Modeling the behavior of elastic materials with stochastic microstructure

Jan Nagel*, Philipp Junker†

* Department of Mathematics and Computer Science
Eindhoven University of Technology
5612 AZ Eindhoven
e-mail: j.h.nagel@tue.nl

† Institute of Continuum Mechanics
Ruhr-Universität Bochum
Universitätsstr. 150, 44801 Bochum
e-mail: philipp.junker@rub.de

ABSTRACT

Even in the simple linear elastic range, the material behavior is not deterministic, but fluctuates randomly around some expectation values. The knowledge about this characteristic is obviously trivial from an experimentalist's point of view. However, it is not considered in the vast majority of material models in which “only” deterministic behavior is taken into account.

One very promising approach to the inclusion of stochastic effects in modeling of materials is provided by the so-called Karhunen-Loèwe Expansion. It has been used, for example, in the stochastic finite element method, where it yields results that are exactly of the desired kind, but unfortunately at drastically increased numerical costs.

This contribution aims to propose a new ansatz that is also based on a stochastic series expansion, but at the Gauß point level. Appropriate energy relaxation provides the distribution of a synthesized stress measure, together with explicit formulas for the expectation and variance. The total procedure only needs negligibly more computation effort than a simple elastic calculation. We also present an outlook on how the original approach in [1] can be applied to inelastic materials.

REFERENCES

[1] P. Junker and J. Nagel, “A relaxation approach to modeling the stochastic behavior of inelastic materials”, *under review*.