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DEVELOPMENT OF AN ACTUATED CORRUGATED LAMINATE FOR MORPHING SKIN

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Summary: The development of a skin for a morphing aerodynamic surface presents challenging requirements [1] and several authors have identified composite corrugated laminates as a particularly interesting solution. Indeed, such components can be used to develop structurally efficient morphing concepts, since they are characterized by flexibility in morphing directions and retain valuable stiffness and load carrying capabilities in non-morphing directions [2]. Moving from such considerations, this work presents a solution for an actuated morphing skin based on a composite corrugated laminate endowed with an embedded system of Shape Memory Alloy (SMA) wires.

In particular, a corrugated laminate with a closed-cell configuration is considered, which is obtained by bonding together two simply corrugated composites panels. A solution to provide such skin system with a smooth external aerodynamic surface is also provided. The manufacturing process gives the possibility to embed in such corrugated element the SMA wires, which are actuated to obtain a skin contraction. The characterization of the SMA actuators is presented, considering tests performed by applying temperature cycles in different conditions of applied stress, to allow the development of numerical models of the morphing skin.

Finite element studies and preliminary experimental tests are performed to investigate the interaction between the actuators and the elastic properties of the corrugate during the actuation and the cooling phases of the SMA wires, considering different configurations of the skin system.

Finally, the general properties of an equivalent homogenized actuated skin are calculated from the FE results and such properties are included in a condensed aeroelastic model of a morphing aileron [3] to show the potential of the actuated skin concept.

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