MTII'S SENSORS HELP KEEP YOU FLYING HIGH!!

Introduction

Whenever we board an airplane we hardly give much thought to the jet engine sitting on the wing. As it comes to life and spins effortlessly we hear little, if any, vibration or noise in the cabin. Seldom do we realize how much testing and effort goes into ensuring trouble free operation through thousands of takeoffs and landings.

Take the turbine blades for example (see figure 1). Under normal operating conditions they are subjected to extreme temperatures, pressures, vibrations and forces. To make certain they can withstand these conditions extensive testing is performed in a simulated setting. One such test is the accelerated fatigue test. This experiment excites the turbine blade and determines the number of vibration cycles it can withstand prior to failure.

Figure 1

The Test:

In order to simulate real world conditions turbine blades are vibrated in a sound chamber at a variety of elevated temperatures. A siren directs a blast of pulsed air at the leading edge of the turbine blade creating a tremendous amount of force. This force excites the turbine blade at its resonant frequency, inducing strain in the blade structure. The test continues for months or years to determine how many vibration cycles a particular blade configuration or design will endure. This provides valuable information to the designer as to how long an engine can operate before experiencing a catastrophic failure.

The Problem:

To accurately monitor vibration amplitude and frequency a non-contact measurement sensor is required. Non-contact eliminates any "mass loading" or dampening of the turbine blade vibration and is not prone to failure or wear. Customarily a CCD camera system is used to view the blade displacement at the leading edge. Although these work well at determining major displacement or frequency changes associated with catastrophic failures they are not able to detect small changes that signify the formation of a tiny fatigue crack. Additionally, their long term stability is poor, making them less than ideal for lengthy tests. A proven high resolution, high frequency response sensor is required.

The Solution:

After reviewing the application details MTII's Application Engineers proposed the Microtrak 7000 laser displacement sensor (see figure 2) because of the 100 kHz sampling frequency and sub-micron resolution. The customer selected the 7000 because the visible laser spot provides a means for easy setup and alignment of the sensor and the 6" operating distance allowed the laser head to operate outside the sound chamber.

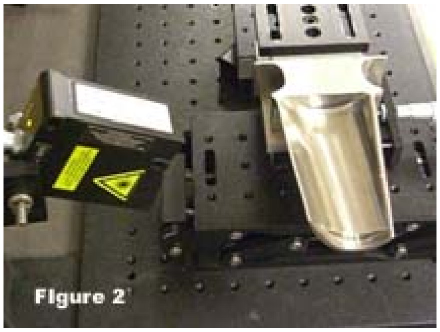

Figure 2

The Results:

The Microtrak 7000's (see figure 3) ability to operate at a safe distance away from the hot turbine blades as well as the ability to measure through a small gap helped the customer obtain higher accuracy and more meaningful data than with previous systems. Vibration results were obtained faster

Figure 3

and at a lower cost than with a CCD camera or a Laser Vibrometer. Additionally the feature of interchangeable laser heads allowed the customer the ability to test and analyze their wide variety of turbine blades and other engine components.

If you have a challenging measurement application contact MTII's Application Engineers for more details on their laser, capacitive, fiber-optic and eddy current products.