

Standardization of V-rep essential for Deployment of Isogeometric Analysis in Additive Manufacturing

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ABSTRACT

A major challenge for the deployment of Isogeometric Analysis (IgA) in industry is the availability of industrial accepted solutions (CAD, FEA) and the legacy and bulk of preexisting digital information. Rather than focusing on application areas dominated by FEA, IgA should focus on novel application areas where fewer established solutions exist and the legacy of exiting digital information is minor. One such area is additive manufacturing (AM). In AM, trivariate spline representations are superior to traditional finite elements with respect to representation of variable and anisotropic material, whilst preserving geometric quality of the design model.

However, even for AM, a prerequisite for deployment of IgA on a broad scale is near seamless interoperability between boundary structure (B-rep) CAD and IgA. The integration of sculptured surfaces (B-splines and NURBS) into solid CAD models (B-rep) was a central research topic in the 1980s, then standardized as part of ISO 10303 (STEP) in the 1990s. The development of B-rep CAD focused on the needs of CAM (Computer Aided Manufacturing) where small gaps between surfaces were not regarded as a major issue. STEP was introduced to provide interoperability between CAD-systems. Direct translators between CAD-systems are still in wide use as they can exchange information not supported by STEP. However, for product life cycle management (PLM) and long-term archiving and storing (LOTAR) the use of standards is important for ensuring that data is accessible also in the future. There is no guarantee that vendor proprietary formats will have future support.

For these reasons, STEP has been the natural standard to augment with IgA capabilities. The EC Factories of the Future Project TERRIFIC (2011-2014) focused on trivariate spline models and IgA. TERRIFIC proposed several extensions to STEP to support IgA with respect to Locally Refined Splines (T-splines, LR B-splines), in addition to trivariate spline models. Some of these extensions have been published as part of STEP in 2018. In the EC Factories of the Future Project CAxMan [1] (2015-2018) the STEP work of TERRIFIC was continued. Further augmentations of STEP related to IgA are also underway supported by other members of the STEP community. The focus of the CAxMan project was on computer assisted technologies for AM with a special attention to analysis-based design, trimmed trivariate CAD-models and IgA. This exposes IgA to an application domain where many challenges are still unsolved.

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REFERENCES

- [1] T. Dokken, V. Skytt, O. Barrowclough, *Trivariate spline representations for computer aided design and additive manufacturing*, *Computers & Mathematics with Applications*, <https://doi.org/10.1016/j.camwa.2018.08.017>, arXiv:1803.05756v3
- [2] <https://www.caxman.eu>