Air Force SBIR/STTR

Innovation

Air Force SBIR/STTR Innovation Story

SBIR Topic Number:
AF071-012

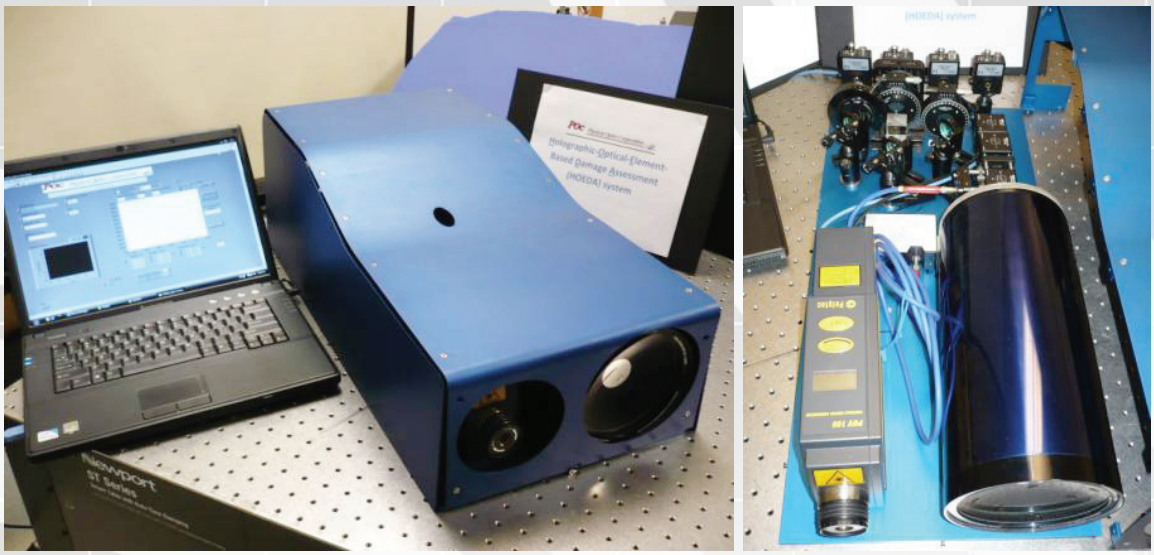
SBIR Title:
Laser Remote Sensing for High Energy Laser (HEL) Damage Assessment

Contract Number:
FA9451-08-C-0067

SBIR Company Name:
Physical Optics Corporation, Torrance, CA

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.



Holographic-Optical-Element-Based Damage Assessment (HOEDA) system

High Energy Laser Damage Assessment

- The Air Force needs a sensor system to optimize directed energy delivery from advanced tactical lasers (ATLs) to the targets
- Physical Optics Corporation (POC) developed a Holographic-Optical-Element-Based Damage Assessment (HOEDA) system based on sensor and data fusion of three laser remote-sensing technologies – laser remote polarimetry, spectroscopy, and vibrometry – to provide accurate, comprehensive, remote, real-time damage data
- This technology has the potential to positively impact the Air Force's development of airborne and ground-based high energy lasers (HELs) and high power microwaves (HPMs)
- Other anticipated benefits of the HOEDA system include remote assessment of damage in inaccessible areas, specifically in furnaces or chemical plants, subsurface damage assessment in automobile engines, and nondestructive testing of aircraft wing surfaces

377ABW-2011-0360

Air Force Requirement

Emerging Directed Energy Weapons (DEWs) offer virtually instantaneous fly-out time, stealth, precise targeting, agile retargeting capability, operation unaffected by gravity, and lethal/less-lethal options. In the case of strategic lasers, determination of the damage timeline is critical in saving laser resources, costs, and dead time.

The Air Force needs a sensor system to optimize directed energy delivery from advanced tactical lasers (ATLs) to the targets. Specifically, the Air Force needs sensor systems and algorithms based on laser remote sensing technologies to provide remote and robust real-time target damage from DEW systems.

SBIR Technology

During this SBIR project, Physical Optics Corporation (POC) developed a Holographic-Optical-Element-Based Damage Assessment (HOEDA) system based on sensor and data fusion of three laser remote-sensing technologies – laser remote polarimetry, spectroscopy, and vibrometry – to provide accurate, comprehensive, remote, real-time damage data.

The HOEDA system primarily consists of three main damage assessment modules:

- A polarimetry module for detecting surface changes.
- A spectroscopy module incorporating fluorescence, Raman, and laser-induced breakdown (LIBS) spectroscopy for chemical damage detection.
- An interferometric vibrometry module to detect structural damage inside the target.

The outputs of these modules are seamlessly fused using physics-based smart software models that enable the HOEDA system to provide comprehensive damage information as feedback (which is not possible using any of these technologies alone).

Potential Air Force Application

This technology has the potential to positively impact the Air Force's development of airborne and ground-based high energy lasers (HELs) and high power microwaves (HPMs). It will be an indispensable tool to assess the damage made by the technology on its targets.

The vibrometry module of HOEDA can be used to determine structural integrity. The spectroscopy module can be used as a novel scientific instrument for conducting in situ robotic geochemical exploration of the solar system. Determination of the chemical composition of planetary surface materials can reveal fundamental information about an extraterrestrial body. This module can also be used in medical imaging to determine changes in physiological tissue parameters.

The polarimetry module can be used in the medical imaging field to determine sub-surface damage in burn victims. Other anticipated benefits of the HOEDA system include remote assessment of damage in inaccessible areas, specifically in furnaces or chemical plants, subsurface damage assessment in automobile engines, and nondestructive testing of aircraft wing surfaces.

Company Impact

"The Air Force SBIR program enabled POC to apply its unique capabilities as a technology-based small systems integrator," states Gordon Drew, POC's Chief Financial Officer. "POC was able to apply its experience in a number of related electronic and high-voltage technologies, together with certain project-specific novel innovations, to create a solution for the Air Force customer. The HOEDA is an important development for multiple systems solutions that have the potential for widespread government and commercial applications. This project directly fits with POC's product development and commercialization plans and is expected to materially contribute to the growth and success of the company."

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