11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

ISOGEOMETRIC COLLOCATION BOUNDARY ELEMENT METHODS

Matthias Taus[1], Gregory J. Rodin[2] and Thomas J. R. Hughes[3]

[1] Institute for Computational Engineering and Sciences (ICES), University of Texas at Austin, taus@ices.utexas.edu
[2] Institute for Computational Engineering and Sciences (ICES), University of Texas at Austin, gjr@ices.utexas.edu
[3] Institute for Computational Engineering and Sciences (ICES), University of Texas at Austin, hughes@ices.utexas.edu

Key Words: *Collocation, Isogeometric Analysis, Boundary Element Methods*

Isogeometric analysis has emerged as a framework for integrating computational geometry and finite element methods. In effect, in isogeometric analysis, interpolation functions widely used in computational geometry are adopted as finite element basis functions. At this stage, there are numerous applications of isogeometric analysis to problems of major practical and scientific significance.

The premise of this work is that isogeometric analysis is extremely beneficial for boundary element methods, especially if they are based on collocation discretizations. The main reason is that isogeometric analysis involves smooth basis functions and exact representations of surfaces. In this work we will show that, on smooth surfaces, these properties allow one to represent singular and hyper-singular operators in terms of weakly singular ones, construct high-order approximations without introducing additional degrees of freedom, and formulate integral equations leading to linear algebraic systems whose conditioning is independent of the mesh size. Further, we will show that these results can be extended to non-smooth surfaces using a local refinement strategy. In particular, this approach of local refinement will allow us to develop provably stable isogeometric collocation boundary element methods on arbitrary surfaces.