Department of the Navy SBIR/STTR Transition Program

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Topic # N131-081

Membrane-Based Deformable Mirrors for High Power Laser Systems

MZA Associates Corporation

WHO

SYSCOM: ONR

Sponsoring Program: ONR Code 35 - Naval Air Warfare and Weapons (no current Program of Record)

Transition Target: Directed Energy (DE) applications (no current Program of Record), PMS-405

TPOC:
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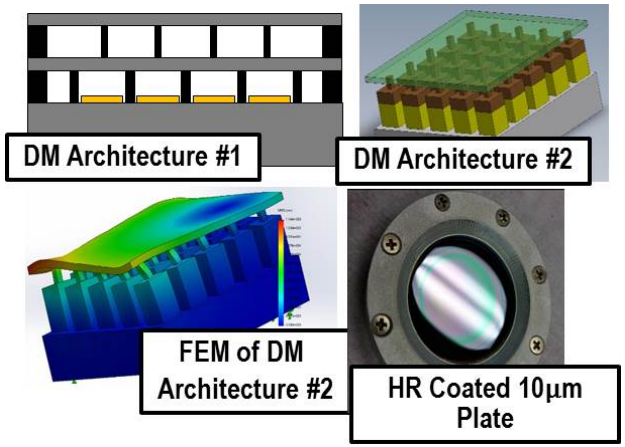
Other transition opportunities: Space Platforms, Tech Maturation programs, Future Naval Capabilities programs, DE Counter Measures



Notes: MZA provides unique expertise in wave-optics modeling, adaptive optics systems, data acquisition/analysis, and management and developed WaveTrainTM, the industry's most widely used wave-optics analysis tool, now the industry standard, for optical atmospheric propagation and adaptive optics systems analysis. MZA has also built beam control components (fast steering mirrors, deformable mirrors, wavefront sensors) and systems for DoD (HEL JTO JHPSSL, DARPA HELLADS, USAF DLWS, and DoN HEFL Helicopter Beam Director).

WHAT

Operational Need and Improvement: The ability to quickly and precisely focus a moving high energy beam onto a moving target. Ships/aircraft/ ground vehicles are in constant motion and have vibrations, wave motion/air motion/ ground motion etc. During operations, an optics system that can "adapt" to the constantly changing ship/sea/ground environment is needed.

Specifications Required: Near to Mid-Term: A 100-actuator mirror capable of high spatial frequency control and capable of being coated for high power laser operation.
Far-Term: A mirror/adaptive optics system capable of handling 40 kW/cm2 and 100 kW total output power at 1.06 - 1.07 um wavelength with phase and amplitude compensation control

Technology Developed: Deformable mirrors/adaptive optics tend to have an optical (in this case, a mirror) face and behind it, there are a number of actuators (tiny-servo mechanisms) which can be precisely controlled to change the shape of the mirror face to keep the beam focused on target even though the ship and/or the target are both in constant motion.

Warfighter Value: Beyond focusing a moving beam onto a moving target, these types of optical systems can be used to detect and track the target as well. The more actuators and the faster the actuators can be controlled drive the optical system's sensitivity, range resolution and response time to target etc. These types of optics can also be used as a countermeasure sensor or also an intelligence, surveillance, reconnaissance (ISR) sensor.

WHEN

Contract Number: N00014-15-C-0071 **Ending on:** July 7, 2016

Milestone	Risk Level	Measure of Success	Ending TRL	Date
100 Actuator Prototype (Phase II Base)	Med	capable of meeting the 1-micron stroke and actuator density (3mm spacing) requirements	4	October 2016
1000 Actuator Prototype (Phase II Option 1)	Med	capable of handling 40 kW/cm and 100 kW total output power at 1.06 - 1.07 um wavelength with phase compensation	5	July 2017
Closed Loop Adaptive Optic System (Phase II Option 2)	Med	A mirror/adaptive optics system capable of handling 40 kW/cm and 100 kW total output power at 1.06 - 1.07 um wavelength with phase compensation control	6	February 2019

HOW

Projected Business Model: MZA has a long history of developing, demonstrating, and delivering hardware and software solutions for the Directed Energy (DE) market. The deformable mirror (DM) product being developed on this effort will be manufactured at MZA for small volumes, but is being considered for technology transfer with a royalty if volumes exceed MZA's capabilities. MZA has manufactured 50 high power DMs in its current facility over the last 10 years including up to 2 a week on some efforts. We have already begun discussing the potential for licensing the technology to large primes if volumes exceed approximately 10 per week.

Company Objectives: MZA has already established itself as the leading vendor of high power deformable mirrors world-wide. We have sold DMs to the government and to defense contractors around the world. The DM being developed on this effort will add to our product line in this space. We are interested in developing this technology outside the DE space further to try to address other market needs.

Potential Commercial Applications: This DM technology addresses an unmet high-power low-cost need with high speed manufacturing for the DE industry, but has applications outside this space as well. Surveillance applications (e.g. ISR and imaging LADAR) and Free-Space Optical Communications suffer from degradation in performance due to atmospheric and environmental aberrations that can be addressed by this DM technology as well. Commercially, this technology can be applied to astronomical applications for improved image quality and laser machining applications for beam shaping on target and improved laser beam quality.

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