

# A helicopter that's easier to maintain and better to handle

**In helicopters the tail mainly serves to keep the aircraft stable. The rotors are used to maneuver the helicopter. But a study at TU Delft revealed that involving the tail in commanding the helicopter not only reduces the structural load on the main rotor, but also makes the helicopter easier to handle, with a better flight performance.**



Helicopter pilots use the rotors to move their aircraft upwards and downwards and to steer them sideways. With a stick they are able to adjust the angle of the rotors, which causes the helicopter to move to the left or the right and forward or backward. But when performing these maneuvers in forward flight helicopters can experience large and sometimes even unacceptable loads on the main rotor system.

But with a new method which is developed at TU Delft it is possible to achieve a considerable reduction of the loads on the main rotor hub of helicopters. In this system both the tail and the rotors are used for commanding the helicopter. Because the tail can generate a large control force up or down at a certain distance from the main rotor hub, alternative commands can be sent to the main rotor hub, resulting in smaller forces. Furthermore, as the horizontal stabilizer of the aircraft, the tail is designed to cope with structural loads.

## Reduced costs

The result is a possible reduction of 25 percent of the structural loads on the main rotor hub for nearly all types of helicopters. The technique was tested on a model of a UH-60A Black Hawk helicopter, but is

designed for all helicopters with a horizontal tail of which the angle can be actively controlled or which is partly flapped: this is the case for the majority of the helicopters. Helicopters with a fixed horizontal tail can be relatively easily redesigned to meet the requirements of this new technique.

With alleviated loads on the main rotor, maintenance costs of the helicopter can be reduced, and the aircraft will be better to handle. Alternatively, one can choose to keep the load at the same level, but to use the new technique to enhance the performance of the aircraft: pilots will be able to fly more aggressive maneuvers, with for instance forces of 3G instead of 2G.

## Simple to design

For the pilot of a helicopter which is equipped with this new system, no new instructions for commanding the helicopter are required. A clever distribution system converts his commands to both the tail and the main rotor hub. This distribution system can be implemented in a mechanical system or as part of the autopilot software, but a mechanical system will have the advantage that it is much simpler to design than

software and it will be easier to get it certified.

For further development of the new technique more detailed analysis is required, plus wind tunnel testing, piloted simulations and a detailed design of a mechanical flight control system. If final flight testing is also successful, helicopters will be cheaper to maintain and better to handle.

## Advantages:

- A reduction of structural loads in the main rotor hub with 25 percent
- Lower maintenance costs
- Improves handling qualities
- Potentially more aggressive maneuvers
- Can be applied to all conventional helicopters with a controllable horizontal stabilizer
- Very simple mechanical implementation. No complex software is needed
- The technology can be used with other solutions to get an even better result

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