Department of the Navy SBIR/STTR Transition Program

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ONR Approval #43-8690-21

Topic # N171-085

Implementation and Demonstration of LUCS, a Live, Ultra-Compact Multispectral USPL Characterization System

Voss Scientific, LLC

WHO

SYSCOM: ONR

Sponsoring Program: PMS-405, Navy Directed Energy and Electric Weapons program office, Surface Navy Laser Weapon system (SNLWS) Program

Transition Target:

TPOC:
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Other transition opportunities: USPL research and development
USPL propagation experiments
Non-linear effects and matter interaction
DOD and DOE laboratories

Notes: Sample screen from the Graphical User Interface (GUI) showing the processed Figures of Merit (FOMs) for the laser with statistics and limit bars shown.
Brass Board demonstrated in several field tests with Near Infrared (NIR),Ti:Sapphire and Short Wave Infrared (SWIR) Optical Parametric Chirped Pulse Amplification (OPCPA) lasers.
The current version supports USPLs from 500 to 1700nm, including Ti:Sapphire, Yb:YAG, Erbium:Glass, and Optical Parametric Amplifier (OPA).
The next generation will be extended to the Mid Wave Infrared (MWIR) 1.5-5 µm.

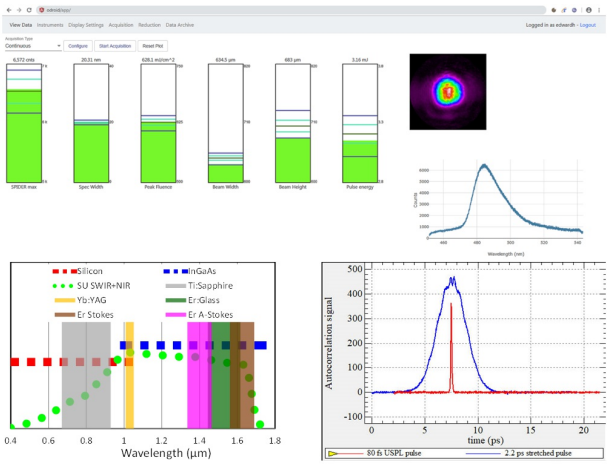

Image Courtesy of Voss Scientific, LLC

WHAT

Operational Need and Improvement: A newly developed instrument overcomes the challenge of characterization of Ultra Short Pulse Lasers (USPL).
Unlike previous systems, this new diagnostic system measures and reports a comprehensive set of USPL pulse characteristics in a live graphical display from a single, compact, detector.
The robust assembly has been tested in both laboratory and field experiments, with environments ranging from desert to maritime, and in stationary and mobile targets.
The Size Weight and Power (SWAP) requirements of the fully integrated package are small enough to allow integration into a broad range of experiments and test platforms.
The data provides a holistic picture of the laser parameters in a user-friendly Graphical User Interface (GUI) that can be viewed on any device with a web browser and network connection to the system.

Specifications Required: All critical USPL parameters are measured with high dynamic range to support variable laser settings and conditions.

Pulse Energy:	30 dB dynamic range, adjustable scale, 500 nJ minimum
Pulse duration:	0.06-6 picoseconds Full Width at Half Maximum (FWHM)
Spatial profile:	Adjustable depending on experiment, resolution is 1/200 of aperture
Spectral resolution:	Select-able based on spectrometer, typically 0.8 nm for NIR, 1 nm SWIR
Data Rate:	Supports lasers up to 10 kHz, image collection rate 100 Hz, GUI update 30 Hz
Input alignment:	the maximum misalignment in milliradians is 15/input aperture (mm)
SWaP:	30 x 20 x 15 (l w h) cm, 10 kg, 50 W

Technology Developed: Live Ultra-compact Short pulse laser Characterization System (LUCS)

Warfighter Value: The ability to rapidly collect complete data for USPL experiments will advance the laser technology and provide reliable solutions to meet the needs of the war fighter,
Specific applications include counter ISR, remote sensing, and electronic warfare.
Commercial applications include: precision machining, high performance surface treatments, ablative surgery, etc.

WHEN

Contract Number: N68335-18-C-0303 **Ending on:** April 21, 2023

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Completed design of SWIR LUCS	N/A	Completed optical and CAD models	3	4th QTR FY18
Laboratory test of SWIR LUCS	N/A	Successful laboratory demonstration	4	3rd QTR FY20
Field test of SWIR LUCS	N/A	Successful field demonstration	6	1st QTR FY21
Complted design of MWIR LUCS	Med	Completed optical and CAD models	3	1st QTR FY22
Laboratory testing of MWIR LUCS	Med	Successful laboratory demonstration	4	2nd QTR FY22
Field testing of MWIR LUCS	High	Successful field demonstration	6	1st QTR FY23

HOW

Projected Business Model: Our goal is to manufacture and sell the LUCS system directly to government, educational, and commercial customers. We anticipate several standard configurations based primarily on the wavelength of interest and desired repetition rate; however, there will be a number of options that can be selected to customized the system for a particular application. As a small company we are highly responsive to the individual needs of each customer and will work with the scientists involved to ensure all requirements are met.

Company Objectives: Voss Scientific is seeking connections with USPL researchers who could benefit from this technology. In the short term we would like to conduct a demonstration of the MWIR LUCS in partnership with a researcher working with this type of laser. In addition, the successful demonstration of NIR and SWIR versions of the LUCS has shown that these systems are ready for use in both laboratory or field experiments.

Potential Commercial Applications: The extremely high intensities and short pulses produced by USPLs enable a wide range of applications. For example, the very short time scale of the pulse allows pump probe type experiments to follow chemical and biological process on a femtosecond time scale. The high intensity can be used to generate self focusing, broad spectral emission in materials, and Optical Parametric amplification. Increasing the intensity further and the laser can be used for extremely precise ablative machining and surface processing. These types of lasers have been used for many years in laser eye surgery due to the ability to ablate tissue with no residual heating or other damage. Future applications include laser driven accelerators capable of producing sufficient quantities of short lived Isotopes for medical use in a very compact system. One important area of research is to expand the available wavelengths of USPL systems. This requires the reliable, user friendly diagnostics the LUCS provides.

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