Performance analysis of a helicopter retract actuator

assignment

If a helicopter has to make an emergency landing—e.g. landing on a severely pitching or heaving ship—the retract actuator and hydraulic system support the shock absorber and tire to absorb the landing impact. The evaluation of such fast transient events requires the integrated simulation of the landing gear mechanics in concert with the hydraulics in the retract actuator and the hydraulic system.

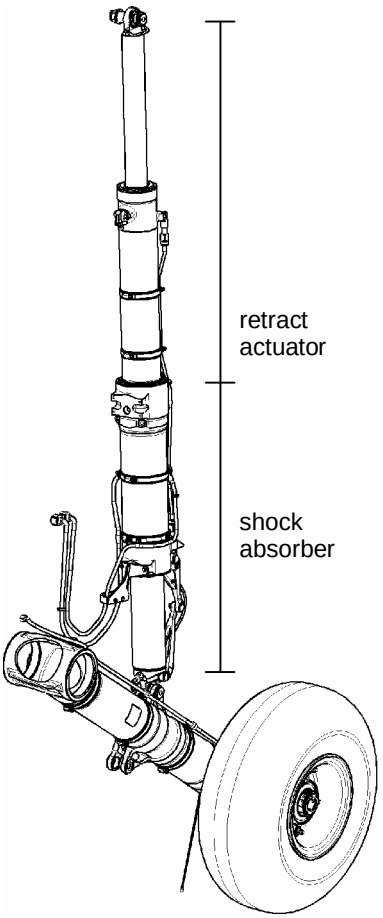
Stork Fokker AESP has commissioned Deltares to carry out the performance analysis of a helicopter retract actuator. The performance analysis consists of a series of dynamic simulations for different static, flight and landing scenarios. “We have selected Deltares for their in-depth knowledge on fluid transients and timely project planning”, says Jan Postma, project leader at Stork Fokker.

client

Stork Fokker AESP, Papendrecht, The Netherlands

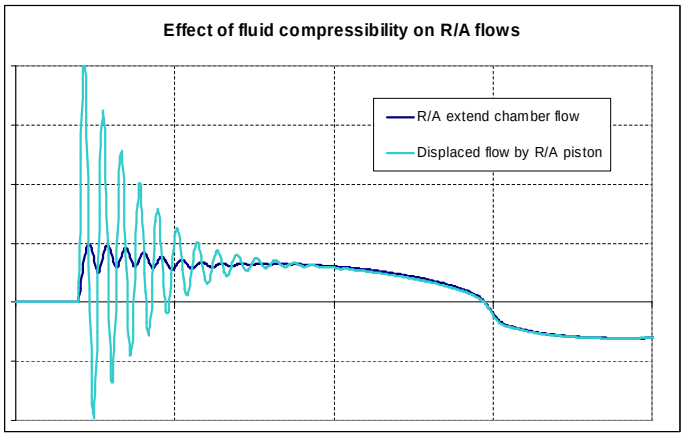
period

June – November 2005



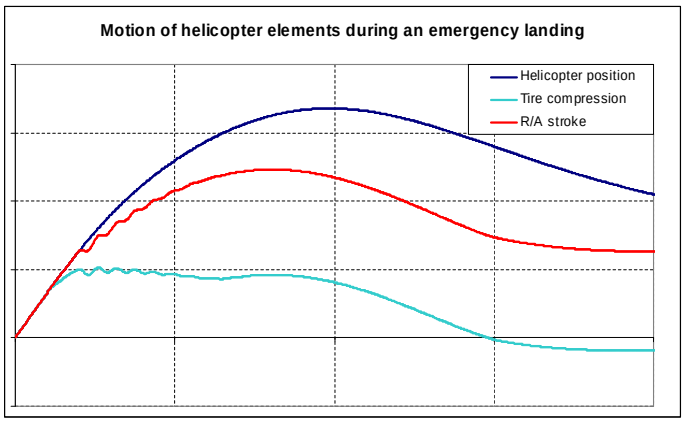
Mechanics + hydraulics in WANDA

The innovative WANDA application is the modelling and transient simulation of the emergency landing scenarios. During an emergency landing the retract actuator (R/A) and hydraulic system support the MLG tire and damped shock absorber to absorb the impact load of the landing.
The MLG has been designed to operate fully automatic without interference from the helicopter crew. During the emergency landing the hydraulic system identifies the severe impact and starts operating accordingly. If the impact force exceeds a certain value, a lock mechanism fails and the hydraulic system is activated. Now, the R/A strongly interacts with the damped shock absorber and tire during the emergency landing. The tire and damped shock absorber compress and start oscillating after the R/A piston is forced into the R/A cylinder by the inertia of the helicopter structure. The tire even starts bottoming. The R/A extend chamber pressure quickly rises to more than 500 bar, creating a fluid transient in the hydraulic system. The steep pressure increase requires to include the pressure-dependent compressibility of the hydraulic oil in the retract actuator (see figure below).
The complete, highly non-linear mechanical behaviour, as described above, has been modelled successfully in WANDA. The mechanical model in WANDA has been verified against a detailed 3D mechanical model of Stork Fokker.
The most important performance criteria for the emergency landing scenarios are the R/A pressures, the hydraulic system pressures, the g-forces experienced by the helicopter crew and the position of the helicopter structure, which should not touch the ground during the emergency landing; see figure on the right.

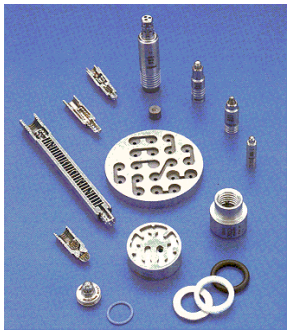


Miniature LEE elements in WANDA

WANDA and its predecessors have been used over the last 4 decades for waterhammer and dynamic control analyses of pipe systems of any size, ranging from the largest water transmissions systems (∅ 4 m) to a helicopter hydraulic system (∅ 8 mm). The performance analysis of this helicopter retract actuator



illustrates the robustness of WANDA's numerical core.
The broad scope, covered by WANDA, is illustrated by the helicopter hydraulic system, which includes a set of interconnected miniature precision flow control elements: LEE elements with nominal diameters of a few millimetres only. The LEE elements have been modelled in WANDA with the available generic set of hydraulic components.



Early identification of malfunctioning landing gear

A number of simulations has been evaluated with missing or misassembled, leaking parts. The results of these scenarios can be used to identify a malfunctioning main landing gear in an early stage or during testing.

More information

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