Improvements in Speed and Functionality of a 670-GHz Imaging Radar

Image acquisition time has been reduced, enabling clearer images of contraband objects hidden underneath clothing.

NASA’s Jet Propulsion Laboratory, Pasadena, California

Significant improvements have been made in the instrument originally described in a prior NASA Tech Briefs article: “Improved Speed and Functionality of a 580-GHz Imaging Radar” (NPO-45156), Vol. 34, No. 7 (July 2010), p. 51. First, the wideband YIG oscillator has been replaced with a JPL-designed and built phase-locked, low-noise chirp source. Second, further refinements to the data acquisition and signal processing software have been performed by moving critical code sections to C code, and compiling those sections to Windows DLLs, which are then invoked from the main LabVIEW executive.

This system is an active, single-pixel scanned imager operating at 670 GHz. The actual chirp signals for the RF and LO chains were generated by a pair of MITTEQ 2.5–3.3 GHz chirp sources. Agilent benchtop synthesizers operating at fixed frequencies around 13 GHz were then used to up-convert the chirp sources to 15.5–16.5 GHz. The resulting signals were then multiplied 36 times by a combination of off-the-shelf millimeter-wave components, and JPL-built 200-GHz doublers and 300- and 600-GHz triplers. The power required to drive the submillimeter-wave multipliers was provided by JPL-built W-band amplifiers. The receive and transmit signal paths were combined in a thin, high-resistivity silicon wafer as a beam splitter.

While the results at present are encouraging, the system still lacks sufficient speed to be usable for practical applications in a contraband detection. Ideally, an image acquisition speed of ten seconds, or a factor of 30 improvement, is desired. However, the system improvements to date have resulted in a factor of five increase in signal acquisition speed, as well as enhanced signal-processing algorithms, permitting clearer imaging of contraband objects hidden underneath clothing. In particular, advances in three distinct areas have enabled these performance enhancements: base source phase noise reduction, chirp rate, and signal processing. Additionally, a second pixel was added, automatically reducing the imaging time by a factor of two. Although adding a second pixel to the system doubles the amount of submillimeter components required, some savings in microwave hardware can be realized by using a common low-noise source.

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In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to NPO-47180, volume and number of this NASA Tech Briefs issue, and the page number.

IONAC-Lite

A combination of energy and performance optimization is attained for high-speed Delay Tolerant Networking.

NASA’s Jet Propulsion Laboratory, Pasadena, California

The Interplanetary Overlay Networking Protocol Accelerator (IONAC) described previously in “The Interplanetary Overlay Networking Protocol Accelerator” (NPO-45584), NASA Tech Briefs, Vol. 32, No. 10, (October 2008) p. 106 (http://www.techbriefs.com/component/content/article/3317) provides functions that implement the Delay Tolerant Networking (DTN) bundle protocol. New missions that require high-speed downlink-only use of DTN can now be accommodated by the unidirectional IONAC-Lite to support high data rate downlink mission applications. Due to constrained energy resources, a conventional software implementation of the DTN protocol can provide only limited throughput for any given reasonable energy consumption rate. The IONAC-Lite DTN Protocol Accelerator is able to reduce this energy consumption by an order of magnitude and increase the throughput capability by two orders of magnitude. In addition, a conventional DTN implementation requires a bundle database with a considerable storage requirement. In very high downlink data-rate missions such as near-Earth radar science missions, the storage space utilization needs to be maximized for science data and minimized for communications protocol-related storage needs.

The IONAC-Lite DTN Protocol Accelerator is implemented in a reconfigurable hardware device to accomplish exactly what’s needed for high-throughput DTN downlink-only scenarios.

The following are salient features of the IONAC-Lite implementation:

• An implementation of the Bundle Pro-