Simultaneous Spectral Temporal Adaptive Raman Spectrometer — SSTARS

NASA's Jet Propulsion Laboratory, Pasadena, California

Raman spectroscopy is a prime candidate for the next generation of planetary instruments, as it addresses the primary goal of mineralogical analysis, which is structure and composition. However, large fluorescence return from many mineral samples under visible light excitation can render Raman spectra unattainable. Using the described approach, Raman and fluorescence, which occur on different time scales, can be simultaneously obtained from mineral samples using a compact instrument in a planetary environment. This new approach is taken based on the use of time-resolved spectroscopy for removing the fluorescence background from Raman spectra in the laboratory.

In the SSTARS instrument, a visible excitation source (a green, pulsed laser) is used to generate Raman and fluorescence signals in a mineral sample. A spectral notch filter eliminates the directly reflected beam. A grating then disperses the signal spectrally, and a streak camera provides temporal resolution. The output of the streak camera is imaged on the CCD (charge-coupled device), and the data are read out electronically. By adjusting the sweep speed of the streak camera, anywhere from picoseconds to milliseconds, it is possible to resolve Raman spectra from numerous fluorescence spectra in the same sample. The key features of SSTARS include a compact streak tube capable of picosecond time resolution for collection of simultaneous spectral and temporal information, adaptive streak tube electronics that can rapidly change from one sweep rate to another over ranges of picoseconds to milliseconds, enabling collection of both Raman and fluorescence signatures versus time and wavelength, and Synchroscan integration that allows for a compact, low-power laser without compromising ultimate sensitivity.

This work was done by Jordana Blacksberg of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-46752

Improved Speed and Functionality of a 580-GHz Imaging Radar

This room-temperature, all-solid-state active submillimeter imager can be used to detect concealed weapons through clothing.

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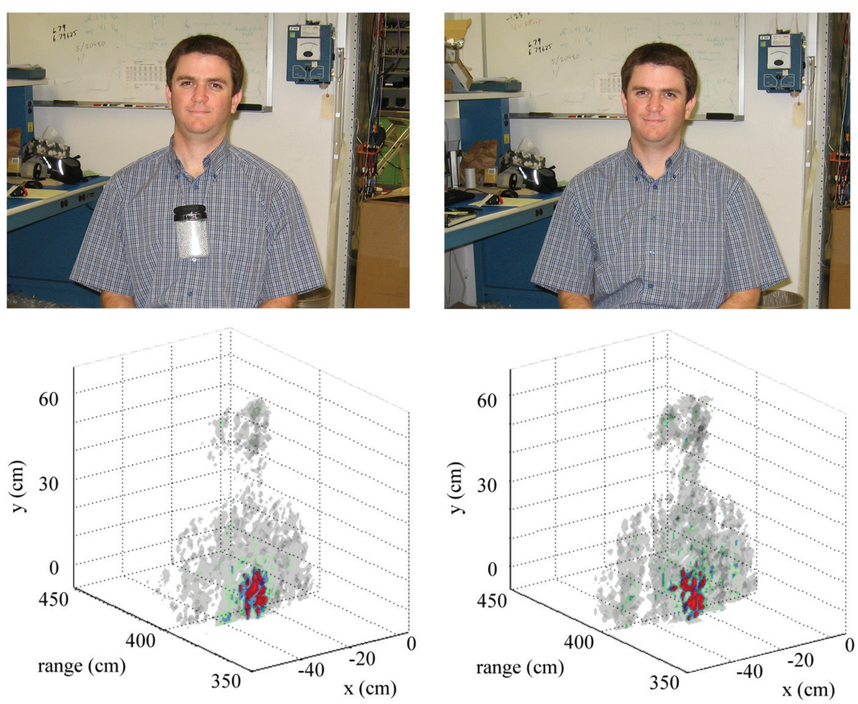
With this high-resolution imaging radar system, coherent illumination in the 576-to-589-GHz range and phase-sensitive detection are implemented in an all-solid-state design based on Schottky diode sensors and sources. By employing the frequency-modulated, continuous-wave (FMCW) radar technique, centimeter-scale range resolution has been achieved while using fractional bandwidths of less than 3 percent. The high operating frequencies also permit centimeter-scale cross-range resolution at several-meter standoff distances without large apertures. Scanning of a single-pixel transceiver enables targets to be rapidly mapped in three dimensions, so that the technology can be applied to the detection of concealed objects on persons.



Photographs (top) and **3D THz Radar Imager Reconstructions** (bottom) of a person. On the left, the subject is wearing an exposed plastic container filled with ball bearings. On the right, the same container is concealed under his shirt.

The system evolved from a tunable, continuous-wave (CW) 600-GHz vector imager system. The radar's key components, custom-built for a different application at JPL, are the Schottky-diode multipliers generating transmit powers of 0.3 to 0.4 mW over 576 to 595 GHz and a balanced fundamental mixer exhibiting a double-sideband noise temperature of ≈4,000 K over the same range. Also no-