Simulating an Open Coaxial Return Line in a Reverberation Chamber

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Abstract—Standardized electromagnetic susceptibility testing for airworthiness qualification according to RTCA DO-160 demands coverage of the frequency range from 10 kHz up to 18 GHz. The Direct Current Mode Stirred (DCMS) test method, which combines Direct Current Injection (DCI)/ High Level Direct Drive (HLDD) with the resonant properties of a Reverberation Chamber (RC), aims at fulfilling the high field level requirements for the whole frequency range. In order to establish the DCMS method as a standardized EMC test, a conversion method between injected power into the Equipment under Test (EUT) and equivalent external field strength is needed. Therefore, a measurement campaign including several test sites and EUTs, supported by numerical simulations, is conducted to provide reliable measurement data and simulation models for corroborating a potential conversion theorem in the future.

Reverberation Chamber; DCMS; DCI; HLDD

I. INTRODUCTION

The DCI method works particularly well in the low kHz frequency range up to some hundred MHz [1] by utilizing the surface conductivity of an EUT and directly injecting the interfering current that would normally be induced by the external field in a HIRF test. To match the generators wave impedance, the EUT must be clamped in a return line. With increasing frequency, the return line starts to radiate due to increasing electrical length. By placing the EUT in a RC this normally lost energy can be utilized as a radiation source for stirred RC operation. To further improve the confidence in this so called DCMS method as an EMC test an ongoing study provides measurement results from different RC test sites with multiple EUTs, which are compared to their corresponding numerical simulations.

II. MEASUREMENT AND SIMULATION SETUP

Fig. 1 shows the setup for one of the RC test sites. Inside an Open Coaxial Return Rig (OCRR) a generic missile (GENEC) is clamped in as EUT and everything is placed within the test volume of the RC. Inside the GENEC two electric field probes and an Electronic Explosive Device (EED) with an attached fiber optic temperature sensor, to monitor the EED's current, is located. The RC is operated in DCI, DCMS and RC mode as described in [2].

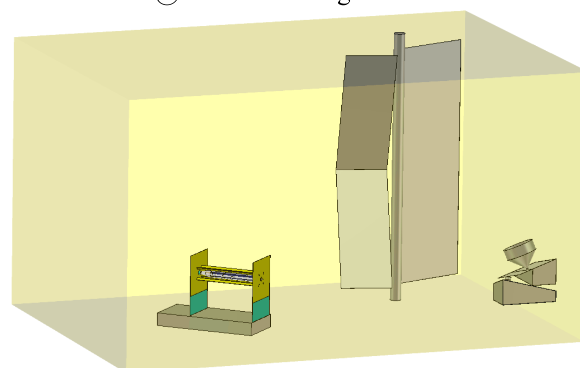

Figure 1. Reverberation chamber setup with GENEC

Those measurements are conducted on four RC test sites with different dimensions to validate the results.
Numerical simulations have been conducted with the software FEKO and its MLFMM solver in the past, but the resulting electric field strength results showed dependencies on the mesh density [3]. In this study Dassault Systemes CST Studio Suite with its frequency domain solver is used for the frequency range up to 1 GHz. Of interest for the comparison with the measurement results are mainly the frequency dependent current maximas through the EED and the electric field strength over frequency inside the GENEC for DCI, DCMS and RC operation. Furthermore, for RC operation, the external electric field strength inside the chamber's test volume has to comply to the homogeneity requirements defined in DIN EN 61000-4-21.

III. RESULTS

First simulation results were used to iteratively improve the simulation model, the final version is in good agreement with the measurement results regarding external and internal electric field strength. The precise modelling of the EED wiring turned out to be a major challenge.
Appreciation goes to the German Customer WTD81 Greding GF410, who enabled this project as a Technology Demonstration.

REFERENCES

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