



# Impact

**SBIR Topic Number:**

AF 99-313

**Title:**

Instantaneous Profilometer for In-Situ Modal Analysis

**Contract Number:**

F40600-00-C-0009

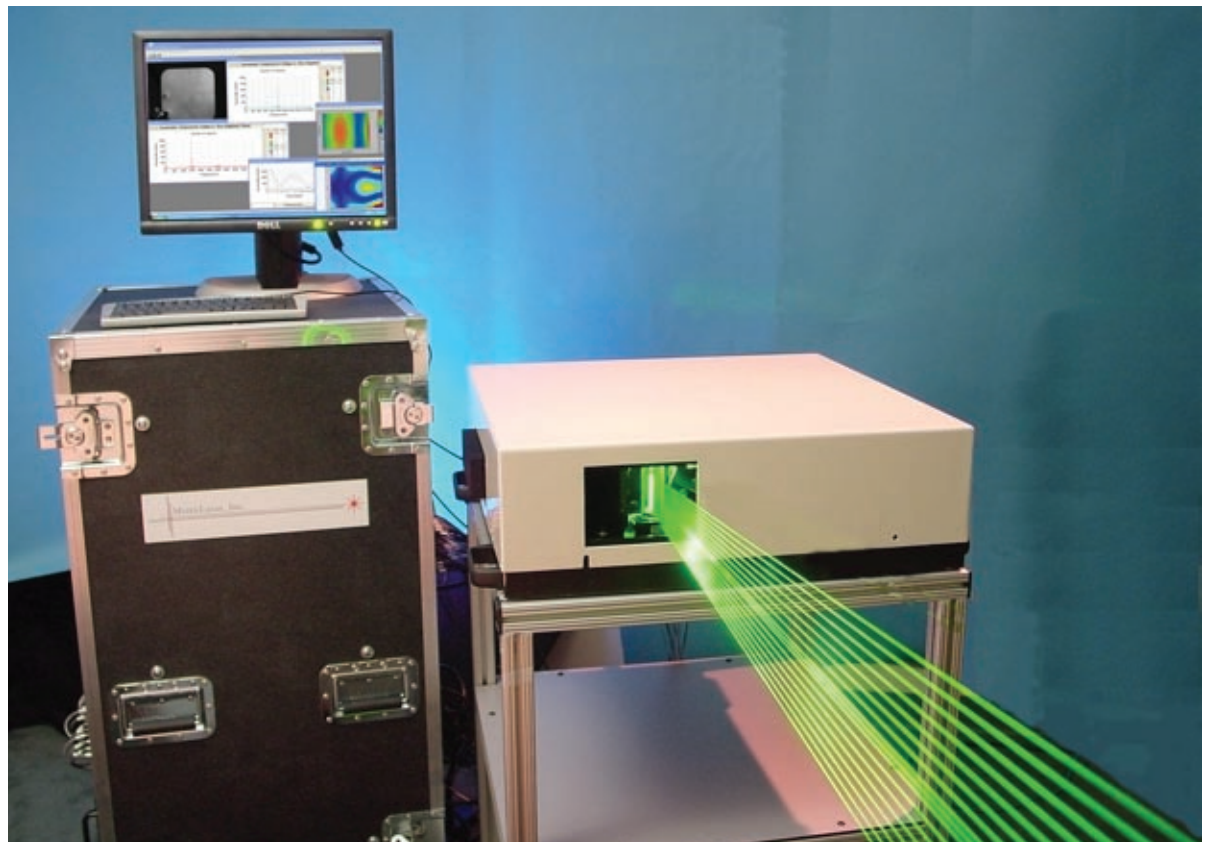
**Company Name:**

MetroLaser, Inc.,  
Irvine, CA

**Technical Project Office:**

Arnold Engineering  
Development Center,  
Arnold AFB, TN

An example of Air Force supported SBIR technology that met topic requirements and is being commercialized by the small business partner.



## Non-Contact Whole Field Vibration Measurements for Aeromechanical Evaluation of Turbine Engines

- The Air Force sought to eliminate the need for intrusive straingage measurement during the evaluation of turbine engines
- Using SBIR contracts MetroLaser scientists developed a specialized version of a MultiBeam Laser Doppler Vibrometer (MB-LDV).

