ACOUSTICS2008/522
Soundfields in coupled rooms: A theoretical and phenomenological synopsis

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In systems of acoustically coupled rooms, energy in the reverberant field is exchanged between constituent rooms via transondent boundaries. Energy in the direct field can be distributed between rooms by the same mechanism. These exchanges of energy have been able to explain the phenomenon of multiple-slope decay curves. Likewise, they result in spatial and spectral variations in steady-state SPL and decay-curve shape. The basic form of the decay curve is governed by the gross locations of the source(s) and receiver: which room(s) they occupy, in addition to properties of the rooms themselves: volume, surface area, and absorption. Historically, these basic dependencies have been well explained by statistical-acoustics (SA) models. More subtle variations in decay-curve shape result from the fine-scale locations of source(s) and receivers relative to one another and boundary regions through which energy is exchanged (e.g., apertures). By accounting for radiation from boundaries, and propagation delays within and between rooms, more sophisticated SA models can reproduce these effects. Even so, these models fail when SA assumptions are violated or energy transfer becomes so great (e.g., large aperture areas) that room boundaries are ambiguous. In these cases, newer computational models yield accurate predictions and physical insight. [Work supported by ONR.]