Smart helicopter thanks to active rotor blades

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Active systems in helicopter rotor blades can adapt the blades' aerodynamic properties to local airflow conditions. The use of such systems leads to lower fuel consumption, increased maximum speed and reduced noise and vibration. A French PhD researcher at the University of Twente, Alexandre Paternoster, has developed a method for implementing these innovative systems, thereby bringing the smart helicopter one step closer.

Dr Paternoster's research is part of the European "Clean Sky" Joint Undertaking, which aims to increase the efficiency of air transport. The researchers involved in this Joint Undertaking are currently focusing mainly on active flap systems in helicopter rotor blades. The integration of these systems is no easy matter, given the enormous forces generated by rotor blade rotation, and the durability and reliability requirements involved. Using software simulations and a wind tunnel, Alexandre Paternoster examined the selection process for these actuators and determined the optimal design for such systems. His aim was to make them easier to integrate.

Dr Paternoster concluded that mechanisms based on piezoelectric materials are capable of meeting these requirements. He feels that the devices best suited for use in rotor blades are the d33 patch actuators from Physik Instrumente.

Gurney flap

Of all the active rotor systems currently under development, the Active

Gurney Flap has been selected in the framework of the Clean Sky Joint Undertaking's Green Rotorcraft Integrated Technology Demonstrator. Extending the Gurney flap during the return movement of the rotor blade improves the blade's lift and overall performance. This technology is already in an advanced stage of development. Alexandre Paternoster's goal was to find the most efficient design for a Gurney Flap. In addition to taking account of the various aerodynamic forces involved, he had to identify realistic combinations of extension levels for the mechanism, flow direction and airspeed. On the basis of a piezoelectric actuator, the design was optimized to generate the maximum amount of movement and actuator power. The result is a "Z"-shaped structure. This mechanism amplifies the extension generated by the piezo element into a relatively large movement.

Prototype

Alexandre Paternoster's aerodynamic model is combined with a multi-body simulation and a simulation that is used to assess the performance of the mechanism in practice. The mechanism's performance is sufficient to extend and retract the Gurney flap while it is exposed to the powerful forces generated by the air flow.

He concluded his study by creating a prototype of this z-shaped mechanism. This prototype made it possible to obtain experimental validation of the movements within the mechanism. The prototype performs superbly, and can be easily integrated into helicopter rotor blades. It also demonstrates the potential of piezoelectric material in actuation mechanisms. The development of such innovative technologies provides actuation system solutions for the highly demanding aerospace industry. The next generation of smart helicopters will soon be taking to the skies.

The doctoral thesis is titled "Smart Actuation Mechanisms For

Helicopter Blades".

Provided by University of Twente