Center Innovation Fund: GSFC CIF

Broadband Laser Source and Spectrally Resolved Detection for Spectroscopic LiDAR Instrument

Completed Technology Project (2017 - 2018)

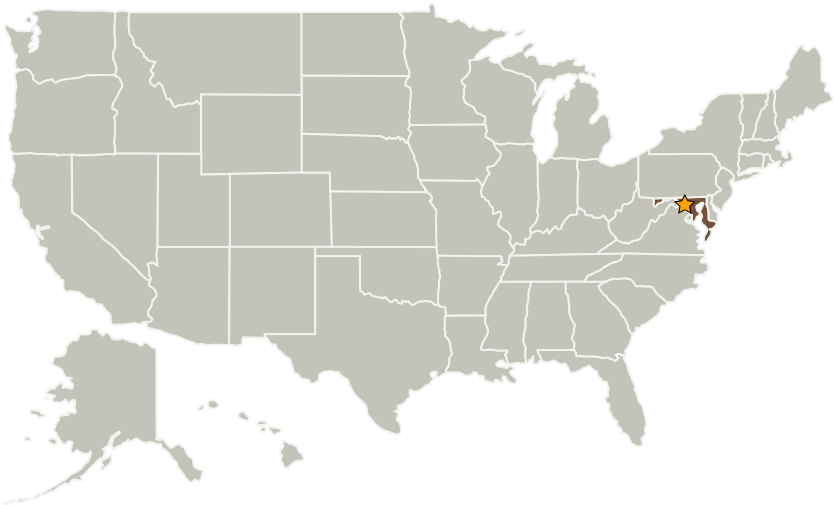
Project Introduction

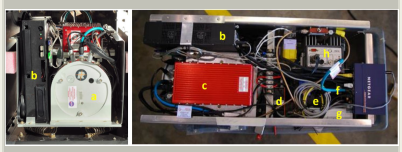
The focus of this early-stage technology development effort is to first optimize the PCF broad-based laser source using a new commercial microchip laser system and characterize the output. While perhaps not suitable for flight applications, this commercial laser would be ideal for development testing. Then an optical design for spectrally dispersing and resolving the laser output will be developed, and a multichannel array detector detection scheme will be conceived. Generating a supercontinuum in PCF has been demonstrated in the literature, however incorporating a supercontinuum laser source into a LiDAR instrument is novel. At present, all of the existing or conceptual multi-wavelength LiDAR instruments are rather limited in scope. Some merely offer a few discrete wavelengths (e.g. a combination of Nd:YAG fundamental and harmonic wavelengths - 1064 nm, 532 nm, and/or 355 nm). Others have the ability to scan a laser over a very narrow wavelength range to interrogate a single absorption feature of a single molecule. The proposed concept offers substantially more spectral range on every measurement without scanning.

Anticipated Benefits

Once developed, such a broadband laser would offer the unique opportunity to make multiple science observations simotaneously from one laser source. This ould increase science yeild, allow mvestigation of connected phenomena, and reduce spacecraft mass by eliminating additional lasers.

Primary U.S. Work Locations and Key Partners





End and top views of G-LiHT instrument package, showing the (a) scanning LiDAR; (b) data acquisition computer; (c) GPS-INS; (d) irradiance spectrometer; (e) imaging spectrometer; (f) thermal infrared camera; (g) GPS time…

Table of Contents

Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Images	3
Project Website:	3
Technology Areas	3
Target Destinations	3

Broadband Laser Source and Spectrally Resolved Detection for Spectroscopic LiDAR Instrument

Completed Technology Project (2017 - 2018)

Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Project Transitions

October 2017: Project Start

September 2018: Closed out

Closeout Summary: The specific objectives of this early-stage innovation are: 1) to develop, test, and characterize a photonic crystal fiber (PCF)-based superc ontinuum laser source and 2) begin work on the spectrally resolved optical retur n path and associated detection. Due to multiple complications discussed in deta il later in this report, the team was unable to make the anticipated progress. Th e team did successfully develop an optomechanical layout for the PCF-based bro adband source, which was ready to go once the procured pump laser arrived. Th e team also worked on developing the spectrally resolved back-end detection ap proach. While the team was able to recruit a detector engineer to help with the effort, but an in-house optics engineer was not available. Fortunately, the PI an d Co-I have limited experience in this area and were able to develop an optical s cheme to spectrally disperse the broadband light. The intention was to measure this with a linear indium gallium arsenide (InGaAs) detector array to demonstrat e proof of concept. The team procured the necessary optical components and su bmitted a request for the detector array. The aforementioned efforts involved pr ogrammatic, technical, safety, and personal issues, all of which negatively impa cted the schedule. . Consequently, while the needed components and equipment were purchased, time ran out and the team was unable to complete the planned measurements.

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Innovation Fund: GSFC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

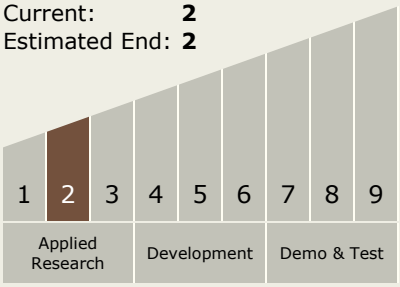
Peter M Hughes

Principal Investigator:

George B Shaw

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **2**



Images

Project Image
End and top views of G-LiHT instrument package, showing the (a) scanning LiDAR; (b) data acquisition computer; (c) GPS-INS; (d) irradiance spectrometer; (e) imaging spectrometer; (f) thermal infrared camera; (g) GPS time server; and (h) profiling LiDAR. *(https://techport.nasa.gov/image/35804)*

Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VC

Technology Areas

Primary:

- TX08 Sensors and Instruments
  └ TX08.1 Remote Sensing Instruments/Sensors
    └ TX08.1.5 Lasers

Target Destinations

Earth, Others Inside the Solar System