This work furthers the recent research efforts in compact coherent receiver modules, including the development of the Q/U Imaging ExperimenT (QUIET) modules centered at 40 and 90 GHz, and the production of heterodyne module prototypes at 90 GHz.

Coupling Between Waveguide-Fed Slot Arrays

NASA's Jet Propulsion Laboratory, Pasadena, California

Coupling between two waveguide-fed planar slot arrays has been investigated using full-wave analysis. The analysis employs the method-of-moments solution to the pertinent coupled integral equations for the aperture electric field of all slots. In order to compute coupling between two arrays, the input port of the first array is excited with a TE_{10} mode wave while the second one is match-terminated. After solving the moment method matrix equations, the aperture fields of all slots are obtained and thereby the TE_{10} mode wave received at the input port of the second array is determined. Coupling between two arrays is the ratio of the wave amplitude arriving in the second array port to the incident wave amplitude at the first array port. The coupling mechanism has been studied as a function of spacing between arrays in different directions, e.g. the electric field plane, the magnetic field plane, and the diagonal plane. Computed coupling values are presented for different array geometries.

This work is novel since it provides a good understanding of coupling between waveguide-fed slot arrays as a function of spacing and orientation for different aperture distributions and array architectures. This serves as a useful tool for antenna design engineers and system engineers.

PCB-Based Break-Out Box

NASA's Jet Propulsion Laboratory, Pasadena, California

Break-out boxes (BOBs) are necessary for all electrical integration/cable checkouts and troubleshooting. Because the price of a BOB is high, and no work can be done without one, often the procedure stops, simply waiting for a BOB. A less expensive BOB would take less time in the integration, testing, and troubleshooting process.

The PCB-based BOB works and looks the same as a standard JPL BOB, called "Gold Boxes." The only differences between the old BOB and the new PCB-based BOB is that the new one has 80 percent of its circuitry in a printed circuit board. This process reduces the time for fabrication, thus making the BOBs less expensive. Moreover, because of its unique design, the new BOBs can be easily assembled and fixed. About 80 percent of the new PCB-based BOB is in a $22 (at the time of this reporting) custom-designed, yet commercially available PCB.

This device has been used successfully to verify that BOB cables were properly made. Also, upon completion, the BOB was beeped out via a multimeter to ensure that all sockets on the connectors were properly connected to the respective banana jack.

When compared to the Gold Box BOBs, the new BOB has many advantages. It is much more cost efficient, it delivers equal usability at substantially lower cost of the BOB, and the Gold Box is much heavier when compared to the new BOB. The new BOB is also a bit longer and much more versatile in that connectors are easily changeable and if a banana jack is broken, it can be replaced instead of throwing away an entire BOB.

Multiple-Beam Detection of Fast Transient Radio Sources

NASA's Jet Propulsion Laboratory, Pasadena, California

A method has been designed for using multiple independent stations to discriminate fast transient radio sources from local anomalies, such as antenna noise or radio frequency interference (RFI). This can improve the sensitivity of incoherent detection for geographically separated stations such as the very long baseline array (VLBA), the future square kilometer array (SKA), or any other coincident observations by multiple separated receivers.

The transients are short, broadband pulses of radio energy, often just a few milliseconds long, emitted by a variety of exotic astronomical phenomena. They generally represent rare, high-energy events making them of great

scientific value. For RFI-robust adaptive detection of transients, using multiple stations, a family of algorithms has been developed. The technique exploits the fact that the separated stations constitute statistically independent samples of the target. This can be used to adaptively ignore RFI events for superior sensitivity. If the antenna signals are independent and identically distributed (IID), then RFI events are simply outlier data points that can be removed through robust estimation such as a trimmed or Winsorized estimator.

The alternative "trimmed" estimator is considered, which excises the strongest n signals from the list of short-beamed intensities. Because local RFI is independent at each antenna, this interference is unlikely to occur at many antennas on the same step. Trimming the strongest signals provides robustness to RFI that can theoretically outperform even the detection performance of the same number of antennas at a single site. This algorithm requires sorting the signals at each time step and dispersion measure, an operation that is computationally tractable for existing array sizes.

An alternative uses the various stations to form an ensemble estimate of the conditional density function (CDF) evaluated at each time step. Both methods outperform standard detection strategies on a test sequence of VLBA data, and both are efficient enough for deployment in real-time, online transient detection applications.

Router Agent Technology for Policy-Based Network Management

NASA's Jet Propulsion Laboratory, Pasadena, California

This innovation can be run as a stand-alone network application on any computer in a networked environment. This design can be configured to control one or more routers (one instance per router), and can also be configured to listen to a policy server over the network to receive new policies based on the policy-based network management technology. The Router Agent Technology transforms the received policies into suitable Access Control List syntax for the routers it is configured to control. It commits the newly generated access control lists to the routers and provides feedback regarding any errors that were faced. The innovation also automatically generates a time-stamped log file regarding all updates to the router it is configured to control.

This technology, once installed on a local network computer and started, is autonomous because it has the capability to keep listening to new policies from the policy server, transforming those policies to router-compliant access lists, and committing those access lists to a specified interface on the specified router on the network with any error feedback regarding commitment process.

The stand-alone application is named RouterAgent and is currently realized as a fully functional (version 1) implementation for the Windows operating system and for CISCO routers.