Increasing Safety of Turbine Disk in Aerospace Engine

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Background

- Design of gas turbine engines deformation caused by vibrations must be reduced below a reasonable level
- High levels of dynamic stresses vibrations can lead to failure of some components or the entire engine
- The problem of evaluating dynamic stresses at the design stage of gas turbine engines is currently an open issue
- One way to reduce dynamic stresses is to include devices that add friction damping into the mechanical system
- Dry friction on contact surfaces in the joint root, on contact surfaces of shrouds of the blades, and contact surfaces of friction dampers

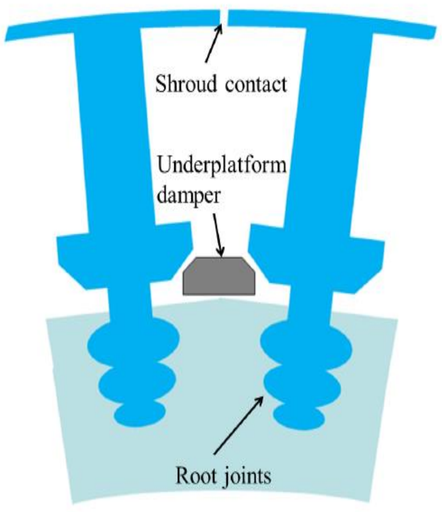

Figure1. Friction Damping Location

Addressed problems

- Frictional forces have a highly nonlinear behavior
- Additional issue is that the real disk that cannot be simulated under cyclic symmetry conditions
- Small variation on the sector geometry and mechanical properties that have a detrimental impact on the dynamic response of the disk. This phenomenon is known as "mistuning".

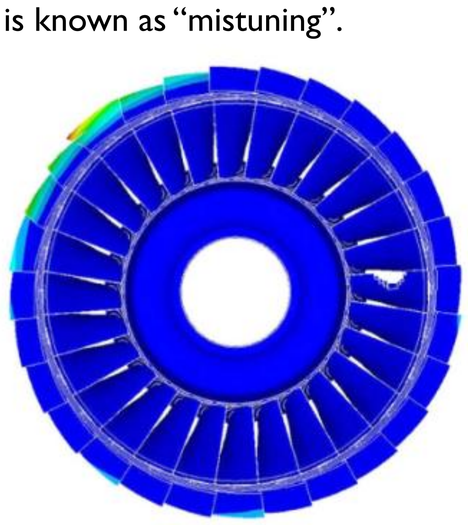

Figure2. Change in Stress Distribution due to Mistuning

Passed Courses

- Modeling of full film lubricated systems
- Numerical Modeling and simulation

Objective

- Obtain a reduced order model of mistuned bladed disk by considering the effects nonlinearity sources like contact between blade and disk shrouds

Stuides and Results

- The effects of mistuning on dynamic response of a bladed disk was studied based on Modal test on a low-pressure turbine rig blade disk designed and tested by Avio

