

Numerical simulations on embedded solids : integration of CAD and eXtended Finite Element Analysis

F. Duboeuf*¹ and E. Béchet¹

¹ LTAS - Aerospace and Mechanical Engineering Department, University of Liège
Chemin des chevreuils, 1, B-4000 Liège, Belgium
fduboeuf@ulg.ac.be eric.bechet@ulg.ac.be

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ABSTRACT

The aim of this communication is to propose a procedure in order to dissociate the geometric description of the field's approximation within the extended finite element method (X-FEM) and with non-matching meshes.

Implicit and explicit approaches are combined in order to represent with accuracy all the CAD entities regardless of their dimension. The choice of appropriate tools such as Level Sets technique allows to describe evolving interfaces with great flexibility.

The design of a dedicated P1 functional space is achieved by decimating the traces of standard finite element (FE) shape functions, thanks to a new algorithm, especially when the problem domain is embedded in a space of a higher dimension. An analysis of the approximation properties of the P1 FE trace spaces on hyper-surfaces is available in [1] and applied for solving PDEs on closed surfaces without boundary.

Dirichlet boundary conditions are applied using a convenient choice of stable Lagrange multiplier space, according to a new generalized algorithm. That extends the solutions proposed in [2,3] to every combination of the space domain and boundary dimensions.

In terms of solvers, the introduction of double Lagrange multipliers can be used to recover the positive definiteness of the bilinear form.

This approach allows to treat any embedding, i.e. 1, 2, or 3D problems embedded in 2 or 3D background meshes. The possibility of applying the methodology to beams is investigated, with a potential application to through-thickness reinforced composites in a mixed-dimensional modelling framework.

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