E-PROPS : NOISE REDUCTION

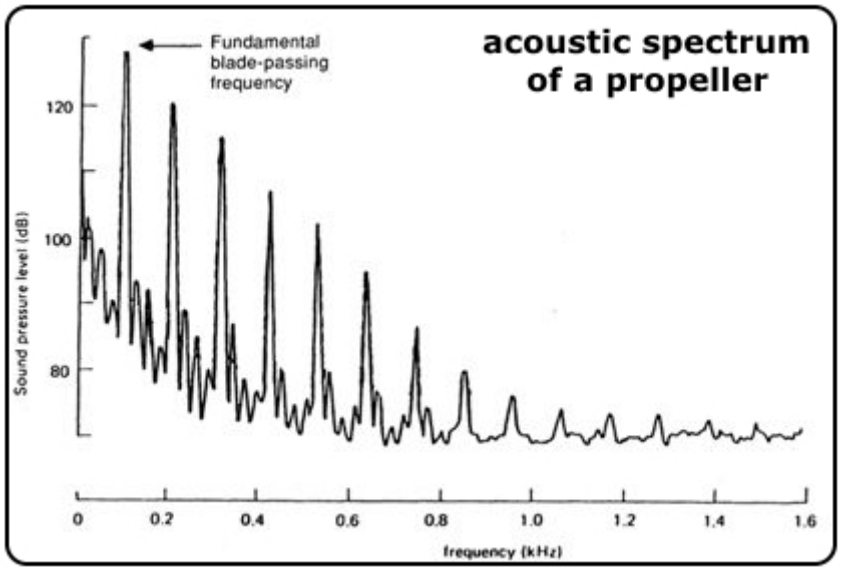
Since 2008, the E-PROPS team is doing extensive research on propellers noise and on solutions to decrease it as much as possible.

1- Propellers noice

The noise pollutions of a propeller are largely constituted by what is called a "line noise" dependent on the frequency of passage of blades, itself linked to RPM and number of blades. This line noise widely dominates the sound spectrum of a propeller.

The sources of line noise are dettailled into three :

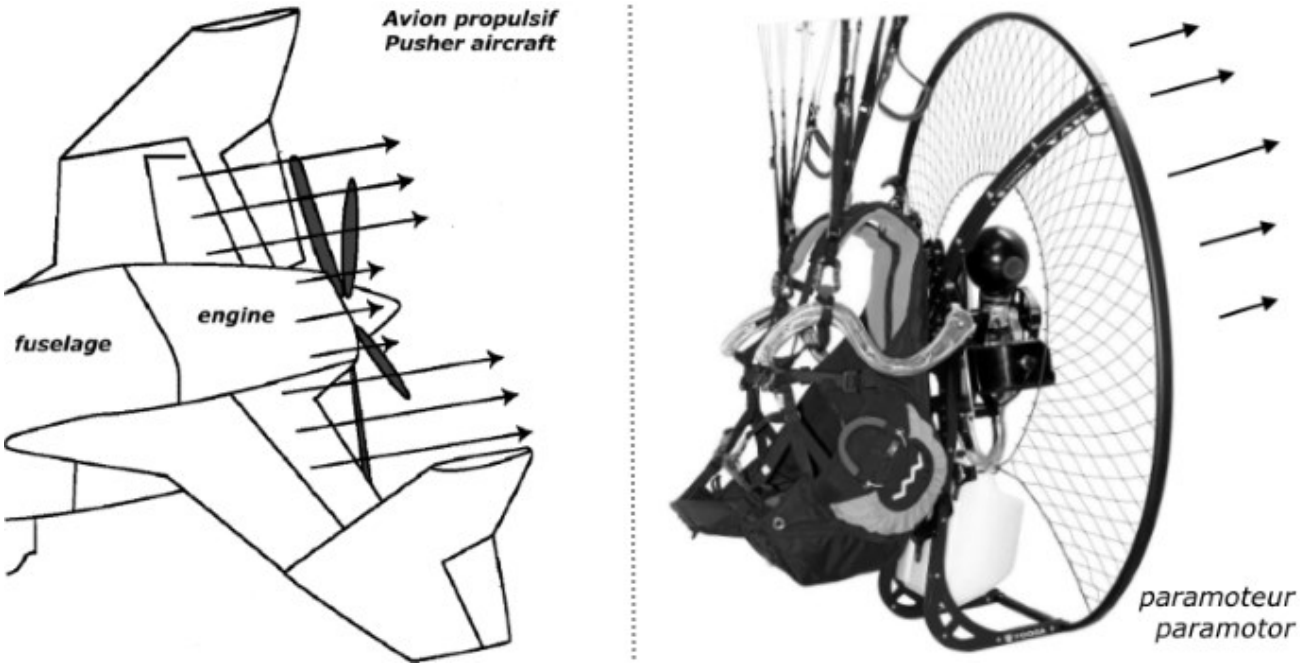
- thickness noise (due to the mass of the fluid moved by blades)
- load noise (made by the strength load on the fluid by blades)
- cutting noise (unimportant)



The tractor aircraft with gear drive engines, which peripheral speed (at tips) does not exceed Mach 0,65 and which are using modern and high efficiency propellers, do not produce high noise pollution.

