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IMAGE-BASED STRUCTURAL ANALYSIS OF MICRO-STRUCTURED MATERIALS APPLYING THE FINITE CELL METHOD

Alexander Düster[1], Stephan Heinze[2] and Simeon Hubrich[3]

[1,2,3] Hamburg University of Technology, Am Schwarzenberg-Campus 4 C,
21073 Hamburg, Germany, https://www.tuhh.de/skf
[1] alexander.duester@tuhh.de
[2] stephan.heinze@tuhh.de
[3] hubrich@tuhh.de

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Micro-structured materials like foams or composites are of growing interest in different engineering disciplines. Such materials are appealing because they combine properties like low mass density with high stiffness. Due to the complicated micro-structure of cellular and composite materials, the modeling and simulation of engineering structures composed of these materials still remains a challenge. Our starting point for the characterization of micro-structured materials is a voxel model obtained by a three-dimensional computer tomography (CT scan) of the specimen of interest. Simulations taking into account the real geometry can be directly performed on the high resolution 3D voxel data by converting it into a voxel finite element model, which leads to a huge number of degrees of freedom and a discretization depending on the resolution of the CT scan. To overcome these problems, we use a discretization technique based on the Finite Cell Method (FCM) which is a combination of the fictitious domain approach with high-order finite elements. Thanks to the use of Cartesian meshes, the pre-processing, i.e. mesh generation is significantly simplified. The talk is intended to give an overview over the FCM and its application to the computation of micro-structured materials, starting from image-based data. We will present results related to our effort to model and simulate metal foams undergoing large elastoplastic deformations. In addition, the application of the FCM to the numerical investigation of nanoporous gold will be also discussed.

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