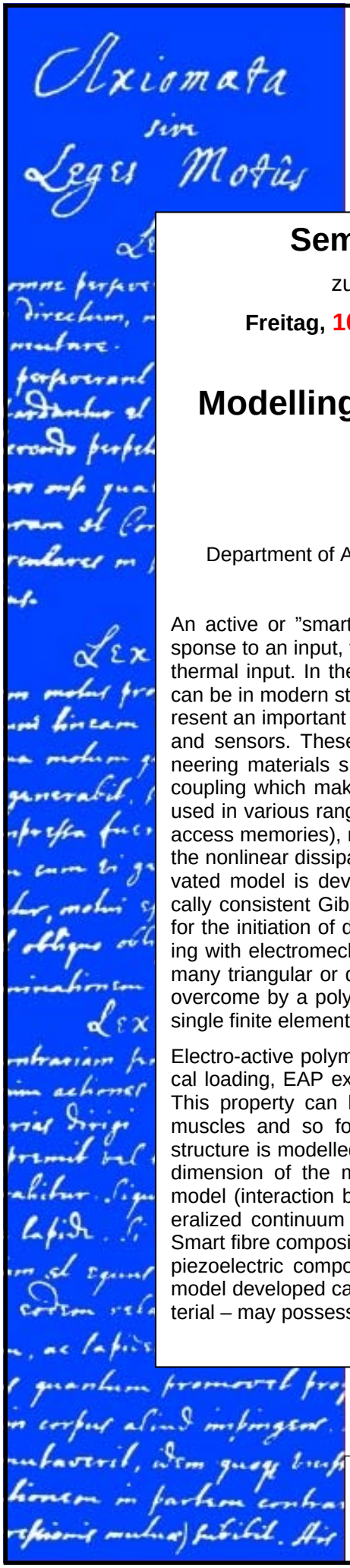

Friedrich-Alexander-Universität Erlangen-Nürnberg

Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

Freitag, 10.07.2009, 14:00 Uhr, Egerlandstr. 5, Raum 0.044

Modelling approaches on electromechanical coupled problems

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An active or ”smart” material is often defined as one that gives an unexpected response to an input, for example, an electrical or magnetic response to a mechanical or thermal input. In the field of engineering, active materials of interest are those which can be in modern structural design and intelligent systems. Ferroelectric materials represent an important class of active materials for applications as transducers, actuators, and sensors. These materials have unique properties compared to traditional engineering materials such as their constitutive behavior involves the electromechanical coupling which makes to serve as smart materials. Ferroelectric ceramics are widely used in various ranges of applications as MEMS devices, FRAM (ferroelectric random access memories), nanopositioning, active damping, ultrasonics and so forth. To study the nonlinear dissipative effects of ferroelectric polycrystals a micro mechanically motivated model is developed based on firm thermodynamic principles. Thermodynamically consistent Gibbs free energy by means of an energy-based criterion is adopted for the initiation of domain switching processes. In regular finite element models dealing with electromechanical plane problems, each grain needs to be subdiscretized by many triangular or quadrilateral elements for required accuracy. This problem can be overcome by a polygonal finite element approach where each grain is modelled by a single finite element without compromising on the results.

Electro-active polymers (EAP) recently attracted much interest, because, upon electrical loading, EAP exhibit a large amount of deformation while sustaining large forces. This property can be utilized for actuators in electro-mechanical systems, artificial muscles and so forth. A strain gradient approach is proposed, where the microstructure is modelled in a very general manner. That is to incorporate the size and the dimension of the micro-continuum into an electro-mechanically coupled continuum model (interaction between electric fields and mechanical deformation) where a generalized continuum is formulated as to consist of a macro- and a micro-continuum. Smart fibre composites in which the effective electromechanical properties of linear 1-3 piezoelectric composites are investigated by means of an analytical approach. The model developed captures that both phases – the PZT fibres as well as the matrix material – may possess anisotropic material properties.

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