Chair for Computation in Engineering
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Software Lab:

Modeling: ★★★☆☆
Mathematics: ★★★☆☆
Programming: ★★★★★

A review of Weak Dirichlet Boundary Conditions in Finite Cell Method (FCM)

Setting

The FCM [1] is an embedded domain approach for high order finite elements (pFEM). As such, it embeds the physical domain in a simple Cartesian mesh. The original geometry is recovered at the integration level using adaptive methods, which are easy to implement for Cartesian grids. Since the FCM utilizes high order FEM technology, it is robust against geometric distortions and can be very accurate even for non-smooth problems.

Since embedded domain methods do not necessarily represent the underlying physical domain with a boundary conforming mesh, imposing Dirichlet boundary conditions needs special care. For this task, several methods are able to solve this issue by modifying the weak formulation of the problem, for example the Penalty, Nitsche, or Lagrange Multiplier methods.

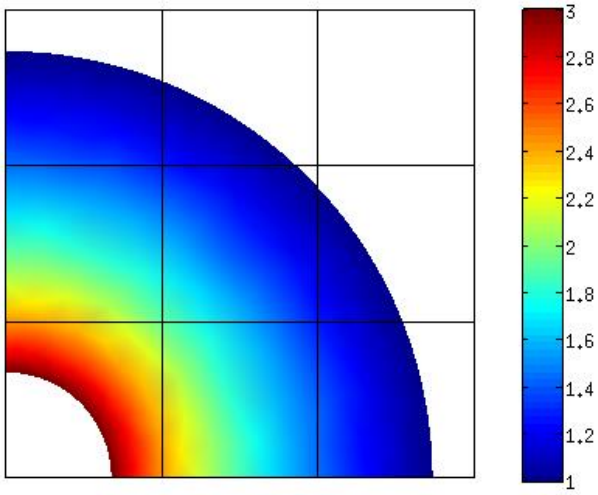

Fig1. Imposition of Dirichlet boundary conditions on inner and outer ring

Task

For the FCM Toolbox for MATLAB [2]

- Implement the Lagrange Multiplier Method
- Investigate different stabilization techniques for Nitsche's method
- Compare the results

Supervisor

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References

[1] A. Düster, J. Parvizian, Z. Yang y E. Rank, The finite cell method for three-dimensional problems of solid mechanics, *Computer Methods in Applied Mechanics and Engineering*, pp. 45-48, 15 August 2008.

[2] N. Zander, T. Bog, M. Elhaddad, R. Espinoza, H. Hu, A.F. Joly, C. Wu, P. Zerbe, A. Düster, S. Kollmannsberger, J. Parvizian, M. Ruess, D. Schillinger, E. Rank, FCMLab: A Finite Cell Research Toolbox for MATLAB, *Advances in Engineering Software*, Preprint/submitted 2013.