

Blade Vibration Measurement System

For characterization of closely spaced modes and mistuning

The Phase I project successfully demonstrated that an advanced noncontacting stress measurement system (NSMS) could improve classification of blade vibration response in terms of mistuning and closely spaced modes. The Phase II work confirmed the microwave sensor design process, modified the sensor so it is compatible as an upgrade to existing NSMS, and improved and finalized the NSMS software. The result will be stand-alone radar/tip timing radar signal conditioning for current conventional NSMS users (as an upgrade) and new users. The hybrid system will use frequency data and relative mode vibration levels from the radar sensor to provide substantially superior capabilities over current blade-vibration measurement technology. This frequency data, coupled with a reduced number of tip timing probes, will result in a system capable of detecting complex blade vibrations that would confound traditional NSMS systems.

The hardware and software package was validated on a compressor rig at Mechanical Solutions, Inc. (MSI). Finally, the hybrid radar/tip timing NSMS software package and associated sensor hardware will be installed for use in the NASA Glenn spin pit test facility.

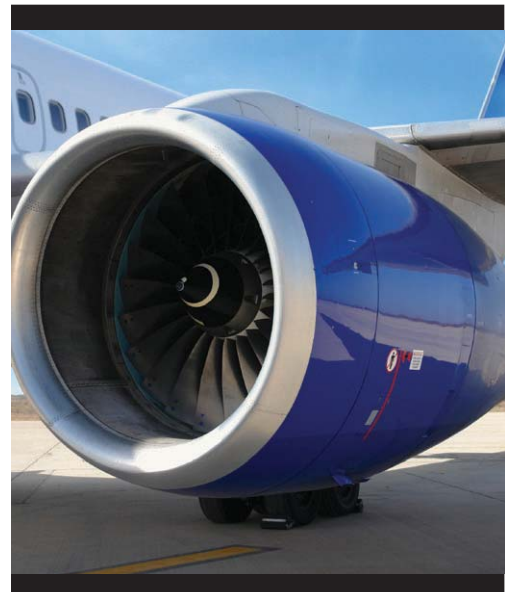
Applications

NASA

- ▶ Gas turbine propulsion engines
- ▶ Turbomachinery for liquid propulsion engines
- ▶ Steam turbines for power generation

Commercial

- ▶ Aircraft engines
- ▶ Industrial gas turbines
- ▶ Steam turbines in power generation and/or oil and gas
- ▶ Predictive health management for aerospace and industrial machines



Phase II Objectives

- ▶ Develop and demonstrate improvements in sensors and data acquisition
- ▶ Validate prototype work using instrumented compressor rig
- ▶ Characterize mistuning, mode shapes, and frequencies in test article
- ▶ Develop prototype software
- ▶ Perform rig tests, with synchronous and nonsynchronous blade excitation
- ▶ Compare strain gage data to noncontacting measurements

Benefits

- ▶ Improves blade vibration measurement capability
- ▶ Reduces cost and risk of developing and operating gas turbine engines

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