Universität der Bundeswehr München

Forschungskolloquium Computational Science and Engineering

Stress and flux-based finite element methods

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Zusammenfassung: This talk explores recent advancements in stress and flux-based finite element methods. It focuses on addressing the limitations of traditional finite elements, in order to describe complex material behavior and engineer new metamaterials.

Stress and flux-based finite element methods are particularly useful in error estimation, laying the groundwork for adaptive refinement strategies. This concept builds upon the hypercircle theorem, which states that in a specific energy space, both the exact solution and any admissible stress field lie on a hypercircle. However, the construction of finite element spaces that satisfy admissible states for complex material behavior is not straightforward. It often requires a relaxation of specific properties, especially when dealing with non-symmetric stress tensors or hyperelastic materials.

Alternatively, methods that directly approximate stresses can be employed, offering high accuracy of the stress fields and adherence to physical conservation laws. However, when approximating eigenvalues, this significant benefit for the solution's accuracy implies that the solution operator cannot be compact. To address this, the solution operator must be confined to a subset of the solution that excludes the stresses. Yet, due to compatibility conditions, the trial space for the other solution components typically does not yield the desired accuracy. The second part of this talk will therefore explore the Least-Squares method as a remedy to these challenges.

To conclude this talk, we will emphasize the integration of those methods within global solution strategies, with a particular focus on the challenges regarding model order reduction methods.

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