Acoustic Black Hole Structures and Their Vibro-acoustic Characteristics

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Acoustic black hole (ABH) effect utilizes the gradient variance of the structural configuration or material properties to realize the diminishing wave velocity in the structure. The wave velocity decreases to zero in an ideal scenario, resulting in zero reflection. The main method to realize the ABH structure is to adjust the structure through proper thickness tailoring in order to achieve energy capture in a certain area. It shows great advantages and potential application for flexural wave manipulation in thin-walled structure because of its high efficiency, broadband characteristic and flexible implementation. In this talk, the recent progress in modeling, analysis, implementation and measurement of ABH structures and their applications in wave manipulation, vibration damping and noise reduction is introduced. Recent results indicates very different vibro-acoustic coupling characteristics between cavity noise and ABH structure, which is beneficial for cavity noise reduction. Applications of ABH structures include enhancement of energy harvesting, vibration damping based on energy focalization and ABH-based wide-band dynamic vibration absorber. Examples of cavity noise reduction using ABH panel is also introduced. Finally, the implementation of a one-dimensional ABH based on material stiffness gradation is demonstrated.