A new non-intrusive data-driven computational homogenization for multi-parametric studies

N. Blal, A. Gravouil

Université de Lyon, INSA-Lyon, LaMCoS UMR CNRS 5259, F69621 Villeurbanne, FRANCE
nawfal.blal@insa-lyon.fr, anthony.gravouil@insa-lyon.fr

ABSTRACT

Robust and accelerated multi-scale approaches offer promising tools for reliability and safety approaches met is different engineering applications (aeronautic, building, biomechanics, etc). This needs the incorporation of the materials uncertainty and variability in addition to the development of advanced computational methods to significantly decrease the CPU time. A new non-intrusive strategy is proposed in order to compute the effective behavior of heterogeneous media with the integration of different design variables. The developed method is based in a data-driven approach with an offline/online strategy. The offline stage is a data learning stage that consists in the estimate of the effective behavior for different design of experiments (e.g. microstructure configurations, material uncertainties, …) with full finite element computations. The Variational Asymptotic Method for Unit Cell Homogenization (VAMUCH) [1] is used for this stage in order to build the localization operator and the effective behavior without imposing six elementary loading directions. The online stage is a predictive stage where new design solutions are obtained instantaneously without any need to re-run full finite element computations. In order to investigate a large set of design variables for high parametric dimensions, the VAMUCH method is coupled with reduced order models. More practically, the High Order Proper Generalized Decomposition (HOPGD) [2] is used to achieve a variables separation of the quantity of interests. Unidirectional modes are thus obtained leading to the actualization of the parametric solution with less time and high accuracy [3].

REFERENCES

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