HIERARCHICAL KRIGING FOR COMBINING MULTI-FIDELITY HYBRID AND COMPUTATIONAL SIMULATORS

G. ABBIATI[*], I. ABDALLAH[†], S. MARELLI[†], B. SUDRET[†]

AND B. STOJADINOVIC[*]

[*] Chair of Earthquake Engineering and Structural Dynamics, Institute of Structural Engineering (IBK), Department of Civil, Environmental and Geomatic Engineering (D-BAUG)
ETH Zürich, Switzerland
e-mail: abbiati@ibk.baug.ethz.ch, stojadinovic@ibk.baug.ethz.ch,
http://www.stojadinovic.ibk.ethz.ch/

[*] Chair of Risk, Safety and Uncertainty Quantification, Institute of Structural Engineering (IBK), Department of Civil, Environmental and Geomatic Engineering (D-BAUG)
ETH Zürich, Switzerland
e-mail: abdallah@ibk.baug.ethz.ch, marelli@ibk.baug.ethz.ch, sudret@ibk.baug.ethz.ch
http://www.sudret.ibk.ethz.ch/

ABSTRACT

Hybrid modelling enables predictive simulations by combining numerical and physical subdomains when a system subpart lacks of a validated model. The aim of the coupled simulation can be: i) generate benchmarks for the validation of physical subdomain models; ii) reproduce the response of the global emulated system that is supposed to be sensitive to the -unknown- physical subdomain behaviour. In the current practice, the coupled system is treated deterministically and information regarding uncertainty of numerical and physical subdomain parameters is ignored. However, hybrid systems suffer the same limitations of large finite element models, which make parametric studies unaffordable. In this context, metamodeling is an attractive solution strategy for casting and solving hybrid models into a probabilistic space with a reduced computational/experimental effort. The basic idea is perform a reduced number of hybrid simulations by sampling system parameters in the corresponding probability space and calculate a probabilistic metamodel based on measured responses. Along this line, Multi-Fidelity Modelling (MFM) based on Hierarchical Kriging (HK) metamodeling is proposed to fuse pure numerical and hybrid simulation outputs to optimize the balance between experimental and computational efforts [1]. Numerical examples are presented and discussed.

Key words: Hybrid simulation, multi-fidelity modelling, hierarchical Kriging.

REFERENCES

[1] Abdallah, I., Sudret, B., Lataniotis, C., Sørensen, J. D., Natarajan, A., (2015) Fusing simulation results from multi-fidelity aero-servo-elastic simulators - Application to extreme loads on wind turbine. 12th International Conference on Applications of Statistics and Probability in Civil Engineering (ICASP12), Vancouver, Canada, July 12-15.