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ON MACRO– AND MULTISCALE–APPROACHES TO ANISOTROPIC FINITE PLASTICITY

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ABSTRACT

The quantitative modeling of developing anisotropies in materials undergoing finite strains is an important issue of current research. A crucial perspective is provided by multiscale approaches which take into account the microstructure evolution of the material by direct scale bridging methods. However, many of these methods are computationally extremely demanding and not suitable for large–scale computations.

There is a need for the construction of multiscale–based constitutive models which are handable in large–scale computations. These constitutive macro–models may be based on direct homogenization of idealized microstructures or can be obtained by parameter identification from virtual driving experiments of complex microstructures. The lecture provides an overview about such conceptual approaches to the modeling of anisotropic plasticity.

The first part covers *purely phenomenological macroscale models*, where multiplicative and additive kinematic approaches to anisotropic finite plasticity are considered. For representative classes of materials with a priori given and developing anisotropy, the modeling capacities of these basic assumptions are compared based on numerical benchmarks.

The second part points out *direct micro–to–macro models* with inherent evaluations of scale bridgings which describe initial and developing anisotropy. Representative applications cover multiscale models for polycrystals and polymers based on simplified microstructure assumptions which make such models computationally handable.

Finally, the third part links the two conceptual approaches mentioned above by *accompanying parameter identification methods*. This concerns a discussion of driving algorithms for complex microstructures and basic identification methods of anisotropy properties based on virtual experiments. All developments are outlined within a variational structure that provides canonically compact representations of the constitutive models. Representative model applications cover composites, polycrystals and polymers.

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