KTH SOLID MECHANICS SEMINAR; Friday, February 24th, 15.15; KTH Solid Mechanics Seminar room

Jörg Schröder "State of the art and challenges in computational scale-bridging"

The present talk focuses on the two-scale simulation of macroscopic boundary value problems with attached microstructures satisfying the assumption of scale separation. The main idea of the so-called FE²-Method is to attach representative volume elements (RVEs) at each macroscopic point, instead of deriving a phenomenological macroscopic constitutive model. This approach involves the localization of the macroscopic process variables on the underlying microstructure and a homogenization step; in addition a consistent linearization of the macroscopic constitutive quantities and the determination of the effective overall properties are performed. The goal of this talk is to demonstrate the applicability of the computational scalebridging for a variety of fields, such as the simulations of hyperelastic composites, polycrystalline materials, porous media and magneto-electro-mechanical compounds. The main focus of this contribution is on the analysis of composites with a magneto-electric (ME) coupling effect, see Fig. 1, a product property arising in composites combining materials with ferroelectric or ferromagnetic characteristics in the individual phases, which solely do not exhibit any magnetoelectric coupling effects. In these two-phase compounds, the ME-effect is strain-induced due to the microstructural interaction and depends on the morphology of the microstructure. The homogenization approach within the FE²- Method yields the desired ME-coefficient. A current field of application is the homogenization of complex microstructures of Dual-Phase steels. A reduction of computational costs can here be achieved using statistically similar RVE. Remarks on homogenization schemes of geometrically nonlinear problems, accompanied by stability problems, are given. Future work is related to the computation of overall responses of a 3D fluid saturated porous microstructure using a fluidstructure-interaction approach and a consistent treatment of thermomechanically coupled two-scale boundary value problems.

Jörg Schröder is a Professor of Mechanics and he was Vice-Rector at the University of DuisburgEssen from 2011 – 2015. He obtained his Diplom-Ingenieur (U) and his DoctorIngenieur from the University of Hannover in 1992 and 1995, respectively. After a Research Assistantship position in Stuttgart University, he became Professor of Mechanics at TU Darmstadt. In 2001, he finally moved to the University of Duisburg-Essen. From 2009 - 2014, he has been a member of the Directorate of the Association of Applied Mathematics and Mechanics (GAMM). Since 2016 he is member of "Akademie der Wissenschaften und Literatur Mainz". Prof. Schröder's areas of research interest are computational mechanics, continuum mechanics and constitutive modelling. Some of his work focusses on the computational treatment of polyconvexity for biological materials and the formulation and implementation of mixed finite elements. Furthermore, methods in multiscale modeling (FE²) have been a focus in the last two decades. He is the author of over 200 technical papers and serves on the editorial board of several journals.

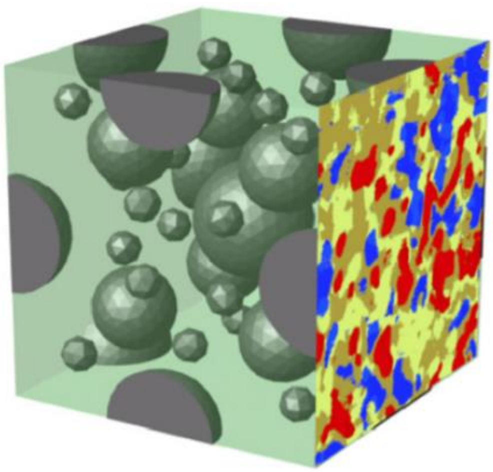

Figure 1: Design of magneto-electric composite.