Topic: N131-076

Advanced Systems & Technologies, Inc.

Advanced Adaptive Optics (AO) for Laser Weapons in Heavy Turbulence

Advanced Systems & Technologies (AS&T) responded to the Navy's interest for advanced high-power directed energy laser beam control by developing a BeaconLess Adaptive-optic System and Technology (BLAST) to enhance high-power laser beams control capabilities enabling tighter focus on an extended image-resolved target in typical marine environments, i.e., moderate to deep turbulence. This is achieved using a specifically designed optical system capable of selective detection of the target-returned coherent or incoherent radiation fragments, and deriving the wave-function associated with detecting the fundamental features of the rough-surface target-scattered radiation. Post-processing of the beacon-detected field enables turbulence-perturbed wavefront retrieval and characterization thus performance enhancement. Laboratory BLAST tests have confirmed its operability. AS&T is a high-tech company having a mission to develop, demonstrate and commercialize laser and opto-electronic-based technologies.

Technology Category Alignment:

None
None
None

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SYSCOM: ONR
Contract: N68335-14-C-0377

Department of the Navy SBIR/STTR Transition Program

STATEMENT A. Approved for public release; distribution is unlimited.

ONR Approval # 43-2203-16

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Advanced Adaptive Optics (AO) for Laser Weapons in Heavy Turbulence

Advanced Systems & Technologies, Inc

WHO

SYSCOM: ONR

Sponsoring Program: ONR Code 35 Directed Energy Weapons

Transition Target: NAVY Solid State, High Power Laser Weapon System Demonstrator (LWSD), USMC Ground-Based Air Defense System (GBADS)

TPOC:
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Other transition opportunities: Hel-MD - US Army High Energy Laser Mobile Demonstrator; Shield - US Air Force; Long range imaging - US Custom and Border Protection

Notes: BLAST's primary role is to support operation of LWSD, enhance power density and beam pointing the target. This is achieved by using the system's ability of capturing the target-scattered light, processing the information it carries out and establishing data set required by AO system to correct aberrations incurred by the laser beam at its propagation through turbulent atmosphere.
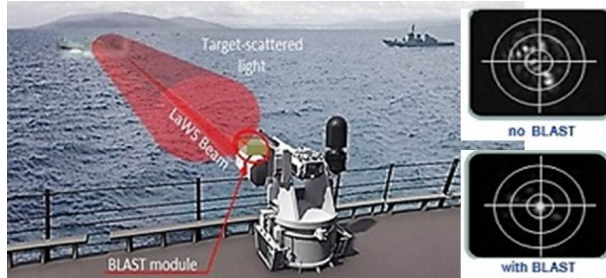
CRS R41526, Released June 2013, http://www.dtic.mil/dtic/tr/fulltext/u2/a583696.pdf, pg 45

WHAT

Operational Need and Improvement: Improved performance of LWSD is enabled by a beaconless Adaptive Optic System (AOS) capable of correcting atmospheric distortion of the power-delivering laser beam and its precise aiming. BLAST uses the target-scattered light as a source to extract information that can be used for beam control. Solution to the problem should address issues associated with straight light from LaWS system and inadequate response time of the AOS in measuring and compensation the aberrations.

Specifications Required: BLAST system should allow near diffraction target imagery through moderate-to-deep turbulence, wave-front aberration determination to a tenth wave at 1 micron, and wave-front correction through the AO system to a tenth wave. Environmental factors of interest are:
- Rytov number >/= 0.3 and Scintillation Index > 1 deep turbulence
- Turbulence structure parameter Cn2 > 5x10-15
- Green Frequency >/= 1.0 kHz

Technology Developed: AS&T responded to the Navy's interest for advanced high-power directed energy laser beam control by developing a BeaconLess Adaptive-optic System and Technology (BLAST) to enhance high-power laser beams control capabilities enabling tighter focus on an extended image-resolved target in typical marine environments, i.e., moderate to deep turbulence. This is achieved using a specifically designed optical system capable of selective detection of the target-returned coherent or incoherent radiation fragments, and deriving the wave-function associated with detecting the fundamental features of the rough-surface target-scattered radiation. Post-processing of the BLAST-detected field enables retrieval and characterization of turbulence-perturbed wavefront for enhancing LaWS performance. BLAST tests in laboratory conditions have confirmed its operability.

Warfighter Value: Enhance operational efficiency, maximize power density, aiming accuracy and position stability of the laser beam on a remote image-resolved target for the LWSD performing in medium-to-deep turbulence conditions.

WHEN

Contract Number: N68335-14-C-0377 **Ending on:** October 7, 2017

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Complete BLAST design	N/A	Blast design is established	2	October 2015
Demosntrate BLAST feasibility	N/A	BLAST feasibility study completed	3	March 2016
BLAST Lab demonstration	Low	Explicit demosntration of BALST performance	4	July 2017
Fielable BLAST Design and Integration	Low	Integration of F-BLAST platfrom	5	April 2018
System field test and Demo	Med	Demosntration of F-BLAST performance in relevant environment	6	May 2019

HOW

Projected Business Model: AS&T is a high-tech company with a mission to develop and commercialize laser and opto-electronic-based technologies. Within this mission AS&T strategy includes all phases of system development from its start to completion. Developed and validated commercial version of the system will be distributed directly or through the partnership with relevant venders associated with the specific field. Current AS&T's portfolio includes:
* Wireless Identification and Tracking system. Area of applications: tracking items in industrial and commercial areas
* Conformal imaging vibrometer (patented). Examples of applications include, but not limited to: whole-field vibrational modal analysis, non-destructive testing, characterization of MEMS-like devices, detection and validation of aero-elastic effects, others

Company Objectives: The AS&T objective is to perform a comprehensive simulation of the BLAST performance, prototype its working module and perform laboratory validation of its operation using specially designed deep-turbulence simulator. Once the lab operation is proven to work AS&T will establish and present to ONR and other interested parties the detailed plan for BLAST upgrade to the field-evaluation level, concluding the program with the field test and demonstration

Potential Commercial Applications: Potential Commercial Applications include: (i) ophthalmology; (ii) long-range optical surveillance systems, including border patrol; (iii) any long-range optical imaging system, (iv) optical communication, and (v) image improvement with a low-quality optical systems

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