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Isogeometric analysis: an advanced solution for industrial applications

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Isogeometric analysis (IGA) is a powerful high-order methodology for the numerical solution of partial differential equations that has come to unify the fields of computer-aided design (CAD) and finite element analysis (FEA). It was originally introduced by T.J.R. Hughes et al. in 2005 to generalize and improve FEA with the goal of achieving a seamless integration of design and computer-aided analysis. IGA has attracted a lot of attention for solving boundary value problems as a result of using splines for both describing the domain geometry and building the numerical approximation of the solution. IGA appears to be clearly superior to standard finite elements, while it has a wide spectrum of industrial applications. This powerful generalization of the traditional FEA exploits the full potential of the CAD model and achieves seamless design-through-analysis procedures. The utilization of the exact geometry mesh for analysis not only improves the geometry modeling within analysis but also eliminates geometric errors and reduces the computational cost, while there is no need to repeat the geometry design for refinement purposes. NURBS were used as a first basis function technology within IGA, while T-splines are proved a mighty tool for IGA. T-splines were introduced by Sederberg et al. in 2003 as a more efficient alternative with sophisticated implementation. They are not restricted to a tensor product structure while exhibiting more design capabilities, like watertightness, that allow better handling of complex geometries and permit local refinement, ensuring higher-order continuity across patches. While on simple geometries, splines have shown superior performance in various demanding applications, there remain many challenging problems in utilizing complex geometries and major difficulties between the basic science research in academia and technology transfer to problem-solving by industry and other end users.

The purpose of this minisymposium is to gather young researchers in computational mechanics and applied mathematics who are engaged in academic/industrial research on IGA to present their work, discuss the latest advancements, and acquire new knowledge, with the aim of contributing to further advance its state of the art. It seeks to present successful collaborations between industries, national laboratories, and academia on underexplored problems, as well as for showcasing emerging paradigms in the industry upon which IGA could have an impact. It will feature a broad representation of both industrial and academic results/projects in IGA. In addition to theoretical study, it will also expose best practices, spark new ideas for effective collaboration on multidisciplinary research, and welcome related presentations on software development. Areas of interest include, but are not limited to:

- Structural statics and dynamics,
- NURBS, T-splines, polycube splines, subdivision surfaces/volumes, HB-splines,
- Complex geometries, multi-patch IGA, trimmed NURBS,
- Flexible local refinement techniques based on T-splines and hierarchical B-splines,
- Volumetric parameterization, mesh adaptivity, design optimization,
- Spline methods on unstructured quadrilateral/hexahedral meshes,
- Treatment of boundary conditions,
- Isogeometric collocation schemes,
- Space time variational multiscale isogeometric analysis, thermomechanical IGA,
- Cloud computing, GPU, high-performance computing.