

INELASTIC PROCESSES IN HETEROGENEOUS MATERIALS: IDENTIFICATION, HOMOGENISATION AND MULTI-SCALE FORMULATION, UNCERTAINTY QUANTIFICATION AND COMPUTATION

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ABSTRACT

Heterogeneous materials are ubiquitous, both natural (e.g. rock, soil) and artificial (such as concrete, fibre-reinforced composite materials). Beyond the elastic range of these materials inelastic/irreversible processes are at the current focus of interest, as such irreversible processes occur at extreme loadings ranging from plate tectonics to micro-indentation tests for material investigation. The heterogeneity present in many instances extends over a large range of scales, frequently to scales much smaller than those of interest for a particular investigation. The inhomogeneity at sub-resolution scales often leads to incomplete knowledge and hence uncertainty and randomness at the scale of interest. Various approaches are proposed to deal with the aforementioned situations computationally, and will be the focus of this session. Of particular interest are cases where heterogeneities at small scales directly initiate some large-scale behavior, so that the result is an amplification of the heterogeneity in inelastic/irreversible behavior.

Hence the main topics of the invited session will include but will not be limited to:

- Mathematical formulations for heterogeneous irreversible processes
- Numerical Homogenization
- Multi-scale formulations
- Computational multi-scale for inelastic processes like FE² and element-in-element methods
- Uncertainty quantification for heterogeneous inelastic materials
- Identification of heterogeneous materials
- Non-local constitutive material laws
- Stochastic upscaling ...