Preface

The micostructure of the material plays an important role in various modern applications in the field of macro-, micro- and nanotechnology. It strongly influences the continuum-mechanical properties of the material and the structural behavior of industrial components. Microstructure can either be present in the material from the beginning, e.g., in porous materials or composites, or evolve during phase transformations, damage or localization of deformation.

Classical continuum-mechanics does not take such effects into account. The extension of the classical concepts is therefore a challenging task. In the past, various methodologies have been introduced, allowing for a rational approach towards "Multiscale Material Modelling". From a general point of view, microscopic information has to be included into phenomenological continuum models.

This special volume of *Technische Mechanik* gives a broad overview of the diversity of modern MMM approaches. The methods outlined in various contributions can be divided into the following categories.

1. *Kinematically extended continua*. The influence of the microscopic inhomogeneity is captured by higher order kinematical fields. These kinematical quantities can either be higher gradients of the displacement fields or additional, i.e. independent degrees of freedom which lead to modified deformation measures. Gradient enhanced inelasticity is discussed in the contributions of Dimitrijevic & Hackl and Neff. A physical interpretation of additional independent degrees of freedom is proposed by Ebinger et al.

2. *Scale-bridging.* The governing aspects of the mechanical behavior of the microstructure are analyzed in detail. This can be done either by analytical methods or by numerical techniques. The response of the microstructure with respect to mechanical loading is homogenized and embedded into the continuum model. Meier et al. discuss the derivation of macroscopic stresses from contact networks in granular media. In the contribution of Zastrau and coworkers, the effective mechanical properties of textile-reinforced concrete are investigated. Goektepe & Miehe propose a scale-bridging technique for rubber-like materials taking into account viscoelastic behavior.

3. *Interphases and Interfaces.* Material inhomogeneities are often characterized by thin regions with continuously varying material properties. The answer to mechanical loading is influenced by the resulting boundary layer effect. The finite thickness of the boundary layer is captured by an additional field in the contribution of Johlitz et al. Svendsen derives a set of balance equations for a continuum with an embedded thin interface of finite thickness (e.g. phase transition, shear band etc.) which may move with respect to the material body. The interface thickness is introduced as a lengthscale parameter and generalizes the standard relations for a continuum with singular surface.

The problem of generalization of classical continua is treated in the GAMM activity group "Multiscale Material Modelling" founded in 2006 by B. Svendsen and S. Diebels. The former contributions highlight some aspects discussed in the activity group. They were presented during the first workshop of the GAMM activity group entitled "Generalized Continua" which took place at the Saarland University, Saarbrücken in spring 2007.

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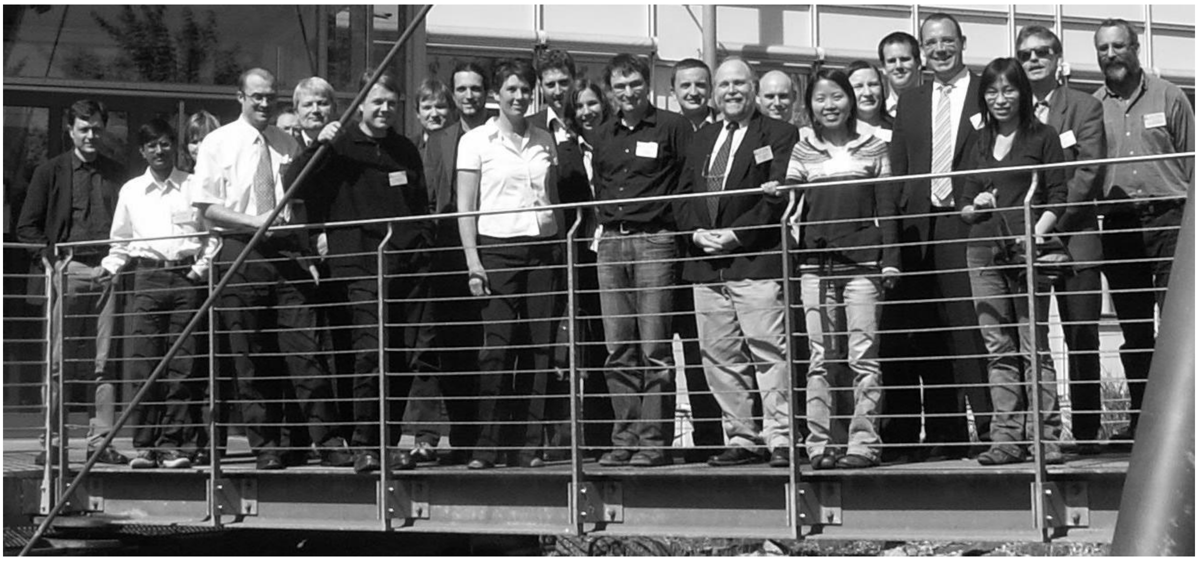

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