Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2019-848

Topic # N11A-T004
STTR Converted to SBIR -- Three-Component Planar Doppler Velocimetry Measurements in a Full-Scale Aircraft Exhaust
MetroLaser, Inc.

WHO

SYSCOM: NAVAIR

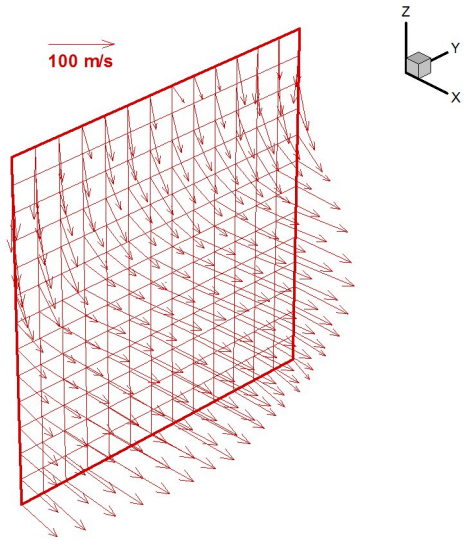
Sponsoring Program: Air 4.4 Propulsion and power

Transition Target: F-35B

TPOC:
(512)373-3201

Other transition opportunities: MetroLaser's technology can be used as a diagnostic tool for supersonic platform engines, as well as subsonic jets.

Notes: Average velocity profile measured with MetroLaser Planar Doppler Velocimetry (PDV) system in the exhaust of a small turbojet engine, area 2.3" x 2.3"



WHAT

Operational Need and Improvement: High quality measurements of the velocity field in the exhaust of a jet engine are needed to assist jet noise mitigation studies. A further need for this technology is for imaging the supersonic and subsonic turbulent flow field around a Short Take-Off/Vertical Landing (STOVL) aircraft. Current jet noise mitigation efforts are hindered by a lack of experimental data on jet exhaust velocity fields. This shortcoming is due primarily to a lack of available instrumentation capable of obtaining instantaneous full field velocity measurements.

Specifications Required: The Navy has requested a non-invasive (non-seeded) approach to measure the unsteady, 3-D velocity field of a supersonic jet plume for a stationary aircraft. They have also requested high resolution, time resolved measurements of the turbulent flow field for STOVL aircraft with both subsonic and supersonic flow regions.

Technology Developed: A diagnostic methodology is being developed for aircraft engine exhausts that measures three velocity components in a slice through the plume. The method measures the Doppler shift of laser light scattered from particles naturally present in the flow, such as soot or dust. Since velocity is a three-dimensional vector, the proposed instrument measures velocity magnitudes in three directions using imaging fiber optics in a cost saving efficient setup.

Warfighter Value: The proposed technology would aid experimental studies of aircraft exhausts hazards, possibly leading to reduced exposure of ground crew personnel to excessive noise and jet blast.

WHEN

Contract Number: N68335-19-C-0031 **Ending on:** December 13, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Demonstrate feasibility in the lab	Med	Soot detection limit of 70 parts per thousand	2	March 2012
Demonstrate feasibility on a lab scale engine	Med	Velocity uncertainty of 8 m/s	3	January 2013
Incorporate imaging fiber bundles for multiple components	Low	Breadboard footprint of 18 inches by 24 inches	3	November 2013
Demonstrate 2-component measurements on a lab scale engine	Med	Velocity uncertainty of 5 m/s over whole field	4	June 2015
Demonstrate 3-component measurements on a lab scale engine	Med	3-component velocity uncertainty of 5 m/s over whole field	5	March 2016
Demonstrate 3-component measurements on a full scale engine	Med	3-component velocity uncertainty of 5 m/s	6	April 2020

HOW

Projected Business Model: MetroLaser will be the manufacturer for the device and is looking to provide on-site measurement services or lease and/or sell PDV systems. With the right partner, the company would consider licensing the PDV technology.

Company Objectives: MetroLaser is looking to ensure testing and final qualification of the PDV device and to supply research labs and aircraft design facilities with velocimetry instrumentation and services.

Potential Commercial Applications: The PDV device being made by MetroLaser, Inc would be useful for the development of commercial jet aircraft engines and would assist in both design and aircraft modifications.

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