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Title: *NASA Fluid Lensing & MiDAR - Next-Generation Remote Sensing Technologies for Aquatic Remote Sensing*

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Abstract 02:
We present two recent instrument technology developments at NASA, Fluid Lensing and MiDAR, and their application to remote sensing of Earth's aquatic systems. Fluid Lensing is the first remote sensing technology capable of imaging through ocean waves in 3D at sub-cm resolutions. MiDAR is a next-generation active hyperspectral remote sensing and optical communications instrument capable of active fluid lensing. Fluid Lensing has been used to provide 3D multispectral imagery of shallow marine systems from unmanned aerial vehicles (UAVs, or drones), including coral reefs in American Samoa and stromatolite reefs in Hamelin Pool, Western Australia. MiDAR is being deployed on aircraft and underwater remotely operated vehicles (ROVs) to enable a new method for remote sensing of living and nonliving structures in extreme environments.

MiDAR images targets with high-intensity narrowband structured optical radiation to measure an object's non-linear spectral reflectance, image through fluid interfaces such as ocean waves with active fluid lensing, and simultaneously transmit high-bandwidth data. As an active instrument, MiDAR is capable of remotely sensing reflectance at the centimeter (cm) spatial scale with a signal-to-noise ratio (SNR) multiple orders of magnitude higher than passive airborne and spaceborne remote sensing systems with significantly reduced integration time. This allows for rapid video-frame-rate hyperspectral sensing into the far ultraviolet and VNIR wavelengths.

Previously, MiDAR was developed into a TRL 2 laboratory instrument capable of imaging in thirty-two narrowband channels across the VNIR spectrum (400-950nm). Recently, MiDAR UV was raised to TRL4 and expanded to include five ultraviolet bands from 280-400nm, permitting UV remote sensing capabilities in UV A, B, and C bands and enabling mineral identification and stimulated fluorescence measurements of organic proteins and compounds, such as green fluorescent proteins in terrestrial and aquatic organics.