High Order Methods on Arbitrarily Many Intersecting Meshes: MultiMesh

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ABSTRACT

We will present the MultiMesh technique, which allows the finite element method to be used on arbitrarily many intersecting meshes. Using this technique, a computational domain Ω consisting of many parts $\Omega = \cup_i \Omega_i$ can be described by individual meshes on each part Ω_i. This is in contrast to the use of a single mesh of Ω, which can be difficult and costly to construct. The interface conditions between the meshes of Ω_i, for example continuity, is enforced weakly by the Nitsche method.

Two key challenges with this method are addressed: First, appropriate quadrature rules are needed for performing the necessary volume and boundary integrals. We will in this talk present a novel procedure to systematically construct quadrature rules with appropriate positive and negative weights using a basic result from combinatorics. Second, following [1], suitable stabilization are needed to to ensure an optimal method also for elements of high order.

Using the Stokes problem as a model problem, we will show that the proposed method is inf-sup stable and *a priori* optimal for high order elements if we start from inf-sup stable spaces on the meshes of Ω_i. The implementation is available in the open source framework FEniCS [2].

REFERENCES

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[2] Alnaes, M. S., Blechta, J., Hake, J., Johansson, A., Kehlet, B., Logg, A., Richardson, C., Ring, J., Rognes, M. E. and Wells, G. N. *The FEniCS Project Version 1.5.* Archive of Numerical Software, Vol. **3**, 2015.