REFINEMENT TECHNIQUES FOR SPLINE SPACES WITH CLOUD-BASED GEOMISO TNL SOFTWARE

Panagiotis Karakitsios[1], Panagiotis Kolios[1]*, Athanasios Leontaris[1], George Karaiskos[1]

[1] Geomiso Company, pkarakitsios@geomiso.com, pkolios@geomiso.com, aleontaris@geomiso.com, gkaraiskos@geomiso.com, www.geomiso.com

Key Words: *Isogeometric Analysis, Finite Element Analysis, CAD, Splines, Adaptive Refinement, Local Refinement, Knot Insertion, Order Elevation, k-refinement, Cloud.*

Geomiso TNL is a new both on-premises and cloud-based software, which delivers isogeometric analysis (IGA) and 3D design with splines. The combination of cloud computing and advanced refinement techniques constitutes a real game changer in CAD/CAE industry. Automatic mesh refinement has not been widely adopted in industry, because it requires access to the exact geometry. This hybrid program achieves seamless and automatic communication with CAD, thus mesh refinement utilizes the exact geometry, while cloud computing enables users to execute large-scale simulation experiments without the need for dedicated hardware.

The Geomiso TNL software uses NURBS and T-splines to represent complicated multi-patch geometries and provides refinement schemes, such as knot insertion and order elevation, as in finite element analysis, and k-refinement, which is available only in IGA. T-splines, which permit local refinement, are very robust in their ability to efficiently sew together adjacent patches, thus facilitate solution of the gap problem of intersecting NURBS patches. Knot insertion is analogous to h-refinement, and knots are inserted without changing a curve geometrically or parametrically, while it splits existing elements into new ones. Order elevation, which is analogous to p-refinement, increases the polynomial order of the basis without changing the geometry or its parameterization, while the number of new control points depends on the multiplicity of the existing knots. The alternative k-refinement is potentially a superior approach to high-precision analysis than p-refinement. In T-splines, all local refinement is done on the control mesh on a single hierarchical level and all control points have similar influence on the geometry.

Applications of refinement techniques on complicated geometric shapes are demonstrated with Geomiso TNL. It is proved that convergence and high-precision results are impossible without the exact geometry. A primary goal of this software is to be geometrically exact no matter how coarse the discretization is and to simplify refinement by eliminating the need for communication with the CAD model once the initial mesh is constructed. This new hybrid program makes refinement available via cloud to everyone through their browser.

REFERENCES

[1] P. Karakitsios, G. Karaiskos, A. Leontaris, P. Kolios, Geomiso TNL: A software for non-linear static T-spline-based isogeometric analysis of complex multi-patch structures, 14th World Congress in Computational Mechanics (WCCM), ECCOMAS Congress (2020).

[2] A. Karatarakis, P. Karakitsios, M. Papadrakakis, GPU accelerated computation of the isogeometric analysis stiffness matrix, Comput. Methods Appl. Mech. Engrg., 269 (2014) 334-355.