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Abstract

In the scope of developing efficient future aircraft, fuel saving becomes one of the main issues. The idea of the project LaWiPro – Laminar Wing Production – is to develop and manufacture a part of a wing upper cover fulfilling the aerodynamic requirement of laminar flow. The surface has to be much smoother compared to current wings. Waviness coming from either manufacturing or load has to be kept in a much smaller tolerance band than at current aircrafts. Also steps and gaps coming from assembly should be disregarded.
Two completely different ways may lead to fulfill these requirements:
– Either by stiffening: The structure can be stiffened until it will be within the requested waviness. This could increase weight and therefore fuel use
– Or by the shape of the tool: It is adapted by predicting the local deformations caused by the manufacturing process, like spring-in, warpage, and loads Multi-Material, Multi-Functional Design:
A multi-material design is developed to eliminate steps and gaps using monolithic carbon with integrated stiffeners for primary structures, metal-hybrid for secondary structures and load introduction areas. The multifunctional design provides the opportunity to integrate anti-icing devices or connectors into the same curing process. Developing innovative process simulation methods gives the possibility to predict the deformations caused by the manufacturing process. The required adaptation of the tooling will be determined first time right, without today's time and cost-consuming iteration loops. The developed methods will be implemented into the Virtual Composite Platform (VCP). Comparing virtual results with real 3D optical measuring from tests ensures the improvement of the methods. Automation is another key issue to produce a part with acceptable costs and quality for the high production rate of single aisle aircrafts. Based on the first investigations done for spring-in, warpage and pre-deformation, automation concepts will be developed to produce the upper wing panel including part of the nose structure. Eventually, the innovative simulation and integration of manufacturing discrepancies and displacements under load on the Virtual Composite Platform might lead to an environmental sensitive design for future aircraft designs.