

Power harvesting in helicopter rotor blades



P. H. de Jong, A. de Boer, R. Loendersloot and P. J. M. van der Hoogt

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 53 4894463, email p.h.dejong@utwente.nl

UNIVERSITY OF TWENTE.



Introduction

In light of the European *Clean Sky* project power harvesting using piezo components is investigated. The goal is electricity generation within a helicopter rotor to power systems locally, thereby eliminating maintenance sensitive components. This study is towards the use of piezo ceramics (PZT) and polymers (PVDF) and aims to establish how much power can be harvested from one 8.15m rotor blade with a chord of 0.65m.

Strain and piezo modeling

The blade surface is treated as a grid of piezo patches. Strains are calculated using time history tip displacement and modal data provided by *Agusta Westland* for straight and level flight. The power density across the blade is found by adding a harvesting model by Lefeuvre [1].

Results

Figure 1 shows the energy potential across the blade assuming only PZT. The peak strain is shown in figure 2 and is used for the piezo material choice based on the strain limit.

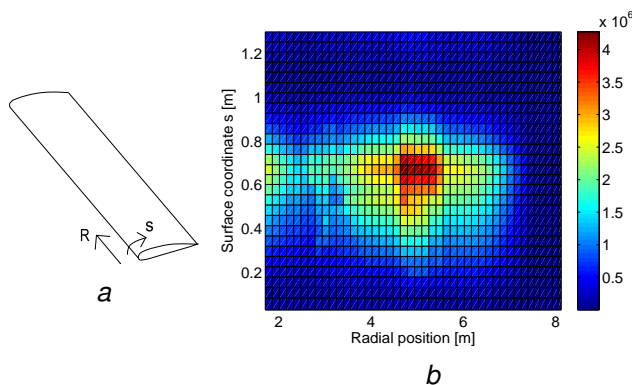


Figure 1 : Definition of coordinates (a) and energy in W/m^3 using a PZT material. (b)

To calculate the power, 0.5 mm thick material is assumed and only patches which achieve at least 50% of the highest efficiency found in the blade are included (figure 3). Approximately 100W of power is then harvested using 1.6 kg of PZT. PVDF yields only

1W using 0.6 kg of material due to the ambient strain being too low to suit the material.

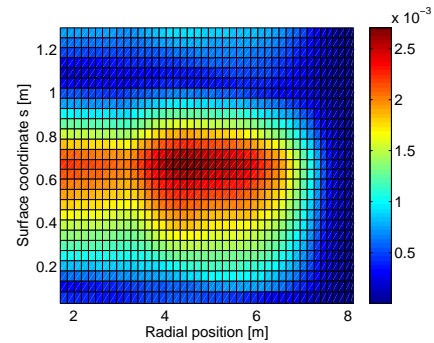


Figure 2 : Peak strain levels found over the blade

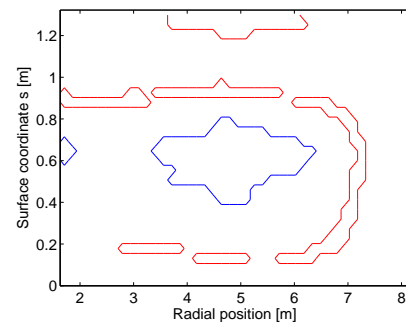


Figure 3 : PZT (red) and PVDF (blue) distribution assuming $>50\%$ efficiency.

Conclusions and future work

The blade generates approximately 100 watts which may be used for low power actuation systems and condition monitoring of the blade. The PVDF is unsuitable due to power harvested. Durability of the PZT is a critical issue which must be addressed as well as power consumption of the harvesting circuit. Other flight conditions and locations of power harvesting systems are under investigation as well.

References

1. E. Lefeuvre, J. Intell. Mater. Syst. Struct. 16(10):865-876 (2005)

Project and main partners:

