PostDoc @ ISAE-SUPAERO, 12 months

Project ACOUDRONE : Towards Silent Micro Air Vehicles

PostDoc advisors: Romain Gojon (ISAE-SUPAERO, DAEP), Thierry Jardin (ISAE-SUPAERO, DAEP), Jean-Marc Moschetta (ISAE-SUPAERO, DAEP)
Contact: romain.gojon@isae-supaero.fr, Thierry.jardin@isae-supaero.fr
Location: Aerodynamics, Energetics and Propulsion Department (DAEP), ISAE-SUPAERO, Toulouse
Funding: DGA
Scientific domain: Experimental aeroacoustics, NLVLM, Opitmisation

Summary:

The demand in Micro-Air Vehicles (MAV) is increasing as well as their potential missions, many of which take place in urban area. Whether for discretion in military operations or noise pollution in civilian use, noise of MAV has to be reduced. So far, beside relatively recent research on cooling fans, aeroacoustic research has mainly been focusing on large high speed rotorcrafts, now yielding significant improvements and original shape designs. An active field of aeroacoustic research at ISAE-SUPAERO is dedicated to reduce the noise produced by the rotors. This is a challenge since MAV's operate at relatively low Reynolds and Mach numbers. A significant first step has been achieved in 2020 using an in-house optimization tool that combines Non linear Vortex Lattice Method (NLVLM) [1], FW-H analogy and broadband noise models. Optimized geometries are 3-D printed and tested in an anechoic chamber (Figure 1) [2,3]. This allows ISAE-SUPAERO to be a main actor in the design of stealth MAV's. In order to reach the next step, new approaches are now required to model the noise due to unsteady flow patterns more accurately.

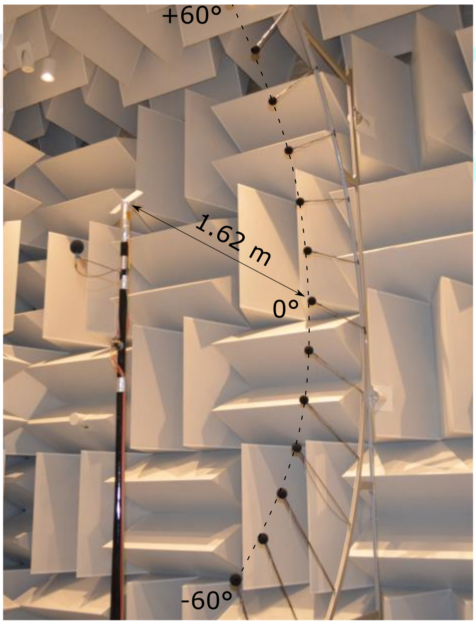

Figure 1: Photography of the experimental setup.

Work agenda:

In 2021, the noise due to the interaction of the rotor with a fuselage is simulated by NLVLM (Figure 2). and validated by tests in an anechoic chamber. In 2022, the plan is to further complexify the geometry by simulating a set of two rotors in tandem and in coaxial configurations.

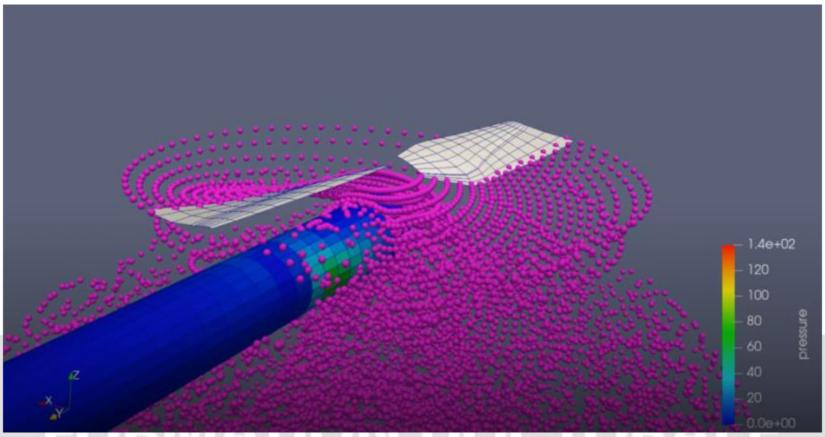

Figure 2: Simulation of the interaction of a rotor wake with a cylindrical body by NLVLM.

Expected skills:

Applicants who are expected to have a PhD in a field related to the subject, should have a firm background in fluid mechanics, applied mathematic, experimental methods, and unsteady CFD methods. More precisely, special skills in aeroacoustics, unsteady aerodynamics, and turbulence are expected to allow for a prompt start. Similarly, some knowledge of data processing, as required to post-process data from flow and sound computations as well as from measurements, are also an important asset. Some practical know-how in experimental techniques and a background in rotor aerodynamics would also be welcome. Furthermore, candidates should feel at ease in the UNIX environment.

References

[1] Jo, Y., Jardin, T., Gojon, R., Jacob, M. C., & Moschetta, J. M. (2019). Prediction of noise from low Reynolds number rotors with different number of blades using a non-linear vortex lattice method. In 25th AIAA/CEAS Aeroacoustics Conference (p. 2615).

[2] Parisot-Dupuis H., Gojon R., Jardin T., Jo Y., Doué N., & Moschetta J.-M., (2020). Experiments on UAV rotor noise at low Reynolds and low Mach numbers, In Quiet Drones International e-Symposium on UAV/UAS Noise Remote from Paris

[3] Gojon R., Jardin T., Parisot-Dupuis H., (2021), Experimental investigation of low Reynolds number rotor noise, JASA, 149(6), 3813-3829.