Computational Strategies for Stochastic Standard Generalised Material Models

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ABSTRACT

Irreversible phenomena in heterogeneous materials such as concrete, rock, metal foams, etc. play a very important rôle. The composition of heterogeneous materials is uncertain to varying degrees, and hence modelled in the language of probability theory. One thus arrives at a stochastic description of irreversible phenomena. Here we take the mechanical model as a "generalised standard material". The material behaviour is described by the Helmholtz free energy and the dissipation function, a velocity pseudo-potential depending on the physical variables and phenomenological internal variables in the form of thermodynamic forces and fluxes.

In the formulation and in the computation one has to distinguish rate-independent and rate-dependent phenomena (classical plasticity and visco-plasticity are prime examples of these phenomena). While the theory and computation are well established in the deterministic (no- stochastic description) case, it is not clear on how to proceed in the stochastic case. Here we extend the deterministic theoretical and computational framework into the stochastic realm. This makes it possible to generalise the established deterministic computational procedures.

After a brief overview on computational pathways in the stochastic case, we settle for a non-intrusive numerical "outer-approximation" computational procedure, allowing the re-use of determnistic legacy codes.