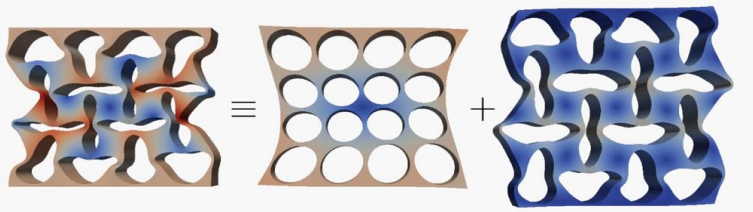
KTH SOLID MECHANICS SEMINAR; Thursday, October 8th, 16.15; https://kth-se.zoom.us/j/61574539884

Marc Geers' KEYNOTE seminar

"Homogenization of dynamical and mechanical metamaterials"

Engineering analyses of structures and devices call for efficient numerical methods that accurately capture the behaviour of its constituting materials. For highly heterogeneous materials, homogenization methods seek to replace the heterogeneous microstructure by an effective continuum that can be easily solved at the engineering level. Among the plethora of homogenization methods, computational homogenization constitutes a powerful tool to establish a two-scale coupling or complex nonlinear materials. Whereas the method has been used for a variety of problems, a new challenge arises when metamaterials are considered.

Metamaterials reveal microstructures that induce a strong emergent effect at the macro-scale. This webinar focuses on our recent progress in the homogenization of dynamical and mechanical metamaterials. First, a computational homogenization scheme applicable to resonant acoustic metamaterials will be outlined. Exploiting linearity, a closed form micromorphic continuum homogenization approach for this class of materials can be obtained. The corresponding dispersion spectra are accurately captured, and the solution of initial boundary value problems is thereby at reach. A more advanced homogenization ansatz that covers Bragg scattering as well, will be presented next. Spatial micro-scale fluctuation fields also emerge in mechanical metamaterials, driven by elastic instabilities. Exploiting a kinematical ansatz that incorporates the microstructural patterns, a micromorphic continuum is recovered. The key aspects of the different homogenization methods and the resulting (emergent) continua will be highlighted, whereby several examples will be shown for the different cases presented.



$$\vec{u}(\vec{X},\vec{\zeta}) \equiv \vec{v}_0(\vec{X}) + v_1(\vec{X})\vec{\varphi}_1(\vec{X},\vec{\zeta})$$

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.