hp-adaptive basis functions of higher differentiability and error control for the Finite Cell Method

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The Finite Cell Method (FCM) [1] combines a fictitious domain approach with a finite element method. Its basic idea is to replace the possibly complicated physical domain by an enclosing domain of simple shape, for instance a rectangle or a cuboid, which can easily be meshed. The variational formulation of the problem and its finite element discretization are defined on the enclosing domain. The geometry of the physical domain is incorporated via an indicator function which necessitates the implementation of appropriate quadrature schemes.

In this talk, we address two aspects related to the FCM. First, we discuss hp-FEM basis functions of higher differentiability tailored to the simple structure of FCM meshes. Compared to the usual B-spline discretizations, the basis functions have a small support. Also, the basis allows for h- and p-anisotropic refinements, which enables exponential convergence of the energy error for non-smooth problems. Numerical experiments compare the performance of the C^k bases. Second, we present a reliable residual-based error estimator suitable for the FCM as well as numerical examples in 2D and 3D in the context of adaptivity.

References

[1] A. Düster, J. Parvizian, Z. Yang and E. Rank, The finite cell method for three-dimensional problems of solid mechanics, *Comp. Meth. Appl. Mech. Eng.* (2008) pp. 3768–3782.