EML WEBINAR

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10 AM BOSTON, 3 PM LONDON, 10 PM BEIJING

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MULTI-SCALE HOMOGENIZATION OF MATERIALS WITH AN EMERGENT MACROSCOPIC BEHAVIOUR

Homogenization is a well-developed field in mechanics of materials, allowing to account for the role of microstructures at the macroscopic level of engineering structures. For complex nonlinear materials, computation homogenization has been developed as a powerful tool to establish this two-scale coupling. It was extended to gradient-enhanced homogenization schemes, thermo-mechanical problems, plates and shells, localization and damage, interfaces, etc. The next target were materials with microstructures triggering a strong emergent effect at the macro-scale. Metamaterials are typical examples in this class. In this presentation, the progress made in our Eindhoven team on this subject will be presented. Departing from computational homogenization of resonant acoustic metamaterials, a closed form micromorphic continuum homogenization approach for this class of materials will be outlined. A more advanced homogenization ansatz will be used to cover Bragg scattering as well. The insights gained on acoustic metamaterials is further exploited for materials revealing anomalous effects in the thermal regime. Likewise, it will be shown that the method is also applicable to remarkable effects in diffusion. The micromorphic nature of the emergent continuum is also recovered in the homogenization of mechanical metamaterials, which are driven by (elastic) instabilities at the micro-scale. The key aspects of the adopted homogenization methods and the resulting (emergent) continua will be highlighted, whereby several examples will be shown for the different cases presented.

Marc Geers is full professor in Mechanics of Materials at the Eindhoven University of Technology in the Netherlands since 2000. His research interests are in the field of micromechanics, multi-scale mechanics, damage mechanics and mechanics in miniaturization. His research group aims to understand, describe, predict and optimise the mechanical response of engineering materials as a function of their underlying microstructure, processing and evolution, through focused and coordinated experimental, theoretical and computational efforts at a wide range of length scales. Particular research topics are: strain gradient crystal and dislocation plasticity, ductile damage, interface mechanics, computational homogenization and metamaterials. He published more than 300 journal papers and supervised more than 50 PhD students. He is an associate editor of the European Journal of Mechanics A/Solids, and he serves on the editorial boards of several other journals. He serves the Dutch and scientific community and international organizations in various responsible roles. He was elected Fellow of the European Mechanics Society in 2012, Fellow of the International Association for Computational Mechanics in 2016 and he received an ERC Advanced Grant. He is the acting President of the European Mechanics Society EUROMECH

Discussion leader: **Professor** Laurence Brassart, Oxford University

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