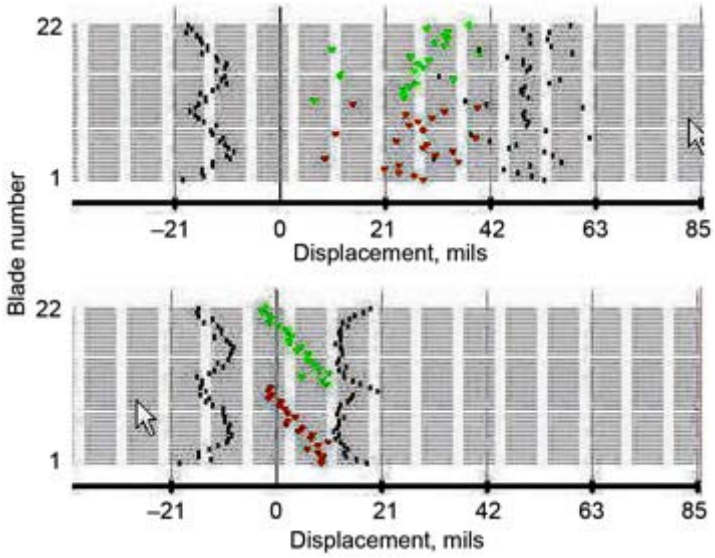
System Developed for Real-Time Blade-Flutter Monitoring in the Wind Tunnel

A real-time system has been developed to monitor flutter vibrations in turbomachinery. The system is designed for continuous processing of blade tip timing data at a rate of 10 MB/sec. A USB 2.0 interface provides uninterrupted real-time processing of the data, and the blade-tip arrival times are measured with a 50-MHz oscillator and a 24-bit pipelined architecture counter. The input stage includes a glitch catcher, which reduces the probability of detecting a ghost blade to negligible levels. A graphical user interface provides online interrogation of any blade tip from any light probe sensor. Alternatively, data from all blades and all sensors can be superimposed into a single composite scatter plot displaying the vibration amplitude of each blade.



Scatter plot display prior and during flutter.

The graphs illustrate a typical screen display during flutter monitoring. The lower trace was obtained just prior to flutter, and the upper trace was obtained during flutter. There are data from two sensors, green (lightest dots) and red (medium dots). The darkest symbols represent the maximum excursion of each blade since the beginning of recording. There are 22 blades and, consequently, 22 dots for each sensor. Ideally, the dots from each sensor in the lower part should line up on a vertical line; however, because of the slight change in the operating conditions since the reference data were collected, the blades are displayed on a sloping line. The upper flutter plot is clearly distinguishable from the steady-state display. Each blade is instantaneously depicted at a particular point in the nonsynchronous vibration cycle.

Bibliography

Radzikowski, Marc, et al.: Real Time Monitoring Systems for Turbomachinery. ASME Paper GT2004-53992, 2004.

Glenn contact: Dr. Anatole P. Kurkov, 216-433-5695, Anatole.P.Kurkov@nasa.gov
Authors: Harbans S. Dhadwal, Mark Radzikowski, Dmitri Strukov, and Dr. Anatole P. Kurkov
Headquarters program office: OAT
Programs/Projects: QAT, UEET