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Composition du Jury

Civilité	Nom	Prénom	Grade / Qualité	Rôle
M.	BOUCLIER	Robin	Maître de Conférences HDR	Rapporteur
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Résumé

Uniting the workflows of geometric design and numerical analysis is one of the aims of IsoGeometric Analysis. Such a goal is addressed by using the same mathematical functions — namely, Non-Uniform Rational B-Splines — to describe the geometry and to serve as a support to solve the analysis. Amongst other advantages, NURBS functions benefit from a higher continuity with regards to Lagrange polynomials, and coarser meshes can be used, reducing the analysis time. When it comes to shape optimisation, IGA offers the advantage of providing a model that is compatible with Computer Aided Design software, without further processing.

The aircraft engine design and manufacturing industry uses numerical methods, and hence can benefit from the features of IGA. Specific concerns arise in this industrial context, the volumetric definition of spinning parts such as blades being a prominent one. The purpose of this work is to propose a framework for the design, analysis and shape optimisation of aircraft engine blades using IGA.

Using an industrial blade geometry, we propose a procedure to reconstruct a B-spline analysis-suitable volumetric model of the blade, ensuring its geometric accuracy and parametrisation regularity. Shape optimisation is performed using the spatial coordinates of control points as design variables. The mechanical response of the structure is computed using the open-source IGA code Yeti. The rest of the assembly, including the platform and tenon of the blade, is considered using a mortar approach for weak patch coupling. An embedded solid element formulation was developed during this study, enabling accurate modelling of the fillet linking the blade to its platform. It guarantees the geometric compatibility of the interfaces between adjacent patches during shape updates in the course of the shape optimisation process.

The results demonstrate the efficiency of the method and its relevance for industrial aircraft engine blade design and shape optimisation.