Helicopter Fluid-Structure Coupling using preCICE

Background:

In the rotorcraft field, the aerodynamics and structural dynamics are mutually dependent. In general, the rotor performance and structural loads are modeled by means of comprehensive rotorcraft analysis tools. These software packages solve the blade motion and the rotor trim conditions. However, the aerodynamic phenomena such as the rotor wake or rotor inflow are predicted using lower-order aerodynamic models. In order to improve the numerical accuracy of the fluid-structure interaction on the blade, the rotor comprehensive analysis tools are coupled with computational fluid dynamic (CFD) tools that solve the 3D Navier-Stokes equations and can provide 3D advanced aerodynamic calculations.

In order to exchange the aerodynamic loads and structure deformation information between the CFD solver TAU and the structural solver CAMRAD II, preCICE was used as a coupling library. In previous study, preCICE adapters for TAU and for CAMRAD II were developed to establish the communication between these solvers.

The proposed study aims to improve the efficiency and functionality of the existing adapters. It will focus on the convergence of coupling between the CFD and TAU solvers, by comparing the explicit and implicit coupling approaches. Additionally, the focus will be on output/input routines to speed up calculation time by replacing the need to read and write output file to the hard drive by the use of memory buffer. These improvements should increase the predicted accuracy of the solutions for the rotor performance and loads. In future investigations, the developed adapters will allow the investigations of adaptive azimuth-dependent structural deformations on an active rotor (see Figure).

Skills:
Python Programming, Data Handling

Language:
German or English

Start:
Flexible (Best October/November 2020)

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Figure: Shape adaptive blades as envisioned by SABRE