Predicting Power Distribution Inside a Reverberation Chamber

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To describe the electromagnetic field inside a microwave cavity such as a reverberation chamber (RC), a statistical approach is often performed. The main advantage lies in the fact that a detailed knowledge of the chamber is not necessary but its volume and its degree of losses. One of the challenges for the last decade has been to look for physical models from which some field-related quantities could be established.

Weibull distribution was found to be a good candidate [1] for modeling a given Cartesian component of the field (as well as its squared value). In spite of its lack of theoretical background, this distribution was shown to be a flexible model and convenient since parameterized by a shape factor, referred to as b, linked to the degree of diffusiveness (or *overmodedness*) of the field in the chamber. The main drawback lies in the impossibility to predict in advance the evolution of the shape parameter as a function of frequency for instance; one needs to apply an a posteriori procedure to compute the shape parameter empirically.

Some years ago, a physical model based on modal theory described the influence of losses on the degree of homogeneity of the field in an RC [2]. Recently the same approach has been used to derive the relative variance of a given Cartesian component squared of the field inside a chamber [3]. The evolution with the degree of modal overlap of such variability was highlighted.

If the relative variance is assumed to result from a Weibull distribution, the empirical and the modal approaches can be matched. By using a fitting model, we can relate the b parameter to the number of overlapping modes M_M as shown in Fig. 1 on which the fitting model is also expressed. This matching allows us to predict *a priori* the shape parameter evolution by characterizing the degree of losses of the RC only at single frequency. This consists in evaluating the composite quality factor that was shown to vary quite linearly with frequency in practice [4]. This measurement is useful to compute the number M_M of modes overlapping in the modal bandwidth. The experimental setup described in [3] was used and M_M values and b values were computed; Fig. 2 shows the good agreement found in practice (dots) with respect to the predicting model (solid line).

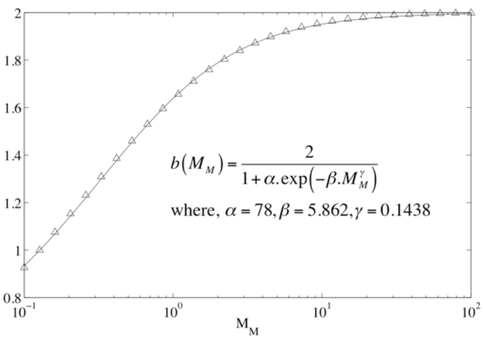

Fig 1: Theoretical evolution of b with M_M

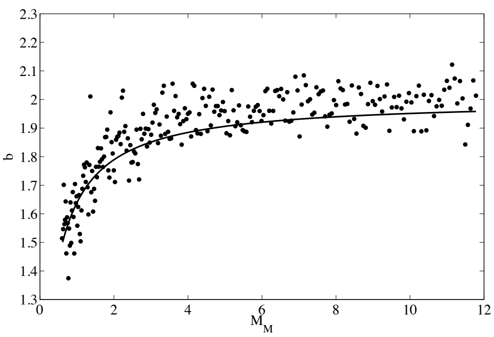

Fig 2: Evolution of b with M_M obtained experimentally (symbols) and theoretically.

References

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[4] Monsef, F., & Cozza, A. Average number of significant modes excited in a mode-stirred reverberation chamber. *IEEE Transactions on Electromagnetic Compatibility , 56 (2)*, 259-265, 2014.