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Statistics of Trans-Impedance of Coupled Electrically-Large Enclosures

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The Random Coupling Model (RCM) [1] can be used to understand the statistical wave properties of electrically-large complex enclosures [2]. Example predictions include the statistics of complex impedance and induced voltages on objects within the enclosure. We are now extending the RCM to include consideration of more realistic scenarios, including multiple connected enclosures, each of which is ray chaotic [3]. This situation is of particular relevance to ships and aircraft loaded with sophisticated electronics in multiple compartments. These compartments are often interconnected by multiple means, including cable bundles, apertures, air conditioning ducts, and common power supplies. However, to test the RCM under such increasingly realistic scenarios requires experimental facilities currently beyond our means at UMD. To address this problem we have developed a scaled-down electromagnetic test setup. We have created complex enclosures that have been scaled down in size by a factor of 20 from full scale. The measurements are carried out in the mm-wave range using cooled metal enclosures in order to maintain the complete equivalence of Maxwell's equations. Tests are being performed on several types of predictions, namely induced voltages on components in chains of connected enclosures [3], and induced voltages for components in enclosures that are illuminated through an irregular aperture [4]. We first prove that the statistical properties of a single scaled enclosure are equivalent to those of a full-scale version. Next we create 2-, and 3-connected-cavity cascades and measure the statistical properties of the trans-impedance. The biggest challenge in comparing the experimental results to predictions [3] is determination of the radiation admittance of the apertures that couple the cavities. We give an update on development of this test facility along with preliminary results for the statistical properties.

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