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JISFA5#3 - Forced and shock vibration reduction in a honeycomb sandwich panel using a Vibro-Impacted Acoustic Black Hole attenuator

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An Acoustic Black Hole (ABH) is a passive technique for vibration reduction without adding mass. It usually consists of a thickness gradient following a parabolic thickness profile, inserted in a thin structure such as a beam or plate. This geometric inhomogeneity, combined with the addition of a viscoelastic thin layer, leads to a localization effect and a particularly efficient damping of bending waves. There is a wide variety of designs with attractive damping performance of vibration levels above a threshold frequency depending on the size of the ABH. In addition, it is possible to significantly improve low frequency performance by introducing contact nonlinearities able to transfer vibrational energy from low frequencies to high frequencies where the resulting device is highly efficient. In the framework of a CNES Research & Development program, an ABH disk with vibro-impactors, designed as an additional attenuator attached to a structure to be damped is proposed. The key points of the design and the performances are studied by means of numerical simulations combining a spatial finite element model and a conservative time integration scheme. A demonstrator is also studied experimentally in both the linear and non-linear regimes (without and with vibro-impactors, respectively). The performance analysis, conducted from the vibrational responses to broadband noise and shock excitations, show promising results for possible further applications.

Presenter(s) : HAIQIN LI (Laboratoire d'Acoustique de l'Université du Mans, UMR CNRS 6613); PATRICK O'DONOGHUE (Laboratoire d'Acoustique de l'Université du Mans, UMR CNRS 6613); ADRIEN PELAT (Laboratoire d'Acoustique de l'Université du Mans, UMR CNRS 6613); FRANÇOIS GAUTIER (Laboratoire d'Acoustique de l'Université du Mans, UMR CNRS 6613); CYRIL TOUZÉ (Institute of Mechanical Sciences and Industrial Applications, Unité mixte CNRS - ENSTA Paris - EDF – CEA); FLORENT MASSON (ACOEM)

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