DISSEMINATION REPORT

Report Title: **Simplified Forced Response HCF Assessment of Turbomachinery Blades**

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Abstract:

A method is proposed for HCF-analysis that is suitable for use in early design stages of turbomachinery blades. Quantitative measures of the risk for later encountering HCF life limiting vibrations are the goal for the development. The novelty of the system is the unique and rational way all design data are processed resulting in a mode risk priority listing. The method makes extensive use of FE calculated modal analyses and simple assumptions on the modal force and damping. The modal force is taken proportional to the tangential force on the blade over the operating range. This choice is made because the tangential force is known early on from the compressor performance map, and gives a reasonable scaling with the operating point. Crossings occurring at low speed get a lower force than at high speed. The system damping used is a constant critical damping ratio. Using a modal force and damping along with the FE model forced response amplitude can be directly computed at resonance crossings inside operating envelope. The modal force calculated this way can be compared to the force amplitude needed to reach the fatigue limit in a Haigh diagram. Using the Haigh diagram this way allows modes with localized high stresses, so-called hot spots, to be highlighted. Taking the ratio of the forces gives a ranking value that can be used to compare risk. Details of the technique along with example applications to compressor blades are presented in the paper. It is found that many mode crossings can be excluded as low risk this way and that a rational way of prioritizing is achieved.

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