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EXPERIMENTAL INVESTIGATION OF A COMPLIANT MECHANISM FOR AN UAV LEADING EDGE

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Summary: The investigation of morphing in airplanes is studied in order to increase the flight efficiency. In the context of the EU project CHANGE different morphing concepts are selected and adapted to fit in one UAV with a span of 4 m. The additional degrees of freedom increase the range of the aircraft while the design space is restricted by the chosen reference of an existing UAV. The design and realisation of an adaptive leading edge mechanism will be presented in this paper.

At first a framework is implemented, which leads to a pre design of a morphing leading edge. One part is an optimisation with different parameters to get the best position of an omega stringer and the displacement at this point to morph from one to another aerodynamic shape. The second part of the framework is a topology optimisation, which uses the stringer motion to realise a pre designed compliant mechanism. The result is a material distribution, which has to be post processed before manufacturing. The optimisation does not regard strains and stresses and therefore hinges, interfaces and bearings were designed manually. The compliant mechanism is made of PLA, which is used for fused deposition modelling.

A test rig of the pure mechanism is set up in a way that clamping condition and boundary stiffness are similar to installation conditions in the leading edge. The mechanism has a rigid clamping condition on one side and is actuated with a servo motor, which will also be installed in the leading edge. Afterwards the displacement of the mechanism is observed with and without loading at the stringer interface.

The main focus of the test rig lies on the deformation of the mechanism. The experimental results are compared with the simulations. Therefore the strain and stress is measured at the hinge and the overall deformation of the mechanism will be evaluated with an optical measurement.

The investigation on the test rig confirms the simulation. The simulation framework will be utilised for the UAV leading edge in CHANGE. The next step is the setup of the wind tunnel model and a flight test.