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Forced response study of an embedded compressor rotor

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If not designed properly, the blade and vanes of rotating machines, such as turbines, are susceptible to high cycle fatigue failure due to high vibratory response. The well-known Campbell diagram is used to help maintain a separation between excitation and natural frequencies. However, the plethora of excitation and natural frequencies can make avoiding resonances difficult, or practically impossible. In these cases, forced response design analyses can be used to predict the resonant response. This has been done for over 20 years, but the accuracy and probabilistic nature of the problem still have many unanswered questions. There are unknowns in the forcing function, damping and mistuned response. This is especially the case for the blades and vanes of embedded compressor stages. This paper summarizes the results of an exhaustive computational and experimental study of compressor blade resonant response. The focus is on the rotor forced response in a 3.5 stage compressor rig at Purdue University. The influence of reflecting boundary conditions on the blade modal force is studied. The computational aerodynamic and hysteretic damping are compared with measured values and the mistuned response with multiple models are compared with measurements.

Biography

Robert Kielb specializes in Turbomachinery Aeroelasticity and has over 45 years of academic, industrial and government research laboratory experience in Turbomachinery for power and propulsion. Currently, he is an Associate Professor of the practice in the Department of Mechanical Engineering and Materials Science at Duke University. He is a fellow of the ASME and was a Chair of the Board of Directors of the International Gas Turbine Institute, Chair of the ASME Structures and Dynamics Committee and Associate Editor of both the Journal of Turbomachinery and Journal of Engineering for Gas Turbines and Power. He received his PhD from Ohio State University in 1981.

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