11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

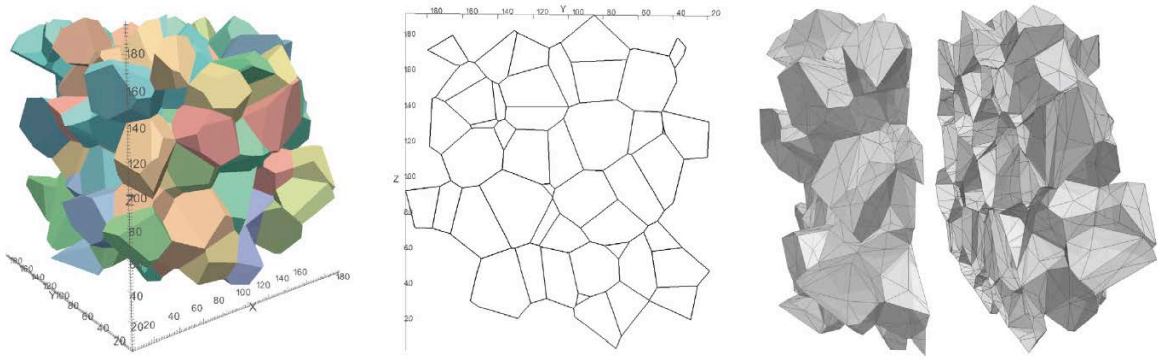
Multiscale analysis applied to material modeling

P. Wriggers[1], Stefan Löhnert and Eva Lehmann

[1] Institute of Continuum Mechanics, Leibniz Universität Hannover
Appelstr. 11, 30167 Hannover, Germany
e-mail: wriggers@ikm.uni-hannover.de

Key Words: *multiscale, homogenization, polycrystals,interface.*

The presentation is aimed to cover areas related to modeling of material behaviour using different numerical schemes. Special emphasis is laid on homogenization procedures and multi- scale approaches that include inelastic microstructural deformations and development of inter- face cracks. In detail the inelastic responses of polycrystals is investigated including induced anisotropy and nonlinear hardening. The necessary numerical procedures will be discussed and examples from different areas are introduced. A typical microstructure of a poly-crystal and its discretization can be seen in Fig. 1.



(a) Polycrystal consisting of VORONOI cell grains

(b) Cut through polcrys-talline structure

(c) Three-dimensional view into the cutted polycrystal

Figure 1: Polycrystal and discretization

Additionally the simulation of a micro crack at polycrystal level can be seen in Fig. 2 using XFEM. Included in this presentation is the design of macroscopic constitutive equations with only few parameters that are obtained from homogenization of polycrystal assemblies. The results are validated at micro and macro scale by means of experiments. These include as well results from microstructural observation as from classical pullout tests. Typical and important industrial applications range from ceramic to ductile materials.

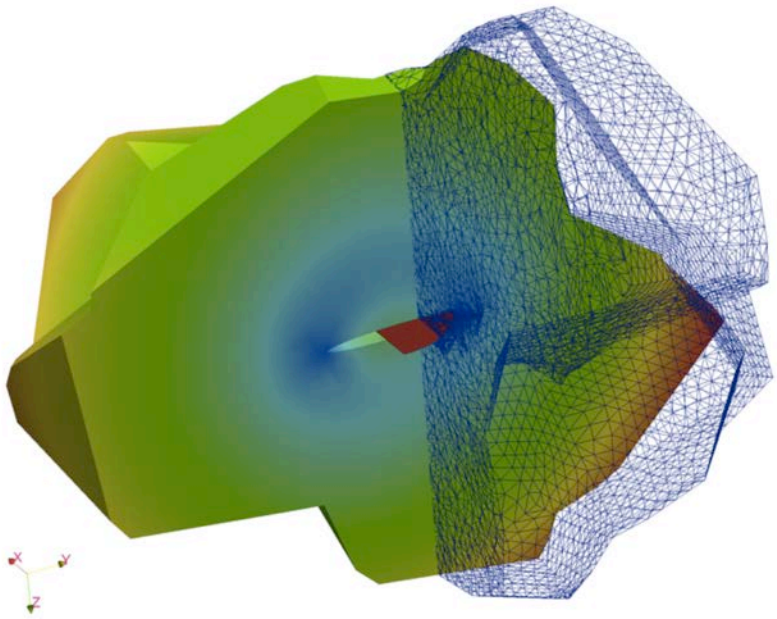


Figure 2: Micro crack in a polycrystal

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