independent interleavers, and the 15 groups of 372 Hamming symbols would be permuted by 15 independent interleavers before being fed to the 15 accumulators. This code structure at the transmitter would enable the use, in the receiver, of a high-speed iterative decoder that could include 372 soft-input, soft-output (SISO) modules to decode the 372 constituent Hamming codes in parallel and 15 SISO modules to decode the 15 constituent accumulator codes in parallel. Hence, the overall decoder could have a parallel architecture.

This work was done by Dariush Divsalar and Samuel Dolinar of Caltech for NASA's Jet Propulsion Laboratory. For further information, contact iaoffice@jpl.nasa.gov. NPO-40678

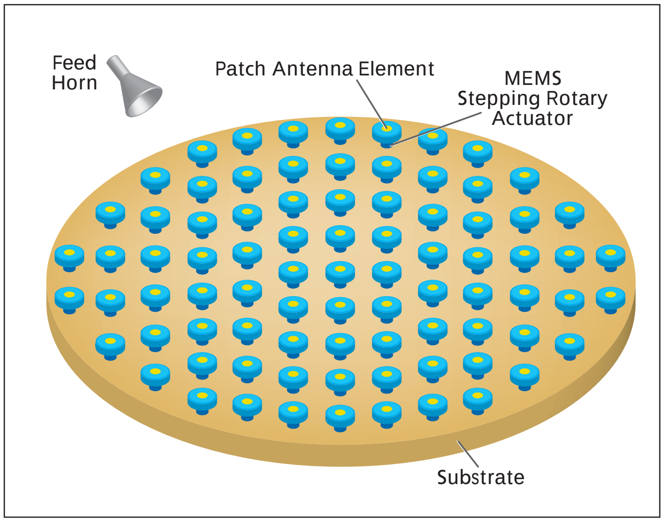
Wide-Angle-Scanning Reflectarray Antennas Actuated by MEMS

These could be simpler, cheaper alternatives to electronically scanned phased-array antennas.

NASA's Jet Propulsion Laboratory, Pasadena, California

An effort to develop large-aperture, wide-angle-scanning reflectarray antennas for microwave radar and communication systems is underway. In an antenna of this type as envisioned, scanning of the radiated or incident microwave beam would be effected through mechanical rotation of the passive (reflective) patch antenna elements, using microelectromechanical systems (MEMS) stepping rotary actuators typified by piezoelectric micromotors. It is anticipated that the cost, mass, and complexity of such an antenna would be less than, and the reliability greater than, those of an electronically scanned phased-array antenna of comparable beam-scanning capability and angular resolution.

In the design and operation of a reflectarray, one seeks to position and orient an array of passive patch elements in a geometric pattern such that, through constructive interference of the reflections from them, they collectively act as an efficient single reflector of radio waves within a desired frequency band. Typically, the patches lie in a common plane and radiation is incident upon them from a feed horn. Certain phase-sensitive types of such elements can be clocked to predetermined angles, relative to those of their neighbors, to modify the phase of the radiation incident from the feed horn and reflected from the elements so as to, for example, make the a flat array of patches act as though it were a parabolic reflector.



Passive Patch Antenna Elements in an array would be mounted on shafts of MEMS stepping rotary actuators that, in turn, would be mounted on a common substrate. The patch elements would be circularly polarized, and would be phase-sensitive in the sense that each would alter the phase difference between incident and reflected radiation by an amount that would depend on the actuator shaft angle.

Another reflectarray characteristic, essential to the present development, is that if the patch elements are rotated in unison, then the beam radiated by the antenna can be steered in elevation and azimuth through angular displacements of as much as ±50°. In an antenna of the type under development, the patch elements would be phase-sensitive in the sense mentioned above, would be circularly polarized, and would be mounted on the shafts of MEMS stepping rotary actuators (see figure). The maximum range of element rotation needed for wide-angle beam scanning would be only about ±180°, and scanning could be effected by use of relatively coarse rotational steps.

This work was done by Houfei Fang, John Huang, and Mark W. Thomson of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). *NPO-45971*

Biasable Subharmonic Membrane Mixer for 520 to 600 GHz

This is a prototype of mixers for future submillimeter-wavelength spectrometers.

NASA's Jet Propulsion Laboratory, Pasadena, California

The figure shows a biasable subharmonic mixer designed to operate in the frequency range from 520 to 600 GHz. This mixer is a prototype of low-power mixers needed for development of wideband, high-resolution spectrometers for measuring spectra of molecules in the atmospheres of Earth, other planets, and comets in the frequency range of 400 to 700 GHz.

Three considerations dictated the main features of the design:

- It is highly desirable to operate the spectrometers at or slightly below room temperature. This consideration is addressed by choosing Schottky diodes as the frequency-mixing circuit elements because of all mixer diodes, Schottky diodes are the best candidates for affording sufficient sensitivity at or slightly below room-temperature range.