8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

Image-Based Computational Modelling of Materials

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Key Words: *Image-based, Microstructure, Reconstruction, Computing Methods*

ABSTRACT

This symposium is focused on image-based computational modelling of heterogeneous materials and composites. With the advent of advanced material characterization techniques and processes, and computational resources, it has become possible to create high-fidelity 2D and 3D material reconstructions that can be accommodated in computational models. Material reconstruction is usually performed with characterization techniques such as serial sectioning, x-ray tomography and x-ray diffraction followed by processing of raw material data in image-analysis software. The image-based data is then input into computing kernels such as the finite element method to create models embedded with highly accurate representation of material morphology, which can then be analyzed. Since maintaining fidelity with actual morphology necessarily requires high resolution, generation of large amount of data is inevitable at every step. The need for accurate constitutive modelling also arises to correspond with the now available high-resolution morphology. Elsewhere, tremendous challenges exist in terms of image-processing of raw material data, rendering of reconstructed data into faithful but lean computational models, and post-processing and mining of analysis data to obtain meaningful results such as microstructure-macro property relationships in metals.

Topics of interest include (but are not restricted to) the following:

- Applications: linear/nonlinear materials (elastic, plastic, viscoplastic), morphologies (polycrystalline, porous, multi-phase composites), phenomena (yield, damage evolution, failure)
- Numerical methods: finite element, meshless methods, finite difference, GIMP, domain decomposition methods, parallel processing
- Efficient and robust algorithms/techniques/methods to generate meshes from large-scale reconstructed images while maintaining accuracy
- Advanced morphological reconstruction techniques: image-processing algorithms (2D/3D), interface identification techniques (grains, pores, inhomogeneities), etc.
- Data-mining techniques
- Coupling of homogenization and image-based modelling techniques
- Consistent methodologies for suitable description of RVEs