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Title of Seminar 1: Uncertainty quantification in the homogenization method of composites

Abstract: The seminar introduces the participants into two major homogenization methods of particulate and fibrous composite materials, namely analytical and numerical. These two methods based upon the deformation energy of the so-called Representative Volume Elements are contrasted with each other and discussed on the examples of polymer-based engineering composites. Further, the basic elements of uncertainty quantification are introduced in the context of discrete and continuous distributions of random variables and fields. Their application in homogenization-based analysis of particulate and fibrous composites leading to uncertainty quantification for effective material tensors is demonstrated. Statistical scattering of material properties is discussed together with a specific interface imperfections for both classes of composites. An impact of the stochastic interphase in fibrous and particulate composites is demonstrated also using three concurrent probabilistic numerical techniques, namely Monte-Carlo simulation, semi-analytical as well as the iterative generalized stochastic perturbation technique implemented in the Finite Element Method program. Some ABAQUS simulations concerning hyper-elastic behavior of the elastomers reinforced with the carbon black particles is also discussed in the probabilistic context.