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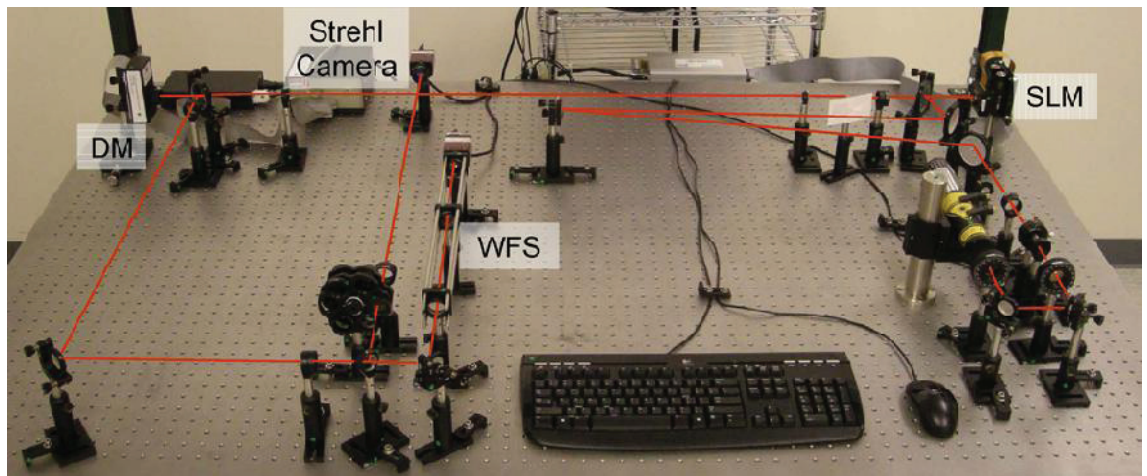
Title:
Aero-Optics Research
and Development

Contract Number:
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Company Name:
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Albuquerque, NM

Technical Project Office:
AFRL Directed Energy
Directorate, Kirtland AFB,
NM

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.



Adaptive Control for Aero-Optical Compensation

- Adaptive optics (AO) beam control is required for aircraft-based laser directed energy systems to maintain laser optical quality while traversing the path from aircraft to target
- The system degradation associated with AO latency can be reduced by use of adaptive control, which implements a predictive adjustment to the current update of the deformable mirror
- The command adjustment by the adaptive controller accounts for AO latency and improves laser compensation quality
- The adaptive control method developed in this SBIR project can be incorporated into any wavefront control processor, thereby doubling the laser irradiance delivered to targets from the laser system as compared to conventional control methods
- Adaptive AO control enhances the performance of aircraft-based laser by 100%

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Air Force Requirement

Adaptive optics (AO) beam control is required for aircraft-based laser directed energy systems to maintain laser optical quality while traversing the path from aircraft to target. This propagation path includes optical disturbances caused by the airflow around the aircraft, commonly referred to as "aero-optics" as well as naturally-occurring atmospheric turbulence over the many kilometers of air through which the laser passes.

Adaptive control technology for AO greatly improves the quality of the laser compensation given the characteristics of the beam control system and the flight/atmospheric conditions. Improved laser compensation increases the laser irradiance incident on a target.

SBIR Technology

Adaptive control is the logic and accompanying computer software which connects measurements of optical disturbances made by the laser beam control system's wavefront sensor with the commands sent to the deformable mirror (DM) which corrects the laser for optical distortions. Since the AO system must be updated several thousand times per second to measure aero-optical disturbances, latencies in the AO system result in AO compensation degradation.

The system degradation associated with AO latency can be reduced by use of adaptive control, which implements a predictive adjustment to the current update of the DM, given a recent time history of wavefront sensor measurements and computer processing to develop the proper wavefront filter.

The command adjustment by the adaptive controller accounts for AO latency and improves laser compensation quality. The controller is truly adaptive and therefore changes the AO command adjustment to account for changes in the properties of the aero-optical or atmospheric disturbances.

Potential Air Force Application

Adaptive control technology for laser AO compensation can make an immediate impact on aircraft-based laser systems. High-speed aircraft platforms suffer from significant aero-optical distortions and therefore need robust AO beam control.

The adaptive control method developed in this SBIR project can be incorporated into any wavefront control processor, thereby doubling the laser irradiance delivered to targets from the laser system as compared to conventional control methods. Therefore, adaptive AO control enhances the performance of aircraft-based laser by 100%.

Company Impact

"The successful development and testing of adaptive control through this SBIR program has established MZA as an industry leader in aero-optics compensation by use of adaptive optics. MZA will apply adaptive control in its wave-optics simulation work for technology insertion into tactical beam control programs. MZA will apply the adaptive control technique in the current Airborne Aero-Optics Laboratory (AAOL) for which MZA will also provide a deformable mirror. Given the adaptive AO control software and our aircraft deformable mirror technology, MZA will be able to offer a high-performance AO capability to be integrated into future laser beam control systems."

Robert W. Praus II
President
MZA Associates Corporation



SBIR/STTR

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