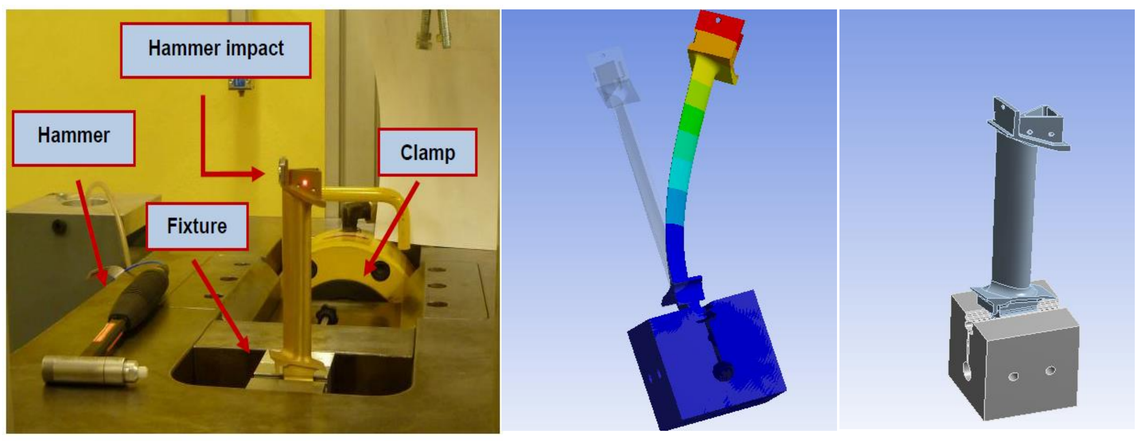

Figure3. View of blade testing and model of fixed blade in Ansys

- Modelling the blade in Ansys and verifying the results with experimental data
- Studying the effects on mistiming on dynamic response of bladed disk at different operating speed
- Obtaining The reduced order model generated in ANSYS with the CMS technique

Pruilmenary Results

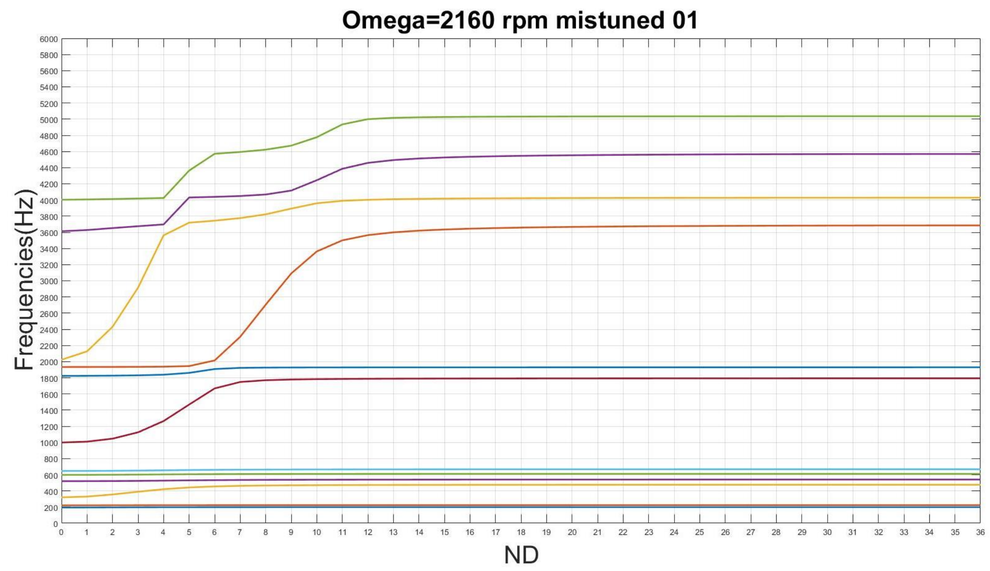

Figure4. Frequency versus Number of Nodal Diameters for a mistuned bladed disk

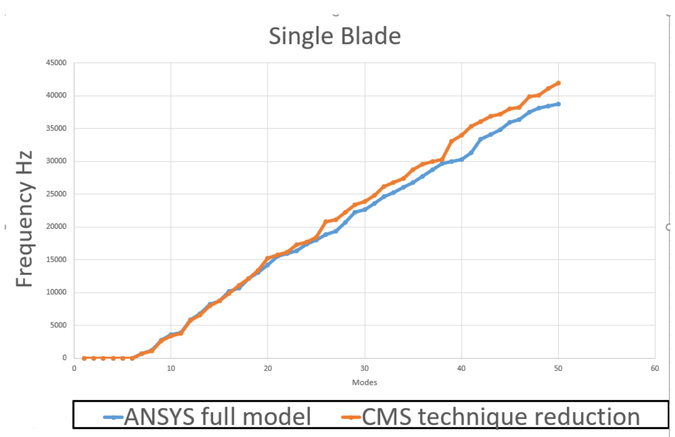

Figure5. Comparing the results of full model and reduced model