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POLYMER BASED MORPHING SKIN FOR ADAPTIVE WINGS

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Summary: The primary challenge for adaptive wings is to find materials that are able to deform and to carry aerodynamic loads simultaneously. One solution to solve this mechanical paradox is the development of multi-material skins consisting of hard and soft segments. While soft skin segments release a smooth, gapless transition between movable and fixed parts of the underlying kinematic structure hard skin segments compensate deformations due to air pressure gradients.

In the SARISTU project, funded from the European Union's Seventh Framework Programme, an Adaptive wing Trailing Edge Device (ATED) was designed with reference to the outer wing of a CS-25 category aircraft. A polymer based morphing skin was developed by Fraunhofer IFAM to cover seamlessly a multi-finger ribs architecture enabling conformal and differential airfoil camber morphing. Wing shape is controlled during flight (cruise condition) in order to compensate the weight reduction following the fuel burning, by allowing the trimmed configuration to remain optimal in terms of efficiency (L/D ratio) or minimal drag (D). Trailing edge adaptations were investigated to achieve significant benefits in aircraft fuel consumption whose reduction may range from 3% to 5% due to the improved aerodynamic efficiency.

The development of the elastomeric materials for the skin focused on the elasticity at -55 °C to ensure morphing at cruise altitudes. FEM simulations and mechanical tests were carried out to optimize fatigue and aging properties of this new multi-material device. Two large skin panels were finally manufactured and successfully assembled into a true-scale wind tunnel demonstrator for the experimental validation of ATED functionality in simulated operative conditions.