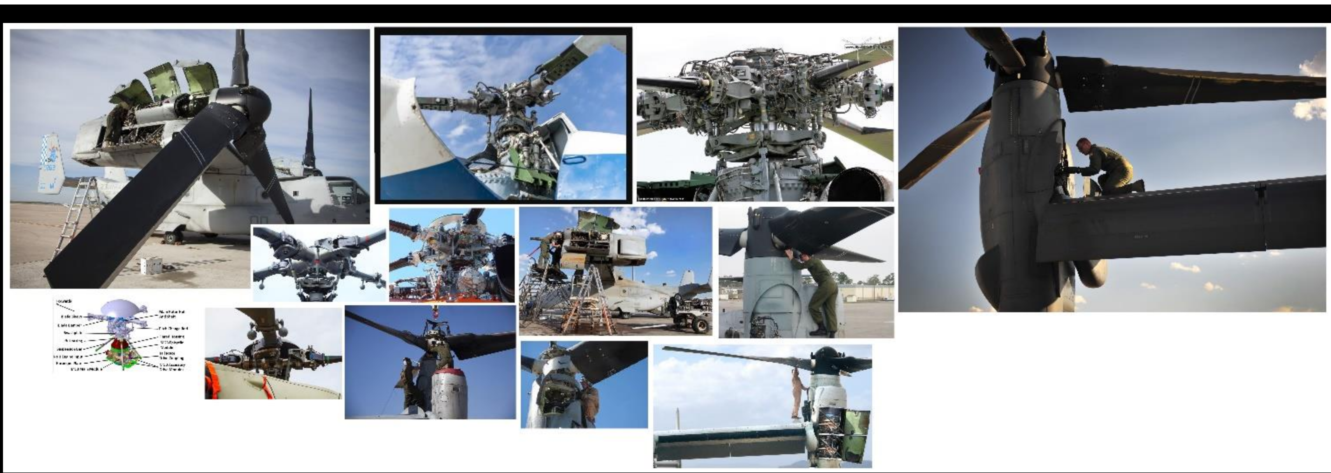
Hub Options of the Proposed Adaptive Rotors/Propellers
With concept documentation

Two Types of Hubs

Main rotor hubs of traditional helicopters, sometimes, look like pieces of art. Mechanical engineering marvels. Their basic complexity comes from the need to allow cyclic control of the pitch of the blades. A not so easy task of setting each individual rotor blade differently, again and again, as they travel along their path in the cycle. Those hubs also handle huge forces. Hence their typical robustness.



https://stallfreepropellers.com/wp-content/uploads/2025/11/Heli-main-rotor-hub_Collection-scaled.png

New multirotors tend to avoid complexities of cyclic control. Having several smaller rotors arranged in a horizontal pattern, makes it possible to lift, balance, and steer the aircraft using simple pitch control alone. Hubs still not simple but mechanically are more “relaxed”. Disregarding the drone sector, it can be stated that the VTOL industry supports rotor hubs based on two main concepts:

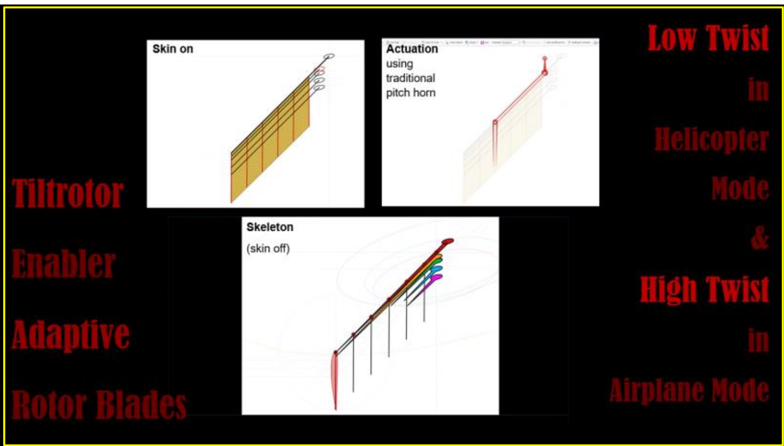
a) complex, cyclic control enabled, and

b) (collective) pitch control only hubs.