In this case, the noise is coming from the engine at 75%.
The noise problem of the propeller is important for the pusher aircraft (delta trike, autogyros, paramotors). In pusher configuration, 80% of the noise is coming from the interactions between the propeller and the aircraft slipstream.
That's why the same propeller, mounted on the same engine but on a different aircraft can make very different noise.

Reduce the propeller's noise begins by designing a very fine aerodynamic, in order to have a propeller working on the less possible disturbed air.



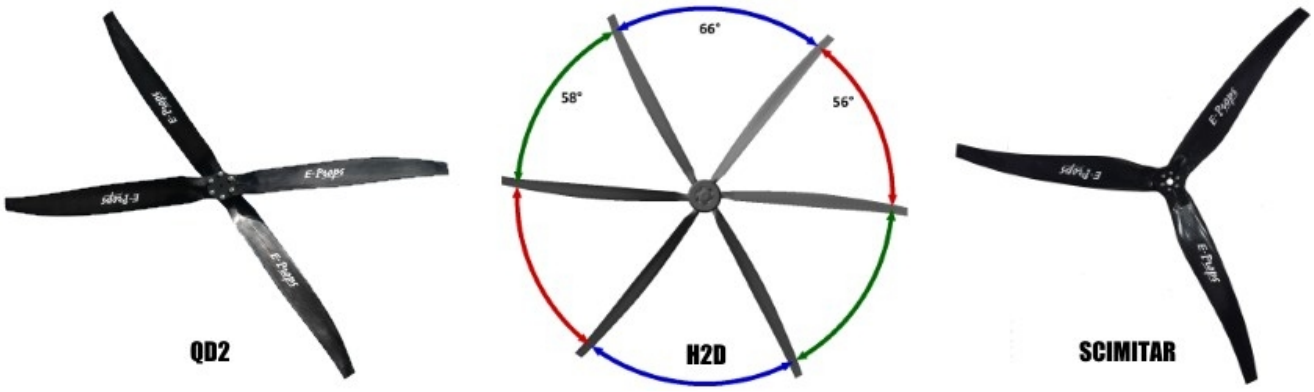
2- E-PROPS solutions to reduce propellers noise

2.1 E-PROPS Concepts

If the standard concepts (Clark Y profiles, standard positions of the blades...) are used, the decrease of the noise pollution is linked to a difficult compromise between acoustic performances and aerodynamic performances.
It is necessary to work with different concepts, as those designed by the E-PROPS team.

Forr example :

- **QD2 concept** : (Quadripale à Double Déphasage)
  a 4-blades composed of 2 x 2-blades with different angles to reduce the noise and increase the performances. Noise reduction in comparison with a standard 3-blade propeller : about 6 dB(A).
- **H2D concept** : (Hexapale à Double Déphasage)
  It is the same principle as some anti-torque tail rotors of helicopters, to significantly reduce vibrations and noise.
  Those concepts and new blades profiles allow to reduce the noise and to increase efficiency.
  Noise reduction in comparison with a standard 3blade propeller : about 8 dB(A), and the noise is very different (a bit like a turbine).
- **SCIMITAR design** :
  The special E-PROPS curved profile is making less noise than a standard straight blade.
  Noise reduction : about 5 dB(A)



2.2 Numbers of Blades

To reduce the noise, it is possible to increase the number of blades. This is true if the blade form is exactly adapted to the configuration : a blade of a 2-blades propeller mounted on a 3-blades or 4-blades hub would not be adapted, and the noise would be stronger.
Sometimes people are saying that a 3-blades (regardless the propeller brand) is making higher noise than a 2-blades.
During months, the E-Props team has made many comparative tests, with different blades geometries, in the same conditions, at exactly the same distances, with approved sonometers.
The results are conclusive : a 3-blades does not generate more noise than a 2-blades.
Just the noise is different and sometimes seems higher pitched, but the noise level (measured in decibels) is the same or lower (depending on the blades geometries).
During flight, the cone of exposure to noise of a 3-blades is less wide than the one of a 2-blades : the local residents perceive the noise of the 3-blades for less time.

By E-Props, the 4-blades have a special design (QD2 : the blades do not cross at 90°), and this design allows to reduce the noise significantly.
The noise is also low pitched. The noise reduction between a QD2 4-blades propeller and a standard 4-blades propeller is about : - 3 to 4 dB(A) according to the model.

