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# Coupling fluid and pressurized membrane structure for the study of helicopter ditching – Coupled Problems 2019

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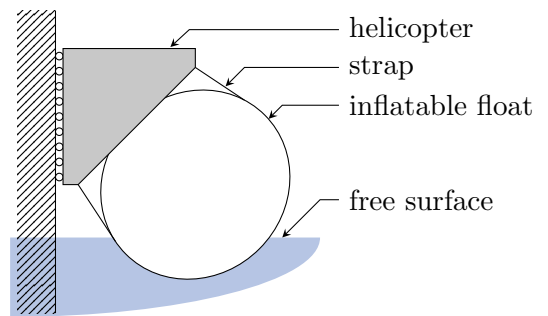
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## ABSTRACT

In the event of ditching, helicopters are too heavy to float or unstable on water. The designers have to add inflatable buoyancy devices to prevent capsizing. Dimensioning such devices is an essential issue in the helicopter's certification.

This study is concerned with the dynamical response of a helicopter equipped with lateral floats and falling vertically in the water. We consider a simplified configuration shown in the figure. The helicopter is represented as a deformable volumic body and the float as an air-inflated tubular membrane. At the initial instant, the float is positioned just above the free surface, with or without initial speed and dropped in a gravity field. The water is modeled as an incompressible perfect fluid.



The structure is solved through a home-made finite element code. The time-stepping is carried out using the Newmark method, where the nonlinear problem at each time increment is solved through a Newton iterative scheme. For lack of an analytical expression for the hydrodynamic water pressure, the tangent matrix coming from the hydrodynamic pressure is only partly computed. The fluid is computed with a home-made boundary element solver using the von Kármán model. The time-stepping is achieved using the explicit finite difference or the fourth order Runge-Kutta method.

In order to perform the coupling, we consider two schemes: (i) the Conventional Serial Staggered procedure [1], where the hydrodynamic load is computed once at each time step; and (ii) a modified Newton scheme, where the hydrodynamic load is computed at each iteration.

The obtained numerical results show which coupling scheme is the most efficient regarding precision and computation speed. Significant quantities to investigate the helicopter's behavior are given, namely the structural deformation, the helicopter/float contact stresses and the tensile forces in the straps.

## REFERENCES

- [1] C. Farhat, M. Lesoinne, Two efficient staggered algorithms for the serial and parallel solution of three-dimensional nonlinear transient aeroelastic problems. *Computer Methods in Applied Mechanics and Engineering* (2000) **182**:499–515.