In the design of the proposed adaptive rotors and propellers these two types have been considered.

Objective and Scope of an Upgrade

According to the promise, future adaptive rotor blades of a helicopter/tiltrotor are supposed to change twist like this. (See the GIF.)



https://stallfreepropellers.com/wp-content/uploads/2025/07/Ikerkepek_montazs_02_feliratos_ver03_enabler_Large.gif

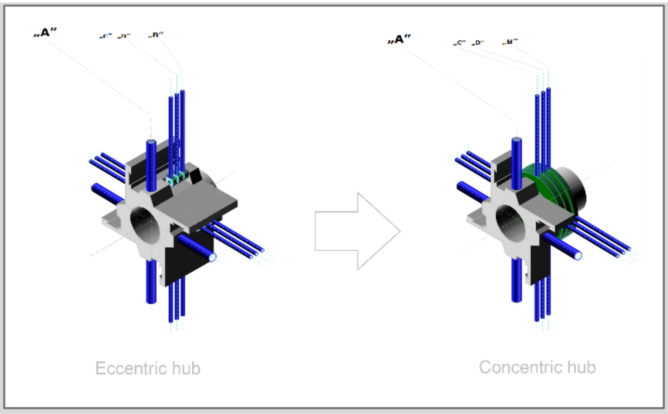
As shown in earlier posts, this kind of operation allows getting rid of blade stall at all speeds. Including vertical takeoff, landing and hover. Safety of flight (and also low speed maneuverability!) greatly improves. Top cruising speed expected to reach near 0.8 Mach. (Of course only for aircraft otherwise fit enough for that speed.) Fuel efficiency peaks. If implemented for the V-22 also devastating downwash will disappear, to be replaced by a much healthier helicopter downwash.

Implementation requires more than just replacing the blades. Part of the proprotor hub (see nacelle scheme below) needs an upgrade too. The reason is very straightforward. In contrast to the monolithic bases of the presently used stiff rotor blades, adaptive blades have more complex, organic-structured root sections. Although, as stated earlier, blade actuation is done using the existing pitch control systems, interfacing the new organic root assemblies still requires a partial modification of the old hub.

Mechanical Concept of the Two Types of the Hubs

As hinted in the eBook, these adaptive rotor/propeller blades are a mechanical derivation of the mainsails of yachts. That is why, based on utter similarity, parts of the skeleton - which define and regulate blade twist - are called masts. There is always a main mast (“A”), and several (but at least one) secondary masts (“B”, “C”, “D” – see figure below).

According to the present implementation, mechanical blade sections are hinged on, and are rotating around the main mast. They also are guided by the secondary masts so the blade can assume the desired twisted shape. The proposed mechanical solution allows setting the sections with a precision necessary for the blade twist to follow the optimal mathematical formula.



https://stallfreepropellers.com/wp-content/uploads/2025/11/Mechanical-Concept-of-the-Two-Hubs__vazlat-scaled.png

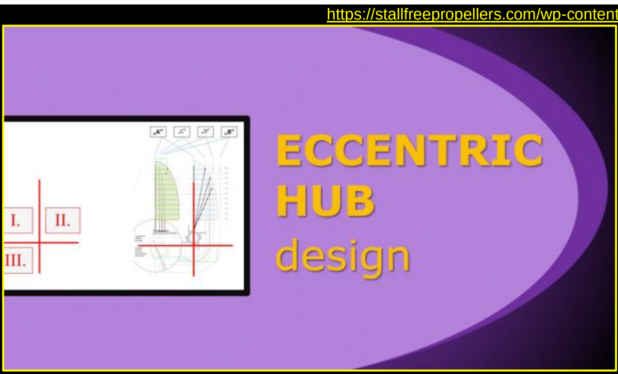
The above scheme is showing hubs belonging to four bladed variable pitch propellers. Main difference between the two is that secondary masts of the blades on the left hub are mounted through separate hinges each. On the right hub secondary masts are fixed to collective disks – all masts of the same number to the disk with the same number. As a result blades of the propeller with the lefthand side hub can have pitches different from those of the other blades of the same propeller. This setup allows e.g. the implementation of the cyclic pitch control of the blades. (You can even say “cyclic TWIST control” of the blades.)

