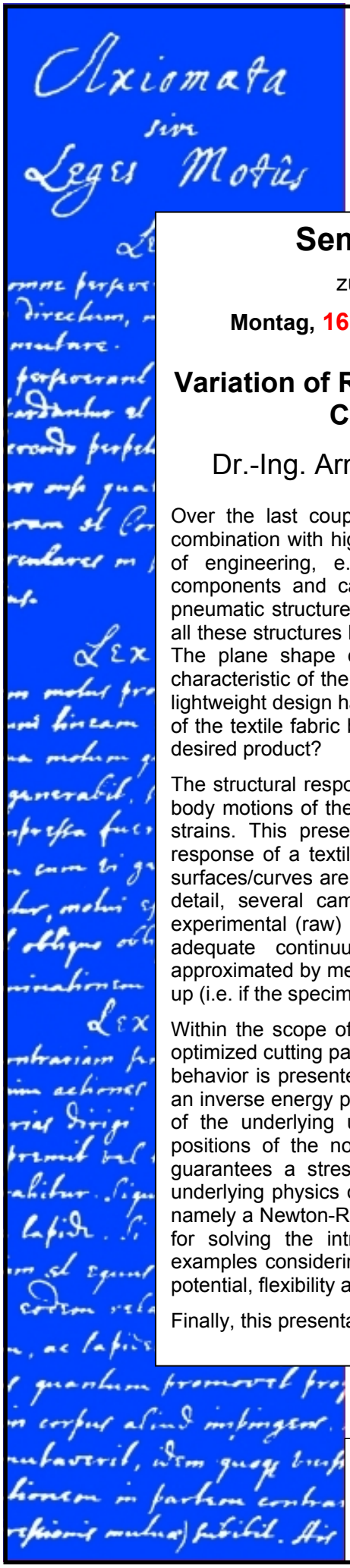

FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG
TECHNISCHE FAKULTÄT

Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

Montag, 16.09.2019, 10:00 Uhr, Immerwahrstr. 1, Raum 01.025

Variation of Reference Strategy – Generation of Optimized Cutting Patterns for Textile Fabrics

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Over the last couple of decades the application of lightweight design concepts in combination with high performance textiles has become very common in various fields of engineering, e.g. stringer and ribs (aeronautic/aerospace structures), frame components and car body panels (automotive structures), membrane rooftops and pneumatic structures (architectural membranes). Despite their widespread applications all these structures have their origin in a plane fabric which is either dry or resin coated. The plane shape of wrought material highly contradicts with the non-developable characteristic of the final structure. Hence, each design engineer working in the field of lightweight design has to deal with this well-known issue: How should the cutting pattern of the textile fabric be such that the final draped shape has minimal deviation from the desired product?

The structural response of textile fabrics is characterized due to a combination of rigid body motions of the micro structure, friction between the single yarns and their elastic strains. This presentation will show a novel approach for modeling the structural response of a textile fabric based on a nonlinear surrogate model. Therefore, Bézier surfaces/curves are introduced representing the fabric's strain-energy function. In more detail, several campaigns of velocity-driven biaxial tensile tests lead to a set of experimental (raw) data. In a second step, the gained set of data is transformed into adequate continuum mechanical quantities. Finally, the processed data are approximated by means of either a surface or curve depending on the experimental set-up (i.e. if the specimens are either mounted in fiber direction or under 45°).

Within the scope of this presentation a novel numerical method for the generation of optimized cutting patterns incorporating both nonlinear isotropic and anisotropic material behavior is presented. The developed Variation of Reference Strategy can be seen as an inverse energy principle (minimum total potential energy) where the design variables of the underlying unconstrained optimization problem are defined as the material positions of the nodes while holding their spatial configuration fixed. This strategy guarantees a stress-free state in the cutting pattern, which is consistent with the underlying physics of the manufacturing process. Two different numerical approaches, namely a Newton-Raphson scheme and the method of steepest descent, are presented for solving the introduced unconstrained optimization problem. Several numerical examples considering different types of surfaces as well as materials demonstrate the potential, flexibility and robustness of the presented Variation of Reference Strategy.

Finally, this presentation will give a brief overview of my post-university activities.

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