NFP-Portugal-report

From Luis Braga Campos (NFP-Portugal)

“Aeroacoustics Research in Portugal 2012-2014”, a succinct report with detailed references to 11 published papers is available immediately below.

Luis adds that, although Embraer has two factories in Portugal in Evora, one for metallic and one for composite structures, and, owns OGMA in Alverca, it is understood that all their aeroacoustics research is done in Brazil.

(Editorial note: Samir Gerges at Universidade Federal de Santa Catarina in Brazil is a partner of the X-Noise EV consortium and has reported in Newsletter#8.)

AEROACOUSTICS RESEARCH IN PORTUGAL 2012 – 2014
The research has covered a range of topics on aeroacoustics with relevance to low-noise airport operations and aircraft and engine design and that were the subject of a recent review [1].

Concerning sound generation two important mechanisms are:-
(i) moving surfaces, and,
(ii) fluid inhomogeneities in a flow [2].

The former topic (i) was addressed in more detail concerning analysis and synthesis of the noise of a propeller at an angle-of-attack including comparison with experimental data from two sets of wind tunnel tests [3]. This includes a generalisation of the classical multipole expansion to rotating sound sources in a mean flow.

An important aspect of sound propagation in ducts, such as aeroengine inlets, is the interaction of sound with vorticity in the boundary layer leading to acoustic-shear waves. The exchange of energy between the sound waves and the mean flow is indicated by an oscillation energy [4] or acoustic Hamiltonian that generalises the classical energy density.

The shear flow also modifies the generation of sound for sources inside a shear layer or a boundary layer [5]. The energy exchange with the shear flow in a boundary layer enhances the sound absorption by acoustic liners, and, may also have a bias flow [6] leading to a third-order wave equation.

The effectiveness of acoustic liners may enhanced by using a non-uniform wall impedance that couples the duct modes and affects:-
(i) sound generation by sources in the duct [7];
the radiation of sound out of the nozzle to an observer in the far field [8].

Downstream of a turbine sound propagation is affected not only by shear, but also by swirl. The interaction of sound with vorticity, either shear or swirl or both, can lead to the appearance of a continuous spectrum [9] in the absence of broadband sources or turbulence. This continuous spectrum is absent only in the case of rigid body swirl, and occurs for any non-constant radial profile of angular velocity; the continuous spectrum also occurs for any axial shear flow velocity profile, and is absent only for uniform flow.

The noise disturbance that affects near-airport residents is due to both engine and aerodynamic sound sources, whose spectra and directivity are modified by atmospheric and ground effects, including:

(i) atmospheric density and temperature gradients and ground impedances that cause refraction and absorption [10];
(ii) atmospheric turbulence that causes spectral and directional broadening [11].

For brevity this note and the references that follow include only papers published in the period 2012-2014, and, exclude papers associated with refereeing and work in progress; communications to symposia are also excluded.

REFERENCES


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