technology ■ opportunity

National Aeronautics and Space Administration
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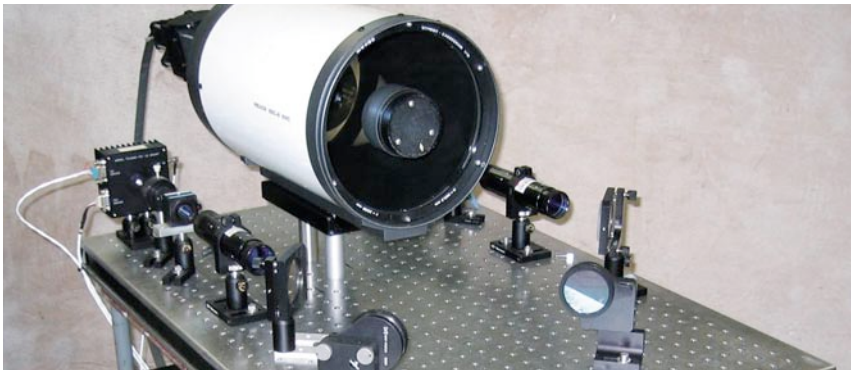
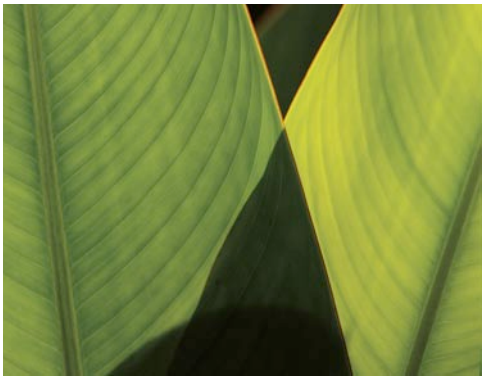
photonics

A Revolutionary Multiple-Wavelength Lidar System for Vegetation Mapping





NASA Goddard Space Flight Center invites companies to license its new active vegetation index measurement technique that enables remote differentiation of vegetative and nonvegetative surfaces. The first method of its kind, this patent-pending spectral-ratio biospheric lidar system uses coded signals on two lasers, enabling researchers to both discriminate between and monitor changes in photosynthetic surfaces. This unique process can greatly benefit environmental and agricultural mapping and monitoring as well as other commercial and government efforts.

Benefits

- **Multiple wavelength**: Uses multiple-wavelength lidar, enabling direct discrimination of vegetative from nonvegetative surfaces as well as monitoring of vegetation changes
- **Reliable**: Employs commercial, off-the-shelf lasers with known reliability
- **Three-dimensional**: Provides a 3-D view of chlorophyll in plant canopies, enabling researchers to obtain information about surface type as well as volume
- **Accurate**: Provides unprecedented information for calibration of passively acquired multispectral vegetation data
- **Proven**: Demonstrates the ability to accurately determine changes in vegetation over time and to discriminate between vegetative and nonvegetative surfaces in NASA testing

Applications

Goddard's technology has great potential for airborne mapping and monitoring of topography and ecosystem changes for applications such as:

- Agriculture
  - – Forestry inventory
  - – Precision farming
- Environmental monitoring
  - – Biomass measurements
  - – Habitat quality assessments
  - – Ecosystem damage assessments
- Mapping
  - – Surface topography beneath vegetation
  - – 3-D surface details of forested flood plains and wetlands
  - – Mixtures of artificial, geological, and living features

Technology Details

How it works

The Normalized Difference Vegetation Index measures the reflectivity and absorption of chlorophyll-containing vegetation. Chlorophyll absorbs visible light for use in photosynthesis, illustrated by blue and red peaks near 0.4 and 0.67 μm. The leaves strongly reflect near-infrared (NIR) light from 0.7 to 1.2 μm. The transition around 0.7 μm is known as the red edge. Less reflected radiation in red wavelengths versus NIR wavelengths indicates healthy and dense vegetation. If the difference between the intensity of the reflected wavelengths is small, then the vegetation is presumed sparse, dead, or absent. Using a wavelength close to the red edge provides an unambiguous signal.

Goddard's technology provides a land-surface lidar method that uses spectral reflectance to make these determinations. The process calls for the use of two telecommunications lasers (O-band and C-band), both of which are frequency doubled, providing imaging wavelengths of approximately 665 nm and 775 nm. Light from both lasers is rapidly modulated to provide precise range information without requiring powerful short laser pulses. Calculating a ratio of the returned signals from these two wavelengths enables vertical resolution of, and differentiation between, vegetative and nonvegetative surfaces. Because the method uses two wavelengths that are absorbed differently by chlorophyll-containing (vegetative) surfaces, changes in the vegetation itself can be determined and monitored.

Why it is better

Typical imaging and mapping lidar systems use a single-wavelength approach that is capable of detecting altitude differences between the ground and objects above the ground. This difference is used to infer the height of vegetation assumed to be in the field of view, but it does not account for dead trees, rocks, buildings, or other structures. Therefore, these methods cannot readily distinguish between vegetation and nonvegetative surfaces. Precursor lidar techniques were able to discriminate vegetative ranges but could not monitor relative changes to the vegetation itself. Using other wavelengths may make it difficult to distinguish between living vegetation and some common, nonvegetative surfaces that have similar reflectance ratios.

Contrasted with these methods, Goddard's technique is a paired-wavelength approach, providing a proven method that enables both determination and tracking of vegetative land surfaces.

Patents

NASA Goddard Space Flight Center is seeking patent protection for this technology.

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the Spectral-Ratio Biospheric Lidar technology (GSC-14439-1) for commercial applications.

For More Information

If you are interested in more information or want to pursue transfer of this technology (GSC-14439-1), please contact:

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More information about working with NASA Goddard's Office of Technology Transfer is available online:
http://techtransfer.gsfc.nasa.gov

GSC-14439-1
03.08.06