

# Anti-Noise Flaps

The noise produced by helicopters, particularly as they come into land, is far from pleasant, and their vibrations also affect the pilot. Both are caused by the air currents in the plane of the rotors. Eurocopter Germany is working on producing piezoelectrically controlled flaps for the rotor blades that will considerably reduce noise and vibrations. The control system for the flaps is being implemented with the aid of a dSPACE prototyping system.

## Air Vortices Cause Noise

The noise arises when one rotor blade collides with the vortex trail of the rotor blade in front. But noise is not the only problem: helicopters also vibrate continuously. The vibrations are largely due to the air flow striking the blades asymmetrically, as typically happens in helicopters. This means that an advancing rotor blade has greater lift than the rotor blade opposite it, which is moving towards the tail. As a result, the dynamic forces are not in overall balance – and the helicopter vibrates.

## The Solution: Additional Flaps in the Rotor Blades

By using controlled deflections of additional, piezoelectrically controlled flaps in the rotor blades, we can considerably reduce both the noise and the vibrations. The flaps perform two tasks: First, they divert the air vortex leaving one rotor blade away from the next rotor

blade. Second, their deflections generate additional forces that decrease the imbalance of forces in the helicopter, thereby reducing the vibrations. Controlling the approx. 35 flap deflections per second is the task of the dSPACE prototyping system, which is based on a DS1103 board. The control system “hears” the collision between blade and air vortex via a microphone on the landing skids and a pressure sensor in the rotor blade, and uses the acoustic behavior to calculate the optimum control for the piezoflaps. To calculate useful control signals for the piezoflaps, we have to sample the acoustic behavior at frequencies of up to 5 kHz.

## Noise and Vibrations Reduced

The piezoflaps considerably reduce the noise and the vibrations. The piezo-controlled flaps are far faster and more compact than the first version, which was hydraulic (see dSPACE NEWS 2/2003). We regard this system as an important step towards production

level. It is even conceivable that the piezoflaps might later be used not only for noise reduction, but also for the primary steering of the helicopter – which would make control rods and swash plates unnecessary.

*Dieter Roth  
Eurocopter GmbH  
Germany*

◀ *The dSPACE prototyping system in action in the helicopter. It causes additional flaps in the rotor blades to perform defined deflections, thereby minimizing noise and vibrations.*

- **Noise reduced by piezoflaps in the rotor blades**
- **Control via dSPACE prototyping system**
- **Noise and vibrations reduced**

