NURBS-Enhanced Finite Element Method (NEFEM)

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The relevance of an accurate geometric representation of the computational domain in the finite element solution of several engineering problems has been pointed out by several authors. In some applications, such as electromagnetic scattering or compressible flow problems, an isoparametric representation of the geometry is far from providing an optimal numerical solution for a given spatial discretization.

Nowadays, non-uniform rational B-splines (NURBS) are widely used for geometry description in computer-aided design (CAD). This fact has motivated new numerical methodologies considering the exact CAD description of the computational domain. NURBS-Enhanced Finite Element Method (NEFEM) allows a seamless integration of the CAD boundary representation of the domain and the finite element method. For elements not intersecting the boundary, a standard finite element interpolation and numerical integration are used, preserving the efficiency of the classical finite element method. For elements intersecting the NURBS boundary a specifically designed piecewise polynomial interpolation and numerical integration is proposed. The importance of the geometrical model in finite element simulations is addressed and the benefits and potential of NEFEM are discussed and compared with respect to other curved finite element techniques using continuous and discontinuous Galerkin formulations.