

Innovation

SBIR Topic Number:
AF04-244

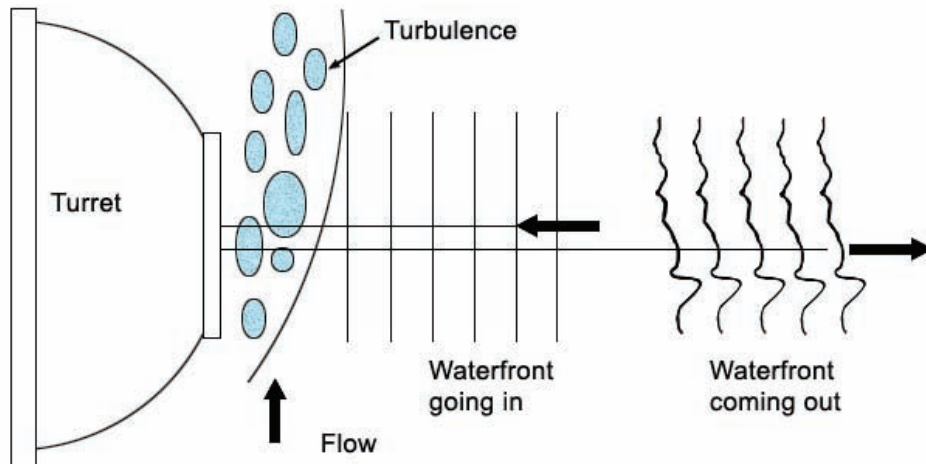
SBIR Title:
Flow Control for Enhanced
Sensor Beam/Directed
Energy (DE) Beam Quality

Contract Number:
FA8650-05-C-3515

SBIR Company Name:
MetroLaser, Inc.,
Irvine, CA

Technical Project Office:
AFRL Air Vehicles
Directorate, Wright-
Patterson AFB, OH

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.



The wavefront is planar before passing through the turbulent flow. Aero-optical effects caused by the turbulent flow add tilt and fluctuations to the wavefront causing distorted images and inability to focus the beam onto a target.

Flow Control for Enhanced Sensor Beam/Directed Energy (DE) Beam Quality

- The Air Force has a requirement to minimize the aero-optic degradation of laser beam wavefronts caused by flow features, such as shear and boundary layer, of their airborne platforms.
- This technology includes a powerful aero-optical diagnostics tool that will enable AFRL to model, test, and analyze the effectiveness of flow control and adaptive optics techniques to correct for these effects.
- Potential Air Force applications exist in all forms of optical propagation through the atmosphere including communication, target designation, tracking, astronomy, and weather.
- Potential commercial applications include free-space laser communications, active laser imaging and aero-optics, high bandwidth video transmission, spectroscopy, and high-resolution imaging.

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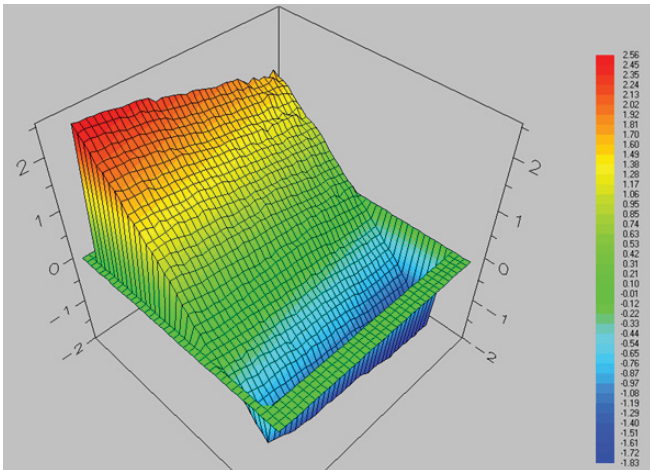
Air Force Requirement

The U.S. Air Force arsenal includes a wide range of systems that project and receive laser beams from airborne platforms. The capability of almost all of these devices is deteriorated by aero-optical effects on the optical wavefront caused by flow features of the aircraft, such as shear and boundary layers. The U.S. Air Force has a requirement for a capability to understand and address these problems through experiment and analysis to improve and optimize the capability of such systems.

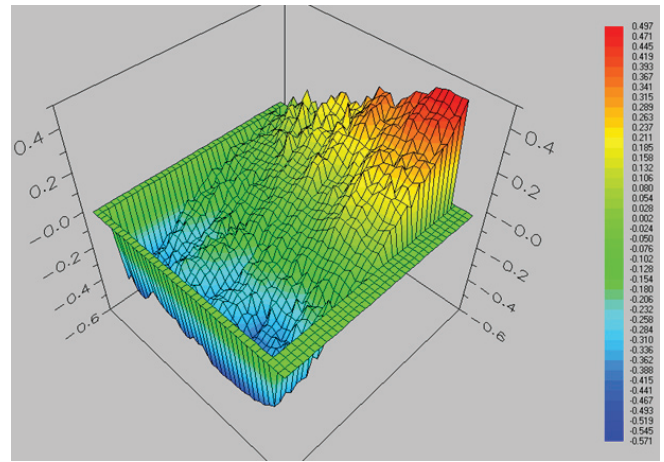
SBIR Technology

The technology delivered under this SBIR program includes a powerful aero-optical diagnostics tool that will provide the Air Force Research Laboratory (AFRL) with a valuable enhancement of their capability in aero-optical testing. The instrument can measure the quality of a wavefront under test conditions including Strehl ratio, root mean square (RMS) wavefront deviation, boresight error, turbulence structure, and temporal properties. This technology will provide AFRL with a unique in-house capability to model, test, and analyze the effectiveness of flow control in minimizing aero-optical degradation of wavefronts.

The figures illustrate direct measurements of the aero-optical effects on an optical wavefront emerging from a turret in a subsonic flow. For this specific condition, produced in the AFRL Trisonic Gasdynamic Facility at Wright-Patterson Air Force Base, the wavefront shown in a) shows little change (other than tilting) from planar in ten microseconds; however, its deterioration in 240 microseconds is quite evident.



a) Change in the wavefront in 10 microseconds



b) Change in the wavefront in 240 microseconds

From these wavefront maps we can, for example, determine precisely how much energy density can be deposited on a distant target from an airplane and, moreover, what type of flow control and adaptive optics will be required to correct for these effects.

Potential Air Force Application

Applications exist in all forms of optical propagation through the atmosphere, including communication, target designation, tracking, astronomy and weather. The technology developed under this SBIR is extremely important for deploying and determining practical constraints of fielded military and commercial systems. It will provide the U.S. Air Force with a unique capability to understand and exploit the relationship between flow control mechanisms and aero-optics. Potential commercial applications include free-space laser communication, active laser imaging and aero-optics, high bandwidth video transmission, spectroscopy, and high-resolution imaging.

Company Impact

The tools developed in this SBIR project will find a wide range of applications in the diagnostics of flow fields and aero-optics, which represents a major segment of our business. This will enable our company to remain on the cutting edge of the state-of-the-art in flow diagnostics and will improve our competitive position in this area.



SBIR/STTR

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