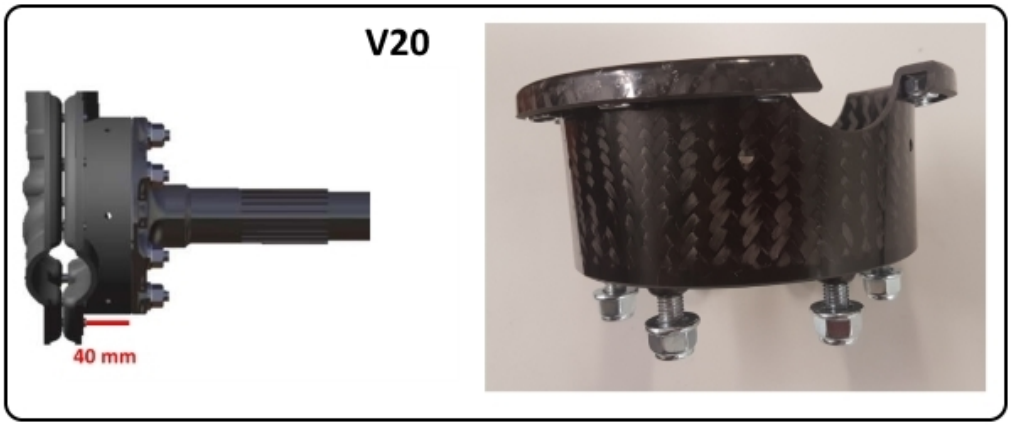
2.3 Spacers

An other solution is to space the propeller from the engine.
The E-PROPS SCIMITAR propellers have a integrated spacer which spaces the propeller from the engine of 10 mm.
The noise reduction between a SCIMITAR propeller and a standard propeller is significant: - 4 to 5 dB(A) according to the model.

Usually propellers manufacturers propose aluminium spacers if the engine is inside the engine covers, in order to space the propellers from the engine fairings.
But aluminium spacers are very heavy (20 g/mm - for example a spacer length 120 mm weights 2,4 kg), difficult to assemble (with many screws and bolts), and expensive.

E-PROPS has developed an exclusive system to replace the usual aluminium spacers : **THE CARBON ESU SPACERS** :

- ✗ The E-PROPS ESU spacers are ultra-light (13 times lighter : 1,5 g/mm instead of 20 g/mm for an aluminum spacer).
- ✗ The "E-PROPS ESU spacer" option is free of charge, regardless of the chosen length.
- ✗ E-PROPS ESU spacers are a part of the hub, easy to install (no unnecessary screws and bolts, thus avoiding vibrations).
- ✗ Orders are facilitated by the interactive drawings published by E-PROPS.



2.4 Tips

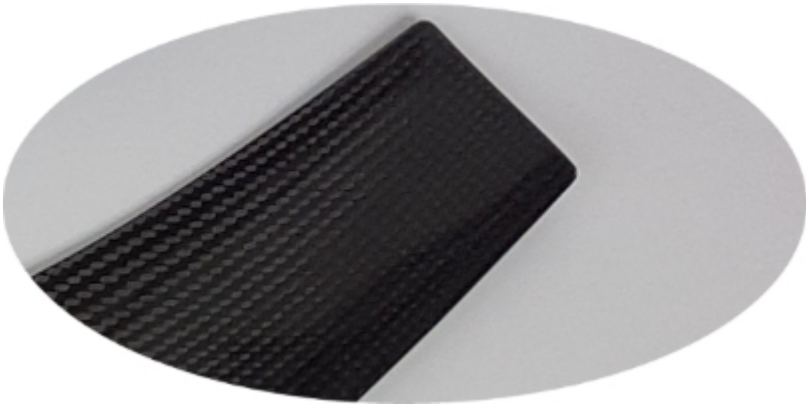
The E-PROPS design department has deeply explored the propellers tips in order to find a design which can decrease the propellers noise.
More than ten different configurations have been tested, while keeping the other identical parameters.

Examples : cut of the tip at 45° of the blades axis rearward, then forwards, rounded (standard by competitors), with winglets, with a small tube (as anti-vortex tuyere), without tips termination...

quelques exemples de tests de saumons

From a commercial point of view, a crafted and exotic tip would have been very interesting (E-PROPS brand more easy to identify).

But from a technical point of view, the verdict is unambiguous : the tips which reduce the noise as much as possible are those which are cutted at 90° from the blade axis. They also allow to obtain the best efficiency - which is closely related.



the most efficient tip form (acoustic and aerodynamic)

The team does not end there : the E-PROPS design department is working on numerical modeling to find new solutions to reduce the propellers noise.
Some prototypes are underway, then ground and flight tests have to be made to measure the potential gains.