PDE-Based Parameterization Techniques for IGA Applications

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ABSTRACT

The generation of an analysis-suitable computational mesh is the first step towards a numerical simulation of any engineering process. However, the full automation of the meshing pipeline remains a difficult problem, often requiring application-specific specially-tailored approaches.
Since the onset of Isogeometric Analysis (IgA) [1], spline-based geometry descriptions have received an increased amount of interest [2, 3]. Thanks to the smooth nature of spline basis functions, the boundary contours of the target geometry can be captured in more detail with fewer elements, potentially reducing the computational costs associated with the meshing process.
The spline-based geometry parameterization can then directly be used for an IgA-based numerical simulation or it can be turned back into a classical mesh with application-specific mesh features and a tunable element density, simply by evaluating the spline-mapping in a large number of discrete points and connecting the resulting point cloud by linear edges.
In this talk, we give an overview of the newest developments in the field of spline-based parameterization techniques, in particular those based on the principles of Elliptic Grid Generation (EGG) [4] with both structured and unstructured spline technologies. We will discuss the case in which the mapping is defined over a single computational domain (single-patch) or several computational domains (multi-patch).
The efficacy and reliability of the proposed approaches are evidenced through their successful application to twin-screw type geometries [5, 6], in both two and three spatial dimensions.

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