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PARAMETER-MULTISCALE PGD METHODS FOR HIGH DIMENSIONAL PARAMETRIC SPACES

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Model reduction techniques such as Proper Generalized Decomposition (PGD) are decision-making tools which are about to revolutionize many domains. Unfortunately, their calculation remains problematic for problems involving many parameters, for which one can invoke the "curse of dimensionality". This works proposes a tentative answer to this challenge in solid mechanics by the so-called "parameter-multiscale PGD".

This work is based on the classical PGD, a model reduction technique using separated variable representations to approximate high dimensional spaces. The method, introduced in [1], uses the physics of the problem to built a more structured representation. It is based on the Saint-Venant's Principle which highlights two different levels of parametric influence, which leads us to introduce a multiscale description of the parameters to separate a "macro" and a "micro" scale.

To implement this "parameter-multiscale" vision, a completely discontinuous spacial approximation is needed. Thus, we use the Weak-Trefftz Discontinuous Method used in [2] for the calculation of "medium frequency" phenomena. Discontinuous spatial methods are rarely implemented in industrial solid mechanics software, thus, a non-intrusive version of the algorithm, compatible with classical finite element discretization, has been introduced.

On different academic examples, we can show that the computation of the algorithm on a 3D linear elastic problem up to the second iteration leads to very small errors. That is done for cases with more than a thousand parameters [3].

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