Actuators for smart rotorblades

A. Paternoster, A. de Boer and R. Akkerman

Institute of Mechanics, Processing and Control- Twente
Structural Dynamics and Acoustics, University of Twente
P.O. Box 217, 7500 AE Enschede, The Netherlands
phone +31-(0)53-4893605, email a.r.a.paternoster@ctw.utwente.nl

UNIVERSITY OF TWENTE.

Impact
Institute of Mechanics, Processes and Control - Twente

Introduction

Adaptive blades change the aerodynamic properties of a wing of a helicopter rotorblade depending on the airflow perturbations. This is one of the key technologies to achieve cleaner and more efficient air transport, the main objective of the European CleanSky programme. A deployable Gurney flap (figure 1) was proven to be a suitable solution to actively modify the aerodynamics of a rotorblade[1]. The objective of this research is to select actuators to achieve active flight control with this smart rotorblade concept.

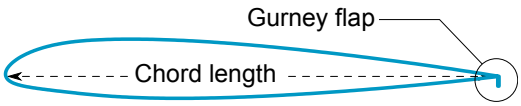

Figure 1 : Helicopter blade profile with a 2% chord length Gurney flap at the trailing edge.

Gurney flap for active flight control

The Gurney flap is a small control surface which improves lift with only a small drag penalty. The reduced lift generated on the retreating side of a helicopter limits its maximum speed and efficiency[2] (figure 2). Deploying the Gurney flap on the retreating side improves the rotorcraft global performance.

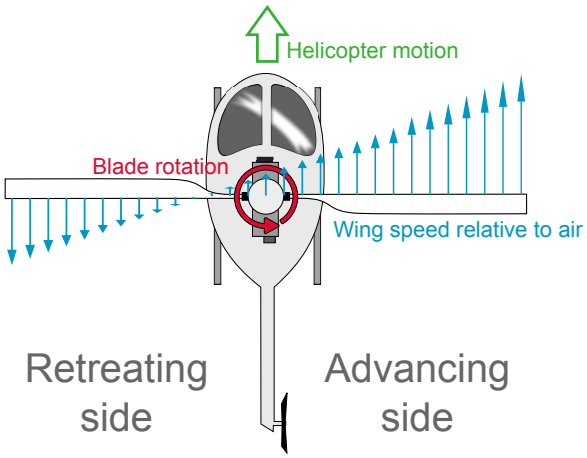

Figure 2 : Airspeed imbalance between the two sides of a rotorblade in motion.

In order to be efficient, the Gurney flap needs to be deployed within 10 degrees of sweeping angle which corresponds to 7 ms.

Actuator selection

Usually, actuators are ranked according to their displacement and force. This actuation problem is driven by time requirements and requires weight efficient solutions. Four types of piezoelectric actuators were ranked according to their specific work and the time required to achieve full motion (figure 3).

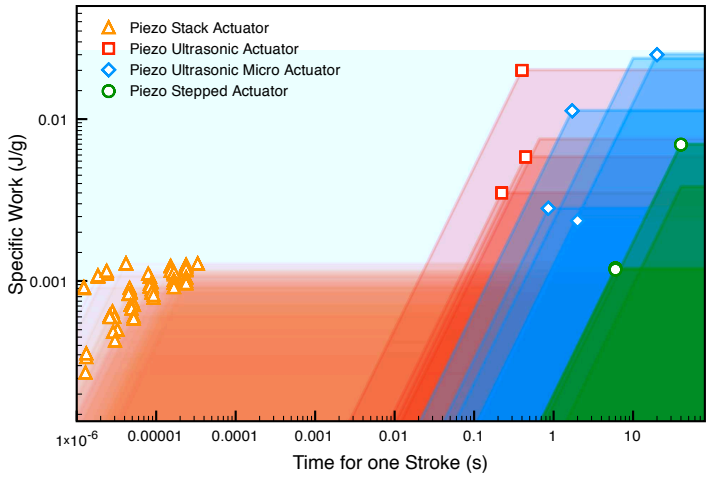

Figure 3 : Specific work versus the time to achieve one cycle for various piezoelectric actuators. The colored area indicates the performances allowed by each actuator technology.

Conclusion & Further Research

This investigation shows that piezoelectric stack actuators are the most suitable solution for the control strategy considered. Further research will model stack actuators to optimize designs of an actuator system to deploy Gurney flaps.

References

1. Wang, J.; Li,Y. & Choi,K.-S. Prog. Aerosp. Sci. 44(1):22-47(2008)
2. Thiel, M. "Actuation of an active gurney flap for rotorcraft applications". PhD thesis, Pennsylvenia University (2006)

The support of Agusta Westand and Eurocopter is gratefully acknowledged.

CLEANSKY Joint Technology Initiative for Aeronautics & Air Transport

AgustaWestland

eurocopter an EADS Company