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Active control of sound radiation from vibrating structures[1]

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Vibrating structures radiate sound that is often unwanted. However, because of the way structures and fluids couple, lower vibration levels do not necessarily result in lower radiated sound power. As a result, active control approaches that rely on simply minimizing the vibration of the structure are often either ineffective or inefficient. Ideally, an active control system designed for these applications would be sensitive to the radiation mechanisms that govern how efficiently the structure will radiate. An active control metric that shows significant correlation with radiated sound power has been developed and will be presented in this paper. The control metric is referred to as the weighted sum of spatial gradients (WSSG), and represents the metric that the active control system seeks to minimize. This paper will describe the sound-structure interaction problem and outline the WSSG metric that has been developed within that context. For a vibrating structure, the natural set of basis functions that describe acoustic radiation are referred to as radiation modes, and it will be shown that there are similarities between the most efficient radiation modes and the individual terms of the WSSG metric. The WSSG metric is a desirable control approach since it represents a localized point measurement, but yields global attenuation of the radiated acoustic sound power. This novel active control approach has been investigated for vibrating plates and cylindrical shells. Both computational and experimental results will be shown that demonstrate the effectiveness of the method for attenuating sound power radiated from these structures.

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