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Modeling and analysis of acoustically coupled spaces using a diffusion equation model

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Acoustically coupled spaces have been studied and applied to concert halls due to a number of interesting phenomena inside the spaces, including non-exponential energy decays, which are believed to benefit both desired clarity and reverberance. A diffusion equation model has been recently applied to acoustically coupled spaces to predict both steady-state and time-dependent sound field [A. Billon, et. al., J. Acoust. Soc. Am., 120, 2006, pp. 2043-2054], good agreements between simulations and experimental measurements have been found. In this paper, the diffusion equation along with a recently proposed modified boundary condition [Y. Jing and N. Xiang, J. Acoust. Soc. Am., 123, 2008, pp. 145-153] is used, to reveal intriguing characteristics of coupled spaces, including the sound pressure level distribution along the aperture, energy flow in both rooms, and location dependence of the acoustic source on energy decay characteristics. Experimental results are employed to verify the model, and show the capability of the diffusion equation model for guiding the design of coupled spaces.