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A CONTACT FORMULATION BASED ON HIGH ORDER FICTITIOUS DOMAIN METHODS

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Problems in contact mechanics are mostly solved using the Finite Element method (FEM). Classically the FEM bases on a conforming discretization, whose generation can be very involved for complex geometries. The quality of this discretization highly influences the overall accuracy of the results. Furthermore, traditional contact algorithms involve the repeated solution of Dirichlet problems to enforce the contact constraints on a priori defined contact interfaces. During calculation, a search algorithms repeatedly checks the status of every contact point or surface to impose the constraints correctly [3]. In particular, the analysis of geometrically highly complex problems, turns out to be very involved.

This contribution will present a method that tries to overcome some of these issues. It is based on the recently introduced Finite Cell Method [1, 2], a fictitious domain approach for high order finite elements (p-FEM). As such, it avoids meshing by embedding the physical domain in a simple Cartesian grid. The original geometry is recovered at the level of integration of element matrices by adaptive methods, which are easy to implement for Cartesian grids. Furthermore, it exhibits the excellent convergence characteristics typical for high order methods.

In this work, this novel approach will be used to solve contact problems. Contact constraints are treated implicitly by embedding all physical bodies in a pseudo contact material, which is based on a hyperelastic Hencky formulation. A similar approach, using a 'third medium', has been presented recently by Wriggers et al. for low order elements [4]. The method overcomes the need to search for contacting interfaces and handles self contact in a natural way (see figure 1). The applicability of the method is demonstrated by means of numerical examples in two and three dimensions. Special emphasis is laid on the investigation of p-extension and the embedded material approach.

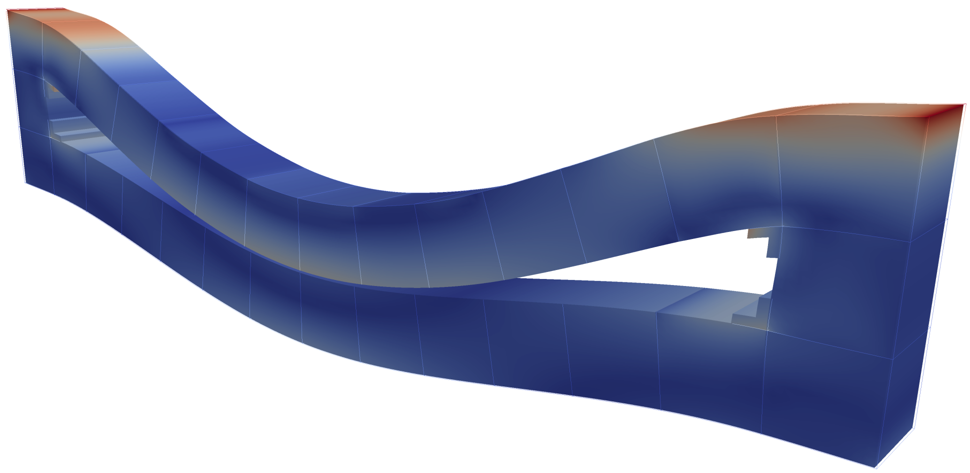

Figure 1: 3D example: Slotted block with a hole subjected to top traction

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