



Flow-induced vibroacoustic responses of an infinite panel stiffened with acoustic black hole beams

Daniel Martins (1), Jamie Kha (1), Mahmoud Karimi (1) and Laurent Maxit (2)

(1) Centre for Audio, Acoustics and Vibration, University of Technology Sydney, Sydney, Australia

(2) Laboratoire Vibrations-Acoustique (LVA), INSA–Lyon, Villeurbanne Cedex, F-69621, France

ABSTRACT

Stiffened structures such as the fuselage of an aircraft or the hull of a ship are subject to flow-induced vibrations due to its relative motion with the surrounding fluid and formation of a turbulent boundary layer that excites the stiffened structures resulting in unwanted vibration and noise. Additionally, periodic stiffening introduces the well-known phenomenon of Bloch-Floquet waves that interact with the flexural waves of the host structure. In this investigation, an infinite panel loaded by water on one side and subject to a wall pressure field of a turbulent boundary layer is periodically stiffened with beams that are inspired by acoustic black hole (ABH) theory. It is shown that the stiffened panel's vibration and noise can be mitigated by manipulating the geometric design of the stiffeners such as tapering the edges of the beam accordingly to ABH theory. To investigate the effect of the design of ABH beam stiffeners on the vibroacoustics of its host panel, an efficient hybrid analytical procedure is presented where the structural dynamics of an acoustic black hole stiffener is modelled with finite element method and coupled periodically to an analytical model of an excited infinite panel. Finally, the ABH-stiffened panel's vibroacoustic response is compared against an equivalent case involving stiffeners of typical cross sections.