Structural design with polymorphic uncertainty models

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Abstract

The design of structures is one of the major tasks for engineers. Structural design should be robust with respect to the polymorphic nature and characteristic of the available information. Generally, the availability of information in engineering practice is limited. Incomplete, fragmentary, diffuse, and frequently expert specified knowledge leads to imprecision in data. In addition, engineers have to cope with the objective variability and fluctuations in material, geometry and loading.

Uncertainties inherently present in resistance of structural materials, environmental and man-imposed loads, boundary conditions, physical and numerical models, and to other types of intrinsic and epistemic uncertainties. The goal of numerical structural design, computing robust and reliable structures, can be realized by means of analyzing different variants, application of optimization tasks, or solving inverse problems.

The contribution presents selected research results recently obtained by the authors. The main focus is on soft computing methods developed for structural design. Artificial Neural Network approaches and Extreme Learning Machines are highlighted, which can by applied for several tasks.

References

Pannier, S. and W. Graf. Simulation-driven sequential metamodels for fuzzy reliability based optimization, *Internat. J. Mathematical Modelling and Numerical Optimisation*, 3(1/2):30–44, 2012

Pannier, S.; M. Waurick; W. Graf, and M. Kaliske. Solutions to problems with imprecise data – an engineering perspective to generalized uncertainty models, *Mechanical Systems and Signal Processing*, 37(1-2):105-120, 2013

Graf, W.; M. Götz, and M. Kaliske. Numerical concepts for structural analysis and design with polymorphic uncertainty modelling, In: Tsompanakis, Y., editor, *Proc. of 3th International Conference on Soft Computing Technology in Civil, Structural and Environmental Engineering (CST)*, Cagliari, 2013, Civil-Comp Press, Stirlingshire

Götz, M.; W. Graf; A. Serafinska, and M. Kaliske. Surrogate models in early design stages, In: Deodatis, G.; B. Ellingwood, and D. Frangopol, editors, *Safety, reliability, risk and life-cycle performance of structures and infrastructures (ICOSSAR11)*, Columbia University New York, 2013, CRC press, Boca Raton