MULTI-SCALE ANALYSIS AND DESIGN OF ADVANCED MATERIALS

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ABSTRACT

Computational design of advanced engineering materials with complex underlying structure requires key enabling numerical techniques such as multi-scale analysis and generalized continuum theories. This is the case of high-performance engineering materials, architected materials, metamaterials or natural materials exhibiting complex phenomena such as fracture across the scales. In these scenarios, dedicated simulation techniques that account for microscale mechanics and its interaction with upper scales are crucial for a successful design process.

The objective of this symposium is to provide a place for discussion and exchange of ideas regarding the modelling, design and analysis of materials, taking into account their microstructure and their (possibly) non-classical behaviour at different scales. On the one hand, recent advances on the numerical description of this class of materials are foreseen, with focus on the multi-scale modelling through homogenisation schemes, techniques for optimal design of macro or microstructure and constitutive modelling based on generalised continua (Cosserat, micromorphic, strain gradient, ...). On the other hand, there is also place to share the application and potential industrial transference of this sort of techniques to specific classes of materials, like multi-phase materials, metamaterials, fibre reinforced composites, polycrystalline materials, biological structures, and architected materials, not to be exhaustive.

Contributions addressing but not limited to the topics listed in what follows are welcomed:

- Multi-scale models based on first and second-order homogenisation, micromorphic homogenisation, and homogenisation of generalised continua;

- Modelling of fracture and damage across the scales;

Analysis of size effects across the scales;

Data-driven, reduced-order and surrogate models for multi-scale and/or generalised continua;

Constitutive modelling and parameters calibration in generalised continua;

Multi-scale design and topology optimisation of high-performance materials and metamaterials;

Analysis of the influence of strain gradients in materials behaviour;

Numerical methods to solve generalised continua and multi-scale problems;

Industrial multiscale analysis of complex and high-performance engineering materials.