Spline-Based Meshing Techniques for Industrial Applications

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ABSTRACT

Isogeometric Analysis (IgA) has become an accepted framework for the modelling, simulation and optimization (MSO) of engineering processes. However, the fully automatized generation of analysis-suitable parameterizations of geometries as they arise in practical workflows is still a challenging task which often requires application-specific parameterization approaches.

In this talk we present a practical approach [1] based on the principles of *'Elliptic Grid Generation'* (EGG) for the efficient on-demand generation of analysis-suitable spline-based parameterizations. Starting from a (point-cloud) description of the boundary provided by the existing MSO-pipeline, an inverse nonlinear Poisson-type problem is solved to obtain a folding-free (planar) parameterization of the entire domain. The nonlinearity is efficiently treated with a globalized hierarchical Newton approach. Automatized boundary contour reparameterization techniques are employed to improve the parametric properties from a numerical viewpoint, such as orthogonal isolines and equally-sized cells. The use of curved instead of straight-sided elements allows us to arrive at an accurate description of the target domain with fewer elements and thus potentially lower computational effort.

Numerical experiments with screw-compressor geometries demonstrate that the proposed algorithm reliably produces high-quality parameterizations typically within $3-4$ Newton-iterations, even in the presence of extreme aspect-ratios. This makes it particularly attractive for the on-the-fly application within an automatized industrial MSO-pipeline.

To support the demands of modern high-performance computing hardware, only a moderate number of sufficiently large and structured patches is generated which can be mapped one-by-one to the different devices (CPUs/GPUs) with only little communication overhead. Also, topology changes are avoided in time-dependent and shape-optimization settings.

REFERENCES

[1] J.Hinz, M.Möller, C.Vuik., *Elliptic Grid Generation Techniques in the Framework of Isogeometric Analysis Applications*. Submitted to: *GMP 2018*.