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MSC graduation Assignment: Optimisation of the design of a flexure meant for morphing application

GKN Fokker is working on the development of morphing wing parts, with as concept the combination of a continuous flexible skin and a structural element meant on the one hand to prevent transverse deformation of the skin due to aerodynamical load, and on the other hand not to resist the morphing of the wing. A sketch of the morphing wing is shown in next figure, with the so-called 'Flexible Shear Element'.

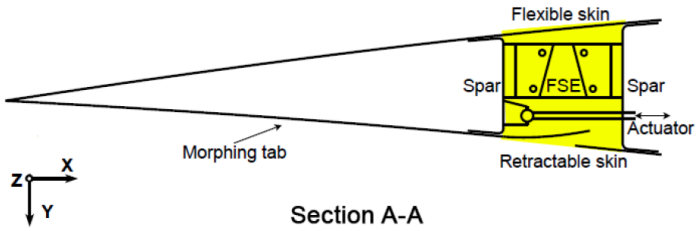

Figure 1: Sketch of the GKN-Fokker morphing wing concept.

The Production Technology group at the University of Twente has worked recently on a methodology meant to propose a design for the concept of the FSE. Main requirements concern space, kinematics and loads. Besides, the design is based on the thorough description of the mechanical behaviour of the used fibre reinforced composite under large deformations. The study has led to the FSE as shown on the left part of Figure 2. This solution is based of a T-joint assembly system and has been validated on a 2m long winglet.

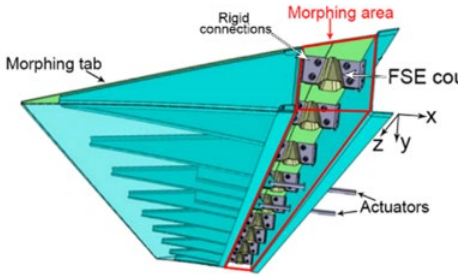

Figure 2a: UTwente FSE design and application on a 2m long demonstrator

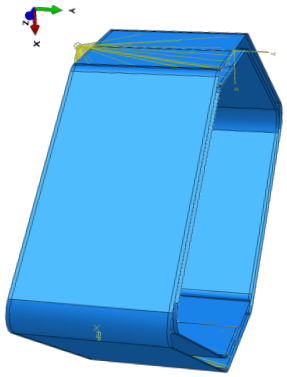

Figure 2b: Alternative FSE using the maximum space between the spars

An alternative FSE was subsequently designed, with a direct attachment to the spars. The result, shown in Figure 2b, and although not demonstrated, shows that the optimum shape of the FSE is also dependent on the space available for the flexure.

The proposed project therefore proposes to work on a structural optimization procedure able to take the shape of the flexure as a variable, besides the requirements mentioned earlier.

The project is to be performed at the UT, in collaboration with GKN Fokker.

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