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## Air Force Requirements

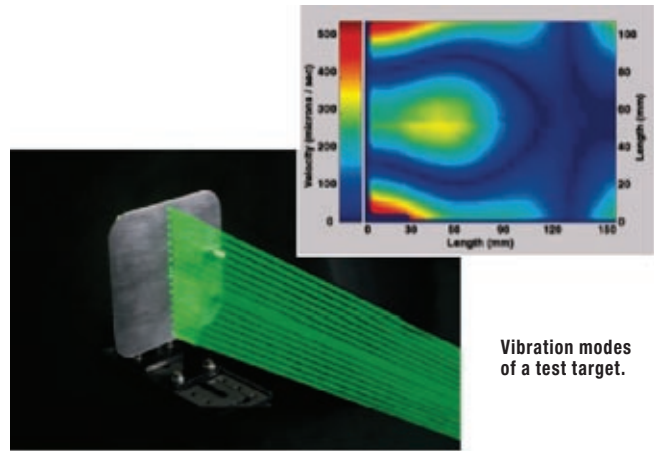
The main objective of this SBIR effort was to eliminate straingage dependency for aeromechanical evaluation of turbine engines. Straingages require costly and troublesome slip rings, generally do not last the full duration of aeromechanical testing, and cannot be replaced without a significant engine rebuild. The Air Force wanted a less troublesome, non-intrusive measurement device, that was comparable to or better than the accuracy of straingages but not requiring a model to determine the stress/strain or displacement.

## SBIR Technology

Working with the Air Force under a Small Business Innovation Research (SBIR) Program Phase II, MetroLaser scientists designed a program to address the issue of eliminating straingage dependency during aeromechanical testing. This program sought to reduce time and cost to evaluate turbine engines and improve accuracy without contacting the parts under test. After reviewing a number of competing technologies the MultiBeam Laser Doppler Vibrometer (MB-LDV) was chosen to engineer further. Over a three year period, several versions of the MB-LDV system were developed that included a scanning array of 16 beams and a 4 x 4 matrix of beams. During the program, the optical and mechanical design of this system continued to shrink as the ability of the user to re-configure the beam pattern increased.

## Company Impact

The MB-LDV has already generated close to \$1 million of non-SBIR government and commercial funds and has become the flagship of MetroLaser's commercial LDV activities. MetroLaser anticipates that commercial revenues from the MB-LDV would be about half a million dollars in 2005 and over one million in 2006. The long-term prospect of this device is of significant importance to MetroLaser since the commercial market for LDV is many tens of million of dollars and the MB-LDV is aimed to capture a significant portion of this market. Commercial applications include many in the automotive industry such as non-contact whole field vibration analysis of chassis and engine auto parts during dynometric testing. Currently, either traditional accelerometers or single beam scanning LDV



Vibration modes of a test target.

systems are used. Traditional accelerometers require attaching the accelerometers to the parts with a cable connecting each to the data collection system. Single beam scanning LDV systems require that the single laser beam be moved from point to point, missing some data during the transition. This is particularly important when running automobile acceleration tests when the engine throttle is run 'Wide Open'. Other potential applications include such diverse fields as vibration testing of micro electro-mechanical systems (MEMs) devices and biomedical evaluations of vibrations in live human test subjects.

## Technology Payoff

The technology developed under this program found immediate potential military applications. In addition to the military and civilian evaluation of turbine blades, this same MB-LDV technology has been successfully aimed at detecting buried landmines. The MB-LDV is already seen as one of the best solutions for acousto-seismic landmine detection. Both the Air Force and the Navy are interested in applying the MB-LDV to structural testing and the market potential for this application is measured in the millions of dollars. Robins AFB has specifically granted MetroLaser an SBIR to develop a whole-field MB-LDV system for aircraft testing.



U.S. AIR FORCE

# SBIR

Air Force SBIR Program  
AFRL/XPTT  
2275 D Street  
Wright-Patterson AFB, OH  
45433-7226

AF SBIR Program Manager: Steve Guilfoos  
e-mail: [stephen.guilfoos@wpafb.af.mil](mailto:stephen.guilfoos@wpafb.af.mil)  
Website: [www.sbirstrmall.com](http://www.sbirstrmall.com)

Comm: (800) 222-0336  
Fax: (937) 255-2329  
e-mail: [afri.xptt.dl.sbir.hq@wpafb.af.mil](mailto:afri.xptt.dl.sbir.hq@wpafb.af.mil)

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