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Fakultät für Mathematik, Informatik
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Fachbereich Mathematik

Lothar-Collatz-Kolloquium für Angewandte Mathematik

Donnerstag, den 20. April 2017, um 17:15 Uhr, im Hörsaal 5

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Geometrically unfitted finite element methods for PDEs on evolving geometries

Zusammenfassung/Abstract:

Many applications of simulation science involve complex and evolving geometries with possibly strong deformations during the evolution. In the context of finite element methods most often a fitted characterization is used where a parametric description in terms of a computational mesh is available. An alternative approach is based on the idea of separating the computational mesh and the geometry description, resulting in geometrically unfitted methods, which allow for a very flexible handling of geometries. On a (typically simple) background mesh a basis discretization is defined. Only afterwards, according to the separately defined geometry this discretization is adapted to the geometrical information. This approach allows to handle complex and possibly time-dependent geometries without the need for complex and time consuming mesh generation or remeshing. In the recent years finite element methods based on this methodology, geometrically unfitted finite element methods, have drawn more and more attention. Despite its advantages unfitted discretizations, often also called cut-cell methods, give rise to new problems. Finite element spaces that are usually directly linked to the underlying mesh have to be adapted to account for the separated geometry description. As a consequence important properties such as the stability of bases, conditioning of matrices, the implementation of accurate numerical integration, stable time discretization or the imposition of boundary and interface conditions have to be re-established. This is often much harder to accomplish compared to fitted finite element methods and requires new techniques and ideas. We present a class of geometrically unfitted finite element methods, apply them to PDE problems arising in two-phase flows and discuss recent advances and open problems in this field.

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