# VIBROACOUSTIC COMPUTATION OF A BUSINESS AIRCRAFT FUSELAGE AREA

***Céline Rousset*[1]*, Yann Revalor*[1]*, Malik Cheikh*[1] *and Eric Garrigues*[1]**

[1] *Dassault Aviation,*
*78 quai Marcel-Dassault – 92552 Saint Cloud*
*FRANCE*
*celine.rousset@dassault-aviation.com*

## ABSTRACT

Aboard a business jet, passengers are nowadays expecting to be flying with the same level of comfort as in a living room, a very comfortable car or a meeting room. One of the business jet aircraft industry indicator is the Speech Interference Level SIL (arithmetic average of acoustic pressure at octave bands 1000 Hz, 2000 Hz and 4000 Hz). This criterion characterizes the potential of background noise to alter a conversation.

A silent cabin relies upon an efficient design of acoustic insulation with a specific care of the mass budget to keep high aircraft performances. In order to optimize the definition of the acoustic insulation of the aircraft, Dassault Aviation draws on various computational strategies depending on physical phenomena to analyse. The paper focuses on the finite element modelization of the fuselage and its acoustic treatments developed by means of the in-house code ELFINI [1]. Such a model is used to understand transfer paths and to help select optimized configurations that will be tested (i.e. those with the best efficiency regarding interior acoustic noise vs mass of acoustic treatments) and to analyse test measurements conducted in acoustic rooms of Dassault Aviation Test Center of Mérignac (Figure 1).

*Figure 1: Dassault Aviation acoustic rooms*

A typical subject of study is a setup composed of a curved stiffened aluminium panel with acoustic mattress connected through mechanical links to a honeycomb panel (Figure 2). The lay-up is quite complex including viscoelastic, poro-elastic or honeycomb materials with different damping properties functions of the frequency. The calculation is led until the upper frequency of the SIL domain (5700 Hz) on a fuselage section of about 2 square meters. Different types of excitation are applied to the fuselage:

- acoustic excitations by defining a model of correlation on an excitation grid: diffuse sound field, turbulent boundary layer, plane wave, spherical wave, etc.

- structural loads for a structure-borne excitation: punctual force, imposed displacement, pressure, etc.

At the end, computational quantities that are analysed are: acceleration fields, pressure fields and acoustic radiated intensity.

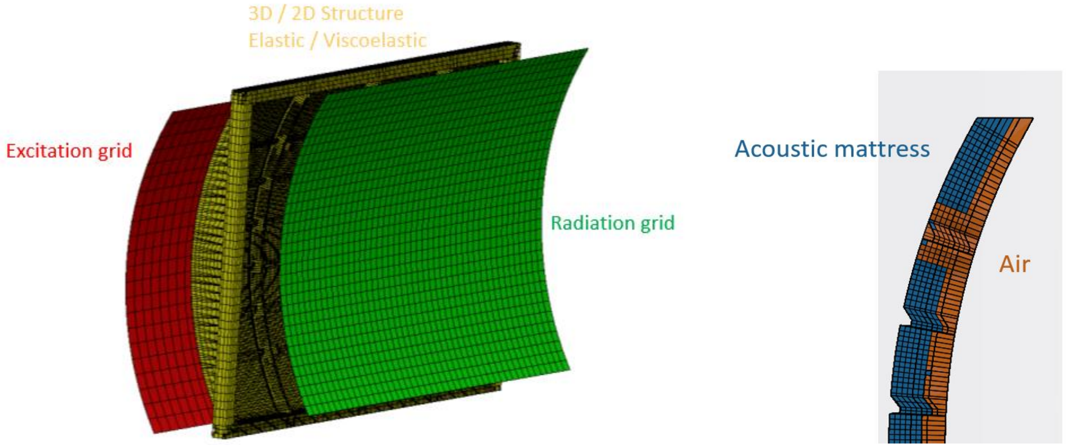

*Figure 2: Finite element model of the fuselage area*

To perform the needed analyses, due to the high modal density at the frequencies of interest, the computational strategy chosen is the direct dynamic structural Finite Element computation instead of a more classical modal superimposition calculation. To do this, the different subparts of the model are defined, coupled and assembled together in a dedicated efficient way [2]. The calculation steps are also organized in order to minimize the computational cost. Thanks to this method, more memory available, parallel solvers and HPC architecture, time computation is now compatible with industrial projects and processes.

The final paper will describe the vibro-acoustic computation strategy of Dassault Aviation and its application on a typical case from Dassault Aviation FALCON jet domain. First, some theory of the vibro-acoustic issue will be given, then the modelled system will be described with a focus on the poro-elastic material, the aero-acoustic excitation field and the equations governing the propagation and radiation and finally some visualization of the results and comparisons with experimental data will be provided.

## References

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