NURBS-ENHANCED FINITE ELEMENT METHOD

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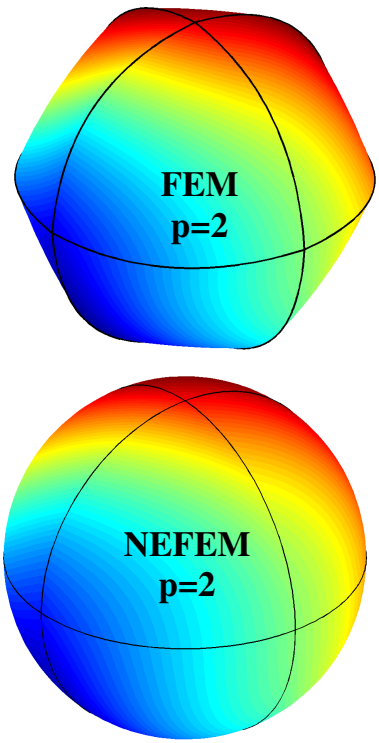
ABSTRACT

The relevance of an accurate description of the geometry has been pointed out by several authors. In some applications, such as electromagnetic scattering problems, a Finite Element (FE) 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, which can be classified as (i) methods considering a NURBS description of the entire computational domain, such as *isogeometric analysis* or (ii) methods considering a NURBS description of the boundary (more usual in CAD), such as the NURBS-Enhanced Finite Element Method (NEFEM, [1]), or p-FEM with NURBS, see [2] for a critical comparison.

NEFEM is able to exactly represent the geometry by means of the usual CAD boundary representation with NURBS, while the solution is approximated with a standard piecewise polynomial interpolation. Therefore, in the vast majority of the domain, interpolation and numerical integration are standard, preserving the classical FE convergence properties, and allowing a seamless coupling with standard FEs on the domain interior. Specifically designed polynomial interpolation and numerical integration are designed only for those elements affected by the NURBS boundary representation.

Elliptic and electromagnetic scattering tests, in 2D and 3D, reveal that NEFEM is clearly more precise than standard isoparametric FEM or p-FEM. Moreover, within a NEFEM framework the characteristic mesh size is given by accuracy constraints on the computed solution, irrespectively of the geometry details.



References

[1] R. Sevilla, S. Fernandez-Mendez and A. Huerta, NURBS-Enhanced Finite Element Method (NEFEM). *Int. J. Num. Meth. Eng.* **76**, pp. 56-83 (2008)

[2] R. Sevilla, NURBS-Enhanced Finite Element Method (NEFEM), PhD thesis, http://www-lacan.upc.edu/sevilla/thesis/SevillaThesis.pdf