National Aeronautics and
Space Administration

technology solution

Instrumentation

Multispectral Imaging, Detection, and Active Reflectance (MiDAR)

A novel next-generation remote sensing instrument

NASA has developed a novel next-generation remote sensing instrument with advanced scientific capabilities for Multispectral Imaging, Detection and Active Reflectance (MiDAR). The MiDAR transmitter and receiver demonstrate a novel and cost-effective solution for simultaneous high-frame-rate, high-signal-to-noise ratio (SNR) multispectral imaging, with hyperspectral potential, high-bandwidth simplex communication, and in-phase radiometric calibration. The use of computational imaging further allows for multispectral data to be fused using Structure from Motion (SfM) and Fluid Lensing algorithms to produce 3D multispectral scenes and high-resolution underwater imagery of benthic systems as part of future scientific airborne field campaigns.

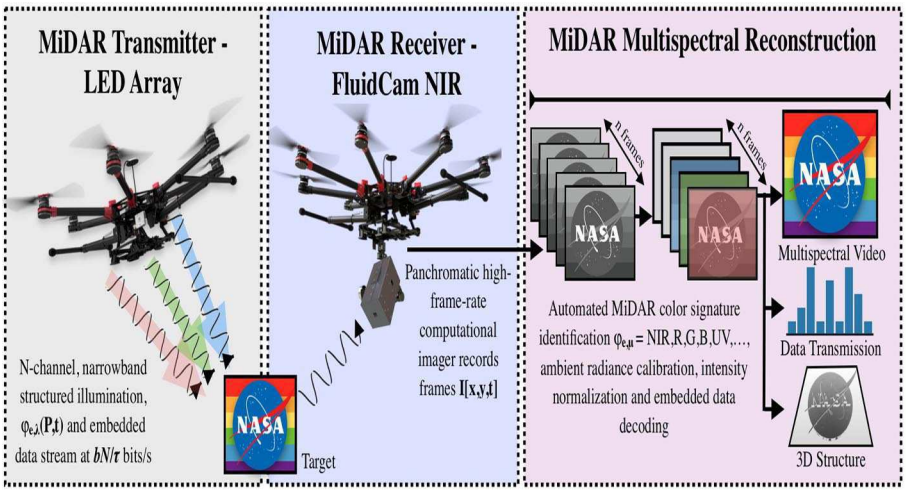
BENEFITS

- High resolution, SNR, and frame-rate multispectral imaging technology
- Demonstrated 7-channel NASA-developed MiDAR transmitter and receiver
- MiDARs SNR is not limited by ambient light
- MiDAR transmitter directly illuminates an object with narrowband structured light
- Cost-effective multispectral system
- MiDAR transmitter simultaneously provides high-bandwidth one-way communication while imaging

THE TECHNOLOGY

The MiDAR transmitter emits coded narrowband structured illumination to generate high-frame-rate multispectral video, perform real-time radiometric calibration, and provide a high-bandwidth simplex optical data-link under a range of ambient irradiance conditions, including darkness. A theoretical framework, based on unique color band signatures, is developed for multispectral video reconstruction and optical communications algorithms used on MiDAR transmitters and receivers. Experimental tests demonstrate a 7-channel MiDAR prototype consisting of an active array of multispectral high-intensity light-emitting diodes (MiDAR transmitter) coupled with a state-of-the-art, high-frame-rate NIR computational imager, the NASA FluidCam NIR, which functions as a MiDAR receiver. A 32-channel instrument is currently in development.

Preliminary results confirm efficient, radiometrically-calibrated, high signal-to-noise ratio (SNR) active multispectral imaging in 7 channels from 405-940 nm at 2048x2048 pixels and 30 Hz. These results demonstrate a cost-effective and adaptive sensing modality, with the ability to change color bands and relative intensities in real-time, in response to changing science requirements or dynamic scenes. Potential applications of MiDAR include high-resolution nocturnal and diurnal multispectral imaging from air, space and underwater environments as well as long- distance optical communication, bidirectional reflectance distribution function characterization, mineral identification, atmospheric correction, UV/fluorescent imaging, 3D reconstruction using Structure from Motion (SfM), and underwater imaging using Fluid Lensing. Multipurpose sensors, such as MiDAR, which fuse active sensing and communications capabilities, may be particularly well-suited for mass-limited robotic exploration of Earth and the solar system and represent a possible new generation of instruments for active optical remote sensing.



MiDAR

APPLICATIONS

The technology has several potential applications:

- Multispectral Remote Sensing from aircraft, robotic explorers, spacecraft, and underwater environments in both low-light and normal lighting conditions
- Hyperspectral Imaging
- Simultaneous Optical Communications
- Fluid Lensing for cm-scale benthic imaging
- Mineral identification
- UV/fluorescent imaging from UAVs
- 3D imaging using Structure from Motion (SfM)
- Mass-limited robotic exploration of Earth and the solar system
- Noninvasive medical imaging and diagnosis
- Semiconductor imaging and engineering structure analysis

PUBLICATIONS

More Information

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