Technische Universität Braunschweig

MUSEN

An Adaptive Finite Cell Method for Multiscale and Coupled Problems IN Solid mechanics

Lecture of

Prof. Dr. Ernst Rank

Chair for Computation in Engineering,
Technical University of Munich

7. Dezember 2017, 16.45 Uhr

Okerhochhaus, Pockelsstraße 3,
Seminarraum EG

Fictitious domain or immersed boundary methods embed a domain of computation into a larger, usually simply shaped region, which can easily be discretized in a grid of simple square or cubic cells. These cells are not aligned to the boundaries of the original domain, i.e. they do not follow one of the central requirements of finite element meshes. Whereas FEM matches the boundary of the domain of computation, FCM precisely integrates its interior, only. Low order fictitious domain methods date back to the 1960ies, whereas high order fictitious domain methods like the Finite Cell Method (FCM) have come into the focus in combination with p-version shape functions or Isogeometric Analysis more recently. They combine high accuracy and efficiency with large geometric flexibility, and for a p-extension applied to smooth problems, even exponential rate of convergence could be proven. In case of singular or multiscale problems, however, locally enriched approximation spaces are necessary. This presentation will outline a flexible h- and p-extension strategy which can be applied to a large variety of problems, including those with transient fronts of refinement and coarsening. Application fields of this adaptive Finite Cell Method range from problems with moving contact over very high resolution models in biomechanics to process simulation for laser based metal additive manufacturing. In this thermo-mechanically coupled problem large scale differences need to be bridged, as the local energy input and the phase change from powder via fluid to solid is induced by a laser beam with a focus orders of magnitude smaller that the workpiece.