ANALYSIS OF APERTURE RADIATION USING COMPUTER VISUALIZATION AND IMAGE-PROCESSING TECHNIQUES

by

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ABSTRACT

In order to accurately describe the behavior of an antenna, one needs to understand the radiation mechanisms that govern its operation. One way to gain such an insight is to view the fields and currents present on a radiating structure. Unfortunately, in close proximity to an antenna empirical techniques fail because the measurement probe alters the operation of the radiating structure. Computational methods offer a solution to this problem. By simulating the operation of an antenna, one can obtain electromagnetic field data near (or even internal to) a radiating structure. However, these computationally intense techniques often generate extremely large data sets that cannot be adequately interpreted using traditional graphical approaches.

A visualization capability is developed that allows an analysis of the above-mentioned data sets. With this technique, the data is viewed from a unique, global perspective. This format is well suited for analytical investigations as well as debugging during modeling and simulation. An illustrative example is provided in the context of a rectangular microstrip patch antenna. A comparison is performed between the visualized data and the theory of operation for the microstrip patch in order to demonstrate that radiation mechanisms can be obtained visually.

An additional analysis tool is developed using Gabor filters and image-processing techniques. This tool allows one to detect and filter electromagnetic waves propagating with different velocities (both speed and direction). By doing so, each mode of an antenna can be analyzed independently. The fields of a multi-moded, open-ended rectangular waveguide are analyzed in order to demonstrate the effectiveness of these techniques.

"Not in the clamor of the crowded street,
Not in the shouts and plaudits of the throng,
But in ourselves are triumph and defeat."

Longfellow

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TABLE OF CONTENTS

LIST OF FIGURES