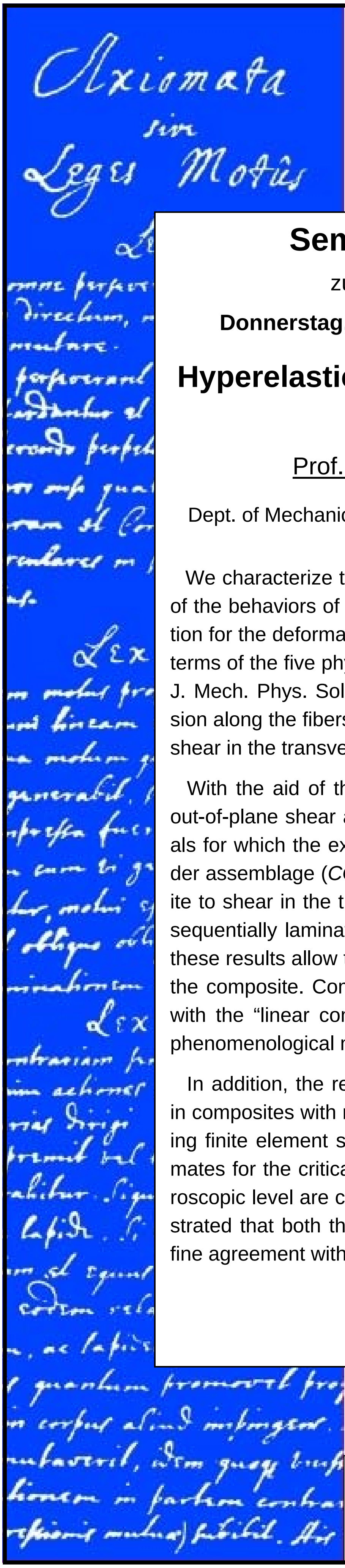

LTM

Friedrich-Alexander-Universität
Erlangen-Nürnberg

Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

Donnerstag, 24.09.2009, 14:00 Uhr, Egerlandstr. 5, Raum 0.044

Hyperelastic fiber composites – Homogenization and macroscopic stability

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We characterize the macroscopic response of hyperelastic fiber composites in terms of the behaviors of the constituting phases. To this end we make use of a representation for the deformation gradient $\mathbf{F} = \mathbf{R}\mathbf{F}_c$, where $\mathbf{R}$ is a rotation and $\mathbf{F}_c$ is expressed in terms of the five physically motivated TI invariants λ_n, λ_p, γ_n, γ_p and ψ_γ [deBotton *et al.*, J. Mech. Phys. Solids 54, 2006]. Respectively, these invariants correspond to extension along the fibers, transverse dilatation, out-of-plane shear along the fibers, in-plane shear in the transverse plane and the coupling between the shear modes.

With the aid of this representation, it is demonstrated that under a combination of out-of-plane shear and extension along the fibers there is a class of nonlinear materials for which the exact expression for the macroscopic behavior of a composite cylinder assemblage (*CCA*) can be determined. The macroscopic response of the composite to shear in the transverse plane is approximated with the aid of an exact result for sequentially laminated composites. Assuming no coupling between the shear modes, these results allow to construct a homogenized model for the macroscopic response of the composite. Comparisons of the responses predicted by these effective potentials with the “linear comparison” estimates of Lopez-Pamies and Ponte Castaneda and phenomenological models for biological tissues reveal good agreement.

In addition, the resulting explicit estimates for the macroscopic stresses developing in composites with neo-Hookean and Gent-like phases are compared with corresponding finite element simulations of periodic composites with a hexagonal unit cell. Estimates for the critical stretch ratios at which the composites loose stability at the macroscopic level are compared with the corresponding numerical results too. It is demonstrated that both the primary stress-strain curves and the critical stretch ratios are in fine agreement with the corresponding numerical results.

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