G-LiHT: Goddard’s LiDAR, Hyperspectral, and Thermal Airborne Imager

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G-LiHT Concept

G-LiHT is a portable airborne system that simultaneously maps the composition, structure and function of terrestrial ecosystems.

Relevance to NASA Earth Science
1) Fusion of 3D LiDAR data and 2D hyperspectral/thermal imagery provides a new, synergistic method for studying ecosystem structure and function.
   - LiDAR provides information on vegetation structure.
   - Hyperspectral and thermal imagery provides information on ecosystem composition and health.
2) “Data fusion” often requires coincident data in time and space; thus, “instrument fusion” can be viewed as a prerequisite to data fusion.
3) Data fusion can enhance the science objectives of planned decadal survey missions, including ICESat-2 and HypsIRI.

G-LiHT was designed to...
- acquire fine-scale (~1 m), co-registered LiDAR/optical/thermal data for ecosystem studies
- simplify worldwide deployment
- minimize collection costs

…and features:
- eye safe lasers
- portability (compact, lightweight)
- single solution GPS-INS
- up/downwelling spectrometers
- ease of installation on common, civilian-use aircraft
- non-ITAR (Int’l Traffic in Arms Regulation) instruments

G-LiHT Technical Specifications

Compatible with Various Airborne Platforms
1) “Low-and-slow” aircraft (e.g., Cessna, Piper, Twin Otter)
2) Two installation options:
   - Wing-mounted pod (mounts to any Cessna 208)
   - Standard camera port inside cabin

Integrated “Off-the-Shelf” Instrumentation
1) Scanning LiDAR (Riegl VQ-480)
   50-300 kHz; 1550 nm; onboard waveform processing
2) Profiling LiDAR (Riegl LD321-400)
   10 kHz; 905 nm; up to 5 returns per laser shot
3) VNIR imaging spectrometer (Headwall Hyperspec)
   50 Hz; 0.4 to 1 μm, 1.5 nm resolution; pushbroom array
4) VNIR irradiance spectrometer (Ocean Optics USB4000)
   1 Hz; cosine diffuser mounted above wing
5) Thermal imager (Menics Gobi-384)
   25 Hz; non-cooled microbolometer, 8 to 14 μm
6) GPS-INS (Oxford RT-4041 with OmniStar HP)
   250 Hz; 10 cm position, 0.1° yaw, 0.03° roll/pitch accuracy

Overall Physical Specifications
Size: (WxHxL): 30 x 30 x 60 cm
Weight: 37 kg (G-LiHT); 10 kg (pod)
Power: 210 W (7.5 A, 28 VDC)

G-LiHT Demonstration Project

Acquisition Details
Date: June 2011
Altitude: 335 m AGL
Swath: ~170 m
Resolution: ≤1 m
Data acquisition rate: ~50 MB/s (1 TB per day)

Ecosystem, Stand, and Tree-Level Observations
The complementary nature of LiDAR, optical and thermal data is immediately apparent in a single flight line over contrasting cover types and within seemingly similar forest stands.

Open-Access Data

Standard data/products
- Classified point cloud data (LAS format)
- Ground elevation, canopy height, return metrics (Geotiffs)
- Vegetation indices and spectral bio-indicators (e.g., NDVI, EVI, PRI, red-edge)
- Reflectance spectra
- Surface temperature
- Derived ecosystem products (e.g., biomass, LAI, GPP, ANPP)
- Associated ground data (where available)

G-LiHT Website (coming soon)
http://forest.gsfc.nasa.gov

For additional information, please contact
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NASA’s Carbon Monitor System (CMS)
Tucker et al., 2011-12, NASA CMS Biomass Pilot Project

CC&E Support

G-LiHT currently supports two of NASA’s CC&E projects:
American ICESat/GLAS Assessment of Carbon
Nelson et al., 2011-13, NASA Carbon Cycle Science

NASA’s Carbon Cycle Science (CC&S)

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