A new computer model greatly speeds up the analysis of data from electromagnetic reverberation chambers

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Electromagnetic reverberation chambers are used to test the safety of electrical devices and identify potential problems, such as interference with other devices, before they are released on to the market. Now, Singaporean researchers have developed a new algorithm that can analyze electromagnetic reverberation chambers data more than ten times faster than the most state-of-the-art commercial software.

Reverberation is fundamental to music recording. Sound engineers use acoustic reverberation chambers to produce a random sound field in which all frequencies echo with similar strength from the walls. Electromagnetic reverberation chambers do the same thing with electromagnetic radiation, using reflective surfaces to achieve high field strengths from a moderate input power.

The introduction of every new electrical device poses a danger of interference with other gadgets to produce intense fields that could start fires or damage health. This prompted Huapeng Zhao at the A*STAR Institute of High Performance Computing and Zhongxiang Shen at Nanyang Technological University to find a way to improve analysis of important 'electromagnetic compatibility' information from electromagnetic reverberation chambers.

In a rectangular reverberation chamber, certain wavelengths will match the dimensions of the room and set up standing waves, such that field strengths are very high in some places and very low in others. To avoid this, specially-designed 'stirrers' are inserted with reflective surfaces at different angles, just as the walls of a concert hall are arranged at a variety of angles to provide uniform, persistent sound of high quality to every area.

"An electromagnetic reverberation chamber consists of a large cavity with one or two stirrers inside," says Zhao. "Rotating the stirrers creates a random environment in the cavity, which is useful for conducting statistical electromagnetic measurements."

Modeling electromagnetic fields in such a complex environment is not easy, especially when a wide band of radiation frequencies is used. Zhao and Shen exploited the regular rectangular shape of the cavity to simplify the simulation geometry, and considered the stirrers as separate components affecting the field. The key to their success was using 'adaptive frequency sampling' (AFS) to identify peaks in electromagnetic fields that could be associated with interference. AFS responds to findings while analyzing the frequency bands, rather than uniformly sampling every frequency band.

"Uniform frequency sampling requires a large number of samples in order to accurately capture the sharp peaks in wide-band reverberation chamber simulations," explains Zhao. "On the other hand, AFS adaptively chooses the location of samples so that the sharp peaks can be captured by using only a small number of samples. The simulation time is therefore reduced."

More information: Huapeng Zhao et al. Fast Wideband Analysis of Reverberation Chambers Using Hybrid Discrete Singular Convolution-Method of Moments and Adaptive Frequency Sampling, *IEEE Transactions on Magnetics* (2015). DOI: 10.1109/TMAG.2014.2356294