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Simulation of SMPs for the bonding process of a gyroid-core and a CFRP aerodynamic profile

Ferdinand Cerbe*[1], Alexander Junge[1], Christian Hühne[2] and Michael Sinapius[3]

[1] Institute of Mechanics and Adaptronics, TU Braunschweig, f.cerbe@tu-braunschweig.de
[2] German Aerospace Center (DLR), Christian.Huehne@dlr.de
[3] Institute of Mechanics and Adaptronics, TU Braunschweig, m.sinapius@tu-braunschweig.de

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Additive manufacturing (AM) allows the manufacturing of highly complex structures, such as lattices or structures derived from triply periodic minimal surface (TPMS), such as the Gyroid. The TPMS can be used as a core to increase the specific stiffness and strength of a sandwich structure, which are relevant in aerospace engineering. A significant challenge is the manufacturing process, where the TPMS core must be inserted and bonded to an aerodynamic profile made of carbon fibre-reinforced plastic (CFRP). This integration can be achieved by using the shape memory effect of a polymeric AM material. The idea is to program the TPMS core to a compact shape, insert it into the airfoil, and eventually expand it during the bonding process to apply pressure on the bonding area.

In our contribution, we present a thermo-mechanical Abaqus simulation of a shape memory polymer (SMP) based on a viscoelastic material model with temperature dependence [1]. In our presentation, we describe the straightforward process from material characterization by dynamic mechanical analysis to the simulation of the shape memory effect. In conclusion, we show the applicability of our approach in the bonding process of a gyroid core to a CFRP aerodynamic profile.

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