PhD grant 2021-2024

Impedance eduction of acoustic liners in realistic conditions : effects of the incident sound field and flow profile

Context :

Noise emissions from commercial air transport is a crucial issue in relation to public health, economic competitiveness and technological developments. For instance, the Strategy Research and Innovation Agenda, recently released by the Advisory Council for Aeronautical Research in Europe, has defined the vision for the reduction of aviation noise in 2050 in Europe. This sets out a number of ambitious targets for the reduction of noise and air pollution, including a 65% reduction of perceived noise levels by 2050 compared to the year 2000. At the national level, the Conseil pour la Recherche Aéronautique Civile has defined similar targets.

This PhD offer is included in the ASTRAL project (AcouStic inTegration for futuRe Aircraft propuLsion) which aims developing novel acoustic treatments to significantly reduce the noise emissions from aircraft. This project is a collaborative effort between the SAFRAN Group and the Laboratoire d'Acoustique de l'Université du Mans (LAUM) and is partly founded by the Agence National de la Recherche (ANR). The interactions with the other tasks and the other students of the project will be fostered by common experimental campaigns and regular discussions/presentations.

Subject description :

Several methods are available to measure the impedance of an acoustic liner with flow. The more commonly used is the so-called "two microphones method" (Malmary & al , 2001). Another one is based, thanks to microphones located in front of the liner, on the determination of the wave numbers that propagate in the treated part of the duct. Until now, we have only applied this method for small section ducts where the modal content is quite simple on the considered frequency range (Renou & Aurégan 2011).

Thus, this PhD thesis is dedicated to apply impedance eduction in conditions where the flow is fast, the sound levels are high and the sound fields are complex (several modes can propagate). To that end, our new test bench MAINE flow (Multimodal Acoustic ImpedaNce Eduction) that replicates realistic aeronautic conditions (rectangular section of150mm x 280mm, flow velocity up to 200 m/s (Mach 0.6), 150 dB for the incident waves) will be used.

The first task will consist in designing (using numerical simulations with a 3D Multimodal Method) and building a 2D microphone antenna (Chen et al, 2020) for the MAINE Flow facility. Then, the whole impedance eduction procedure will be validated using numerical predictions and existing data from the literature (Qiu et al, 2018). Finally, two research subjects will then be tackled using this facility :

- the links between the acoustic incident field (and thus, the angle of incidence of the waves) and the acoustic behaviour of the liner.
- the links between the flow profile and the liner behaviour (Weng et al, 2018). To that goal, the impedance of the same liner will be educed on several of our duct facilities (cross sections of 2x5 cm2, 4x5 cm2, 5x8 cm2 and 15x28 cm2). Boundary layer control technologies will also be used to establish a well detailed data set.

Candidate profile

This PhD thesis has a strong experimental part, but the development of the data processing tools as well as the antenna design will require a taste for numerical works too. The candidate must have completed a Master and have knowledge in one or more of the following fields: acoustics, duct acoustics, aeroacoustics, fluid mechanics, signal processing… Programming skills (Matlab or Python for example) are expected.

As a first step, Curriculum vitae and motivation letter are expected to be sent by **email to** gwenael.gabard@univ-lemans.fr and thomas.humbert@univ-lemans.fr **before the 15th of June 2021**. After a pre-selection step, the best profiles will be interviewed online.

Gross Salary : 1768,55€ / month

Date and location :
This PhD will begin on september or october 2021, will last 36 months, and will take place at LAUM (Laboratoire d'Acoustique de l'Université du Mans):
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Key words :
Aeroacoustics, impedance eduction, duct acoustics, experiments, sound-flow interactions, metamaterials

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