, such as a quantile of a safety margin.
This method will be illustrated in a nuclear engineering application which concerns the thermal-hydraulic responses of a test facility during a cold leg Intermediate Break Loss Of Coolant Accident (IBLOCA) modeled using the calculation code CATHARE2. In this study, uncertain inputs are various physical model parameters and the influence of their distributions on the 95%-quantile of the peak cladding temperature is the topic of interest.

*Speaker