Topic: N11A-T004

MetroLaser, Inc.

Three-Component Planar Doppler Velocimetry Measurements in a Full-Scale Aircraft Exhaust

The Planar Doppler Velocimetry (PDV) system measures airflow velocity, such as in the exhaust plume of a jet engine. MetroLaser is a leading developer of laser-based instrumentation for a wide range of defense and industrial problems. Like particle image velocimetry (PIV), PDV provides spatially resolved measurements, but unlike PIV it does not require adding particles in many practical flows. The MetroLaser PDV system is hardened for outdoor use in full-scale aircraft testing. Since it is a non-contact method, it does not disturb the flow field or suffer from probe survivability issues. Demonstrations on a lab-scale turbojet engine showed good agreement with measurements from a pitot probe. MetroLaser is seeking customers for indoor/outdoor airflow velocity measurement services that include setup, conducting experiments, processing data, reporting, and sales of complete PDV systems.

Technology Category Alignment:

Aircraft Propulsion, Power and Thermal
Electro-Optical/Infrared (EO/IR)

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SYSCOM: NAVAIR
Contract: N68335-19-C-0031

Booth: 1113
Room: FST at WEST 2020
Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-19-C-0031

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

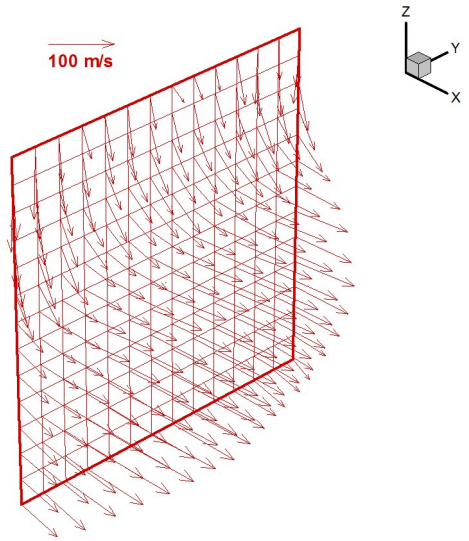
Sponsoring Program: Air 4.4 Propulsion and power

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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