

# Mutual information for global sensitivity analysis and adaptive-learning surrogate modelling

U. Alibrandi<sup>1)</sup>, L. V. Andersen<sup>2)</sup>, and E. Zio<sup>3)</sup>

<sup>1)</sup>Civil and Architectural Engineering, Aarhus University, Aarhus, Denmark, email: [ua@cae.au.dk](mailto:ua@cae.au.dk)

<sup>2)</sup>Civil and Architectural Engineering, Aarhus University, Aarhus, Denmark, email: [lva@cae.au.dk](mailto:lva@cae.au.dk)

<sup>3)</sup> Centre de Recherche sur les Risques et les Crises (CRC), MINES ParisTech / PSL  
Université Paris Sophia Antipolis, France;  
Energy Department, Politecnico di Milano, Via La Masa 34, Milano, 20156, Italy,  
email: [enrico.zio@polimi.it](mailto:enrico.zio@polimi.it)

**Keywords:** *Information theory, informational coefficient of correlation, global sensitivity Analysis, Active Learning, Kriging*

## Abstract

In this paper tools of information theory are applied for probabilistic sensitivity analysis and surrogate modelling with adaptive sampling. One of the authors has recently proposed the adoption of the informational coefficient of correlation as a measure of dependence between the random variables, instead of the largely adopted linear coefficient of correlation (Alibrandi and Mosalam 2020). First, it is shown that it can be used for probabilistic sensitivity analysis. Moreover, two novel learning functions for adaptive sampling () are proposed. The first, called *H*-function, gives rise to the method AK-H (Adaptive Kriging - Entropy), and it describes the epistemic uncertainty through the entropy. The second, called *MI*-function, gives rise to the method AL-MI (Active Learning - Mutual Information), which describes the model error through the Mutual Information. The second has the peculiarity that allows the implementation of adaptive learning in any kind of surrogate modelling, even different from Kriging. A simple numerical example shows the features and the potential of the proposed approach.

## References

- Alibrandi, U. and K. M. Mosalam. In: The informational coefficient of correlation as a measure of dependency. In: *29th European Safety and Reliability Conference 2020*
- Echard, B., N. Gayton and M. Lemaire. AK-MCS: an active learning reliability method combining Kriging and Monte Carlo simulation. *Struct Saf*, 33(2):145-154, 2011