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Evaluation of Radiating-Source Parameters by Measurements in Faraday Cages and Sparse Processing

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Abstract

We have developed an algorithm that enables characterization of radiating sources by amplitude measurements in a Faraday cage. The algorithm uses equivalent dipoles and exploits electromagnetic scattering from the cage walls. To extract the parameters of the equivalent dipoles, we use sparse processing. We have verified the proposed approach by comparing experimental results obtained in an anechoic chamber and in a Faraday cage. In this way, we have shown that the Faraday-cage measurements may be used as a low-cost alternative to the standard electromagnetic-compatibility test sites such as (semi)anechoic chambers and open-area test sites.

Keywords: Electromagnetic compatibility, equivalent dipoles, anechoic chambers, open-area test sites, Faraday cages, sparse processing.

1. Introduction

Electromagnetic compatibility (EMC) standards require the utilization of an open-area test site (OATS) or a (semi)anechoic chamber for the measurements of radiated emissions and radiation susceptibility. However, such measurement facilities are expensive and not always available. Consequently, a number of techniques have been developed over the years to enable performing EMC measurements at alternative test sites, such as transverse electromagnetic (TEM) cells [1–4], gigahertz transverse electromagnetic (GTEM) cells [5–8], and reverberation chambers [9–11].

Here, we develop a method that correlates measurements in a Faraday cage with those at an OATS. The Faraday cage is a low-cost alternative to a (semi)anechoic chamber or an OATS. The proposed method approximates a radiating source by a set of orthogonal dipoles, which can be used to evaluate the radiated field in an arbitrary environment, e.g., above a ground plane or in a free space. By exploiting the multipath from the Faraday cage walls, we mitigate the ill-posedness of this inverse scattering problem and therefore improve the estimation accuracy. The advantages of using the multipath have been observed in, e.g., through-the-wall imaging [12] and direction-of-arrival estimation [13]. We note that the proposed method is capable of providing the characterization of radiation sources even for measurements below the lowest resonant frequency of the Faraday cage, and, consequently below the lowest usable frequency (LUF) of a reverberation chamber.

Equivalent dipoles have been employed in the analysis of radiating devices by means of TEM-cell measurements [14–17] and in evaluating radiating emissions from printed-circuit boards (PCB) [18]. In

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