KTH SOLID MECHANICS KEYNOTE SEMINAR; Wednesday, October 27th , 16.15; https://kth-se.zoom.us/j/67751368288

Samuel Forest's KEYNOTE seminar "Microstructural mechanics of plasticity in metallic porous media"

Microstructural mechanics consists in estimating the overall properties and local strain fields of representative volume elements of heterogeneous materials for instance by means of computational homogenization methods. Adopting the statistical approach for the definition of representative volume elements, a large number of simulations were performed for a broad range of material porosity values and mechanical loading in order to evaluate the yield locus and ductile fracture of metallic alloys [1].
Another important class of porous metallic materials with high void volume fractions is represented by metal foams. Microtomographic images are used to model the 3D microstructure of the foam and obtain a fine 3D finite element mesh. This detailed knowledge of the characteristic lengths and morphology of foams is used to calibrate a micromorphic constitutive model and simulate plasticity and fracture of nickel foams [2].
The last part of the presentation deals with the modeling of size effects in porous single crystalline metallic alloys. Plastic strain gradients in the matrix affect the growth of cavities. The intrinsic length scale involved in the proposed reduced order micromorphic crystal plasticity model interacts with the pore size and modifies the plastic flow in these highly anisotropic materials [3].

[1] C. Cadet, et al., Int. J. Fracture, 230, 2021.
[2] A. Burteau, et al., Int. J. Solids and Struct., 49, 2012.
[3] J.M. Scherer, et al., Comp. Meth. Appl. Mech. Engrg, 372, 2020.

Samuel Forest is research director at CNRS and continuum mechanics professor at Mines ParisTech. He obtained his PhD in Materials Science and Engineering in 1996 at Mines ParisTech. His work aims at introducing the physical aspects of deformation and fracture of materials into the framework of continuum mechanical modeling. He has actively participated in the recent developments of the mechanics of generalized continua, including strain gradient and micromorphic media. He has published more than 150 articles in international journals in mechanics and physics of materials and structures. He has supervised more than 35 PhD theses, notably within the framework of projects with industrial partners in aeronautics, energy and material processing. He received the bronze (1998) and silver (2012) medals from CNRS, as well as the Jean Mandel Prize (2001) and the Plumey Prize (2008) from the French Academy of Sciences. He recently became a Fellow of the Euromech Society for his contributions in computational mechanical metallurgy. He is Associate Editor for Philosophical Magazine and International Journal of Solids and Structures.