Measurement and Analysis of Volumetric and Helical Stirring of Reverberation Chambers Using Stir Matrices

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Extended Abstract

In this paper, we revisit and extend the class of conventional rotational and linear mechanical mode stirring techniques in reverberation chambers. The aim is to explore methods for achieving higher maximum or lower minimum field strength and to reduce the measurement uncertainty, particularly at relatively low frequencies, with a view to reduce the lowest useable frequency (LUF).

In general, the spatial correlation distance of a random EM field defines its characteristic length scale for random fluctuations in a geometrically static configuration. Across this scale, the stir process adds a temporal dimension of field fluctuation with its own quasi-static or dynamic scale (stir-domain correlation distance). Based on a detailed measurement campaign, and without relying on any a priori models for the probabilistic distribution or correlation structure of the field, we demonstrate that the temporal stir process at relatively low frequencies can greatly benefit from an extension across the same 3-D volume of the chamber as that of otherwise static random spatial variation. This results in more efficient randomization (stirring), with the same stir effort compared to conventional rectilinear or rotational stirring with a chosen stir step.

A particular practical implementation, called helical stirring, enables the extension of the stir dimension to be achieved in a single continuous motion, in a relatively easy manner. It is shown that the values for the parameters of the helix (pitch, radius, and free length) can be traded in order to achieve improved performance. In particular, for variable pitch but with otherwise arbitrary values of the other parameters, an optimization of the stir path geometry is possible. For the analysis and study of the optimization of the stir path, interpolation of measured data is required in order to provide values of the field statistics in between measurement points (locations on the stir grid). It is shown that the concept of stir matrix allows for an efficient simulation and estimation of performance for additional tuples of parameter values. Detailed results are presented in [1].

Figure 1. (a) Experimental set-up for emulated virtual helical stirring. (b) Correlation coefficient for rectilinear, circular and helical stirring [1].

Reference