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ISOGEOMETRIC ANALYSIS OF THE BLISK

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Research Program:

Introduction

Gas turbines are used to power many industrial applications such as aircraft, cruise ships, and electric generators. The cost to manufacture and maintain gas turbines is high, and, as a result, advanced numerical simulation is often used to help assess the engine performance, identify the mechanical factors that cause component failure, and suggest design modifications that improve gas turbine efficiency and durability. Recent advances in Isogeometric Analysis create a unique opportunity for the development of the next generation of predictive simulation methods and tools for gas turbine engines, with significantly improved representation of complex geometry and multi-physics phenomena.

In this work, we perform isogeometric analysis on an integrally bladed rotor (IBR), which is a single engine component—consisting of a rotor disk and blades—increasingly used in the modern gas turbine design. Damage to IBR blades usually requires the full removal of the engine so that the IBR may be replaced. Predictive numerical simulation can be used to improve the design and durability of the IBR and reduce associated cost.

We show important steps of using Rhino to extract control point and knot vector information from a CAD model with trimmed NURBS surfaces. The IBR is a solid piece of metal and therefore it is important to build a trivariate solid NURBS model for the structural analysis purpose. We design a template-based geometry modeling tool to construct an analysis-suitable multi-patch solid NURBS model of IBR. Finally, eigenvalue analysis of the structural model is performed and the results will be presented.

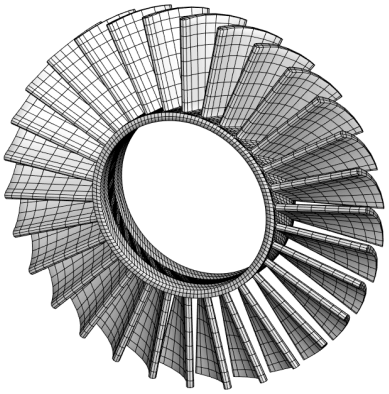

Fig.1 Trivariate NURBS Blisk

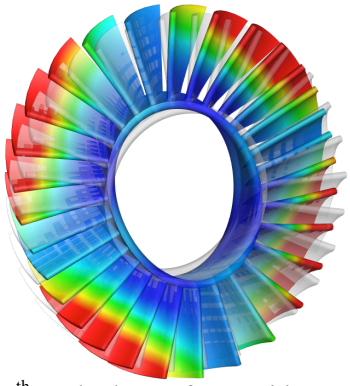

Fig.2 7th mode shape of IBR with Free Hub

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