STATISTICAL PROPERTIES OF FIELDS IN REVERBERATION CHAMBERS

David A. Hill
Radio Frequency Technology Division
National Institute of Standards and Technology
Boulder, Colorado 80305
USA

The use of reverberation chambers (also called mode-stirred chambers) for electromagnetic compatibility (EMC) measurements has increased rapidly during the past decade. Reverberation chambers are electrically large, multimoded cavities that use either mechanical stirring or frequency stirring to create statistically uniform fields. Reverberation chambers are reciprocal facilities that are equally useful for radiated immunity and emissions measurements. They are particularly advantageous for high-power immunity testing because the high Q of the cavity allows the generation of high field strength with modest input power.

The interpretation of reverberation chamber measurements requires a thorough knowledge of the statistical properties of the electric and magnetic fields throughout the chamber. A plane-wave integral representation (D.A. Hill, *IEEE Trans. Electromag. Compat. 40*, 209-217, 1998) has been found useful for predicting field properties and responses of test objects and reference antennas in reverberation chambers. For well-stirred fields, the ensemble averages (obtained from mechanical stirring) of the electric and magnetic fields are zero, and the averages of the squared electric and magnetic fields are spatially uniform with a ratio equal to the square of the free-space impedance. The fields are completely depolarized, and the rectangular components are uncorrelated. All of these properties have been verified by three-axis electric and magnetic field probe measurements. Field probability density functions have also been derived and verified experimentally.

Spatial correlations of the fields and energy density are important in understanding the responses of electrically large antennas or test objects with separated entry points (apertures). Spatial correlation functions have been derived for the total electric (or magnetic) field, electric and magnetic field components, and the energy density. Some of these correlation functions have been verified by measurements with separated receiving antennas (D.A. Hill and J.M. Ladbury, *IEEE Trans. Electromag. Compat. 44*, 95-101, 2002).

Most reverberation chambers are constructed in the shape of a rectangular box. For this shape, it is possible to use multiple image theory to derive the field properties near the chamber walls and corners as well as in the central region of the chamber. Expressions that satisfy the wall and corner boundary conditions (tangential electric and normal magnetic fields equal zero) have been developed. These expressions reduce to the expected uniform-field expressions at large distances from the walls and corners. These results are helpful in determining the useful (uniform-field) test volume of reverberation chambers.