In a context of increased global competition in aeronautical industry, aircraft manufacturers must ally productivity, low production costs and lightweight products. In this aim, a project of STELIA Aerospace was to design an airplane’s nose fuselage which meets the production rate requirements. The skin of the considered structure is planned to be in composite materials and produced by the mean of Automated Fiber Placement (AFP) Technologies.

This work focuses on the development of an optimization method in buckling of the skin of an airplane’s nose fuselage.

Methodology

Using AFP production methods allow to generate curved trajectories of the fibers along the structure. This last property of the composite laminates can be exploited to generate optimal fiber paths in terms of load reacting. The goal of this presented work was to evaluate if placing fibers along the most loaded paths can improve the structure’s behavior in buckling and gain a substantial margin of mass.

When sizing an aircraft, numerous loading cases are to be taken into account. This adds a difficulty when determining fiber trajectories. First an analysis over all load cases was led to determine the most loaded directions (1). Then an approach was elaborated to choose the fiber orientations through the whole model (2).

Conclusions

This type of research seems to be promising regarding the first results. Nonetheless it is still at an early stage of development. It allowed to have a first impression on how all the load cases affect the structure. This gave clues on how the fiber trajectories could be programmed to cover all the load cases while decreasing the number of plies.

In future studies, one may include the minimization of the defects induced by the AFP process during the generation of fiber trajectories.

Reference


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