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NUMERICAL INTEGRATION MEHODS IN ISOGEOMETRIC ANALYSIS

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ABSTRACT

Isogeometric Analysis (IGA), originally introduced by T.J.R. Hughes, J.A. Cottrell, and Y. Bazilevs in 2005, has in recent years brought a renewed interest in developing highly accurate simulation models. The main characteristics of the isogeometric models are exact representation of the geometry using CAD standards, most commonly polynomial and rational splines, and using the same type of basis to describe the approximate solutions of PDEs.

To fully profit by the high accuracy of the isogeometric methods, the development of accurate and efficient numerical rules for both regular and singular governing integrals that appear in the formulation in Finite Element and Boundary Element Methods is of the highest interest. The vast topics include research fields related to special integration routines for B-splines, which exploit the inter-element continuity of the basis functions with a reduced number of quadrature nodes compared to the traditional Gaussian rules. Interpolation, quasi-interpolation and lookup tables are conventional techniques for the development of these rules, with machine learning tools gaining its importance in recent years. To improve efficiency of the adaptive methods, numerical integration for locally refinable splines (THB, LR, T-splines, splines on triangulation, etc.) that fully exploit local spline techniques is crucial. A special care is needed when applying the numerical integration on more challenging domains that include multi-patch domains, trimmed surface/volumes, and geometries with corners or sharp features. The importance has additionally increased due to popularity of the immersed methods, where the difficulty of domain meshing is greatly reduced by shifting the importance to the integration side. Last but not least, a special attention is needed to address integration with different singular kernels in Boundary Integral Equations, by combining techniques of analytical integration, singularity removals, coordinate transformations etc.

With the listed challenges written above, the goal of this session is to gather experts from IGA, numerical integration and PDE to further advance the state of the art of the isogeometric technologies.