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MODULATED SCATTERING TECHNIQUE SPEEDS MEASUREMENT OF NEAR FIELD ANTENNA PATTERNS AND RADAR CROSS-SECTION OF TARGETS

Researchers have demonstrated the feasibility of a new technique that will substantially reduce the time required to make near-field measurements of both antenna patterns and target scattering characteristics.

Information from near-field measurements of antenna fields helps predict how well the antennas will perform in actual use. For complex telecommunications antennas, reconfigurable antennas or sophisticated phased arrays, however, obtaining the information can require hundreds or even thousands of hours of measurement time.

Similarly, determining the radar scattering patterns of targets can require excessively long measurement periods, particularly for large military vehicles.

In a project for U.S. Army Communications-Electronics Command (CECOM), researchers at the Georgia Institute of Technology have developed laboratory prototype measurement systems based on the modulated scattering technique (MST). The technique, developed in cooperation with researchers from the Ecole Superieure d'Electricite (SUPELEC) in France, can reduce measurement time by a factor of 25 over conventional measurement methods.

The technique uses a 128-element array of modulated scattering probes which vertically scans the antenna's field or the target's scattered field by electronic means, while it moves mechanically in a horizontal direction. Computer codes compensate for the horizontal movement of the array, and perform the near-field to far-field transformation to generate a two-dimensional map of the far-field electrical field.

By comparison, conventional near-field measurement is done with a single probe moved mechanically over a two-dimensional surface through the electrical field in raster fashion, much as a television screen is scanned.

"There are many applications which require near-field measurements to be made efficiently and accurately," explained Dr. Barry Cown, senior research scientist in Georgia Tech's Electronics and Computer Systems Laboratory (ECSL). "Existing technology is capable of making these measurements accurately, but not very rapidly. What we are looking at is a technology that would speed up this process by a factor of 10 to 100."

The electronic scanning requires just milliseconds, he said, while the array moves horizontally at a rate of several inches per second. Cown's research shows that the MST can, for example, reduce the time required to measure huge telecommunications or tracking antennas from nearly 700 hours to just two hours.

Similar savings could be realized in radar cross-section measurements, while providing more scattering data for the target than is generally available from existing compact ranges, Cown believes.

"Existing compact ranges now used for indoor testing provide only mono-static data -- information on the radar scattering that comes directly back toward the source illuminating the target. By using modulated scattering arrays, these compact ranges could be modified to also provide bi-static data -- information on the scattering in other directions," he said.

Complete indoor testing also offers better control over measurements, immunity from the effects of weather, and important security advantages for sight-sensitive equipment.

Following extensive indoor tests, Georgia Tech researchers have begun development of a portable tester which could measure antennas and radomes in the field.

"This could be taken out to Army field sites to test antennas where they are used," he explained. "The Navy and Air Force are also interested in this technology for looking at antennas and radomes on aircraft."

No technology currently exists for making fast, comprehensive measurements of antennas and radomes in the field in a few seconds or minutes. Other uses being explored by Georgia Tech and SUPELEC include biomedical imaging and nondestructive testing of materials.

Presently, each element in the MST array consists of a dipole antenna with a PIN diode at its center. A 25 KHz modulating current is applied to each diode sequentially, producing a modulated signal that can then be detected by a homodyne receiver. The feasibility of using optically-switched materials such as vanadium dioxide to eliminate the present hard-wired multiplexing network is being explored under an internal research and development program.

"The MST allows you to isolate the scattered signal from the dipole being modulated from all the unmodulated information coming back from the rest of the array and the environment," Cown said. "This essentially gives you a direct measurement of the electric field existing in the neighborhood of the dipole."

The Modulated Scattering Technique was developed initially with internal support from ECSL at Georgia Tech. Further information on the MST will be presented at the IEEE Antennas and Propagation Symposium in June 1989, and additional details on its use in cross-section measurements are discussed in the May 1989 issue of IEEE Transactions on Antennas and Propagation.