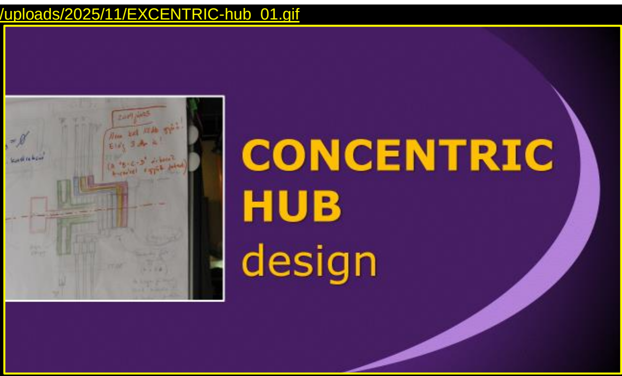
Documents

Two chapters of the PPT version of the eBook have been transformed to (i.e. saved as) GIFs. These are “fast forward” alternatives of the description - primarily not for reading - just for watching. Steps of assembling the hub assemblies shown in motion can help understanding the concept. Also the way of derivation of the concentric hub structure from the mechanical structure of the excentric hub becomes quite self-explanatory thanks to the moving images.

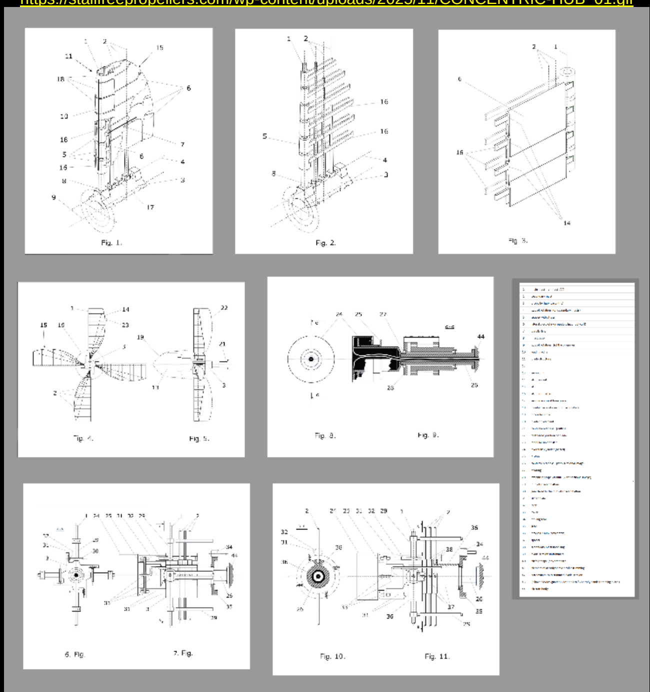
A collection of the drawings taken from the patent description is included too. The respective item list is part of the collection.

https://stallfreepropellers.com/wp-content/uploads/2025/11/EXCENTRIC-hub_01.gif





https://stallfreepropellers.com/wp-content/uploads/2025/11/CONCENTRIC-HUB_01.gif



https://stallfreepropellers.com/wp-content/uploads/2025/11/All-drawings_02-3.png

One more note. The above sketches of the hubs do not contain the mechanical parts used to control (i.e. to move) the secondary masts. However some of the patent drawings (figures 7. and 11.) do contain them. Part number is 29, and the name is “Hub of spaced batten”. Driven by a hydraulic cylinder, a sliding plate and a rack (items 24, 31 and 32) these parts use their forklike head to guide the secondary masts. A detail of interest can be too the piston (item 24) belonging to the hydraulic cylinder. It has a rim resembling a swashplate. True it never slants here, just controls the pitch of every blade in a collective fashion. It seems to be a good reference point for an engineering transformation from the propeller hub to that of a helicopter rotor. Or – a proprotor.

November 2025