PhD position: Acoustic liners integrated inside blades of VTOL drone rotors

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During the last decade, the Micro Air Vehicle (MAV) market has experienced a significant growth. Nowadays, MAVs are commonly used in both civil and military sectors. In the former, they are a very good asset, for example in the cinema and photographic industry. In the military sector, their use is mostly for reconnaissance purposes. In any case, MAVs are increasingly used because of their low cost, low set-up time, and the possibility to fly them in closed and difficult environments. For these reasons, they are intended to replace helicopters in many more applications.

With the increase in the use of MAVs, the issue of noise pollution is becoming critical in both military and civilian fields. The main noise component in quadcopter MAVs is generated by the rotors and their interaction with the whole body. For the rotor itself, a tonal noise source due to the loading noise and a broadband one due to the trailing edge noise are currently studied at ISAE-SUPAERO [1,2]. The experimental setup consists of an isolated rotor placed at the acoustic center of ISAE-SUPAERO anechoic room, see Figure 1.

Several research teams are working on the optimization of the shape of the rotor to decrease its acoustic footprint. In this PhD, a new way to mitigate this noise will be studied and tested: a new generation acoustic liner [3] will be incorporated inside the rotor blades.

Figure 1: Experimental setup in the anechoic room for the study of rotor noise at ISAE-SUPAERO

The objective of the proposed PhD is to study the implementation of acoustic liners inside the rotor blades in order to act directly on the sources of the blade self-noise by modifying the acoustic impedance at the blade surface. Acoustic liners are already used in turbofan engines to reduce the fan noise. However, their size is of the order of one quarter of the wavelength of the acoustic wave one wants to work on. Here, a new architecture called LEONAR in which perforated holes at the treated surface are connected via flexible tubes to a cavity inside will be investigated. This architecture should permit to decrease the size of the acoustic liner up to one thirtieth of the acoustic wavelength of interest [3]. An example of such a liner is given in Figure 2.

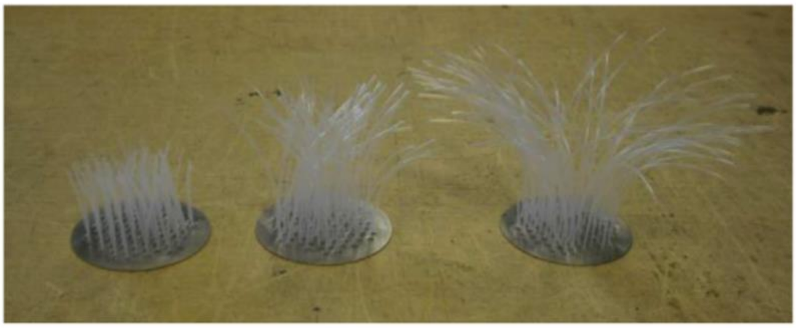

Figure 2: Example of acoustic liners, type LEONAR (ONERA).

The PhD will benefit from the experience in liners at ONERA and the experience on rotor noise at ISAE-SUPAERO. More precisely, the PhD will start by designing LEONAR type acoustic liner adapted to rotor noise as well as simulating the noise radiated. Once built, the liner will be characterized precisely first with a grazing flow at ONERA before to test the new rotor concept in the ISAE-SUPAERO anechoic room.

Bibliography :

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