Direct IR Diagnostics of Antenna Aperture Distributions

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ABSTRACT

A thermal imaging technique has been developed to measure electromagnetic (EM) fields. This technique is applied in this paper to measure the EM fields radiated by large phased array antennas. This thermal technique is based on infrared (IR) measurements of the heating patterns produced in a thin, lossy detector screen made from a carbon loaded polyimide film placed near the antenna in the plane over which the field is to be measured. The temperature rise in the screen material (over the ambient background temperature of the screen) is related to the intensity of the field incident on the screen. An experimental calibration table was developed at NIST/Boulder to convert the temperature rise into equivalent field strength at any point on the screen by irradiating the screen with a plane wave of known intensity. This thermal imaging technique has the advantages of simplicity, speed, and portability over existing hard-wired probe methods and produces a 2D picture (a pseudo-color image) of the field. In general, these images can be used for field diagnostics of the antenna (near-field or far-field patterns) and/or to evaluate the aperture excitation of the array. The aperture distribution can be compared to a standard "test pattern" to determine the operational state of each individual element of the array, which controls the radiation pattern of the antenna. Phase shifters and/or attenuators which produce incorrect element magnitudes or phase shifts can be identified with this technique.

Keywords: Phased arrays, aperture distributions, field diagnostics, infrared, thermograms

Published in the QIRT Journal 2.2