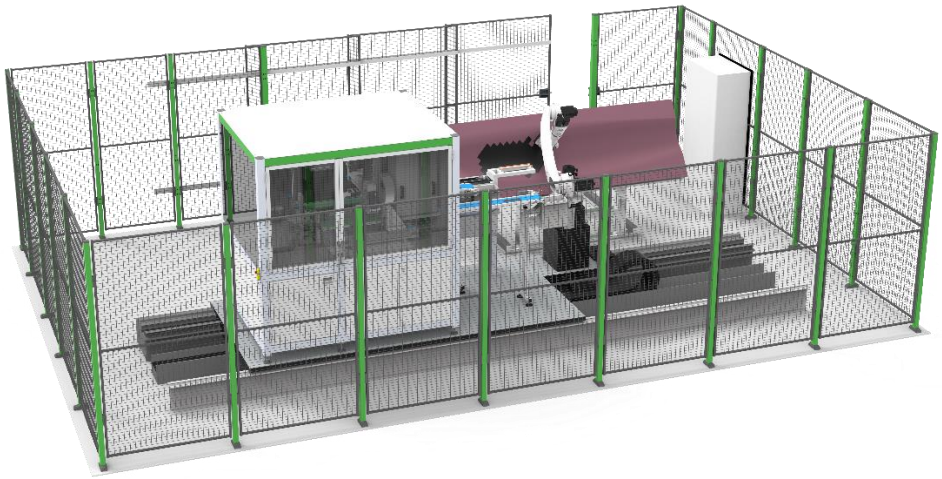
Fiber Patch Placement automation for sandwich parts: Potential for 7x lay-up acceleration in legacy processes

Cevotec has partnered with Tier 1 aerospace manufacturer GKN Aerospace Deutschland, material supplier SGL Carbon and two academia partners, TUM – Chair of Carbon Composites and Augsburg University of Applied Sciences, in a grant-supported project to develop a fully automated lay-up process for legacy sandwich parts using Fiber Patch Placement technology, achieving an overall lay-up rate improvement by factor 7x.

Background & motivation

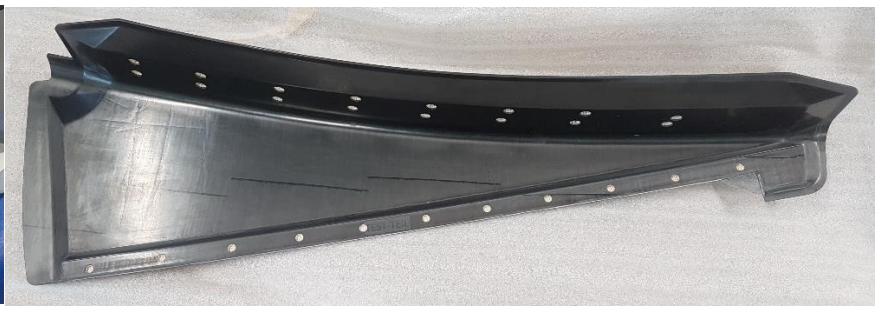
Cevotec has developed an industrial equipment solution that is able to process multiple materials in one machine in order to produce aerospace sandwich components. Fiber Patch Placement (FPP) is the first automation technology capable of laying-up different type of materials, from structural (carbon fibers) to auxiliary ones (glass fibers, adhesives), onto a 3D tool in order to produce complex aerospace parts with one single machine setup.



The aerospace industry is currently relying to a great extent on legacy parts that are still being produced manually at high production costs and with limited scaling capability. In this context, Cevotec partnered up in a R&D project consortium to develop and test an industrial solution for these problems. The goal of this project was to prove that via automation, legacy parts can remain financially viable and production rate increases in the aviation market can be met. To quantify that goal, the project team set an ambitious target to demonstrate a lay-up rate increase to 15 m^2/h for the reference part.

Part introduction

As reference part, a horizontal tail plane (HTP) fairing was selected. On the aircraft, it protects and shields the structural attachment of the horizontal tail to the empennage. This legacy part features high geometric complexity and a sandwich structure that combines monolithic skins and film adhesive with a Nomex honeycomb core, making the manual manufacturing complicated and time consuming.



Project approach

The HTP fairing is a complex part that put previously developed FPP capabilities to a test and called for the development of new features in order to perform the demonstrator production according to specification. The following table summarizes key FPP features deployed in the actual demonstrator lay-up. [enabling automation also for complex areas of the part]

Key feature	Status	Description
Zonal Suction	Commercially available	Independent suction zones inside the gripper to enable rolling motion lay-up
Advanced Rolling Motion	Commercially available	Draping the patches with a rolling movement of the robot along the path of maximum curvature, applying constant pressure during the entire lay-up
Post Placement Push-In	Commercially available	Utilizing the patch-gripper to further push the patches / plies in areas of complex features. This features imitates a typical manual lay-up operation.
Post Placement Vision Inspection	Prototype tested, in further development	Additional patch inspection with a robot-mounted camera to ensure placement according to program. Image analysis used neural network algorithm.
Honeycomb Gripper	Prototype tested, in further development	Mechanical gripper able to grab honeycombs without causing any damage by e.g. needles, and to transport and place them onto the tool

The combination of the above features enabled the production of 5 demonstrator parts, validating the capability of Fiber Patch Placement technology in automating the manufacturing of legacy parts. At the same time, the mechanical performance of the part was not compromised. After performing bending tests in accordance with the OEM's requirements, the FPP parts showed 25% improved deflection at an increased material deployment of less than 10% due to planned overlaps. In addition to the increase in mechanical performance, the lay-up time also was significantly reduced by efficient FPP lay-up.

Project results

In conclusion, the project came to very successful results: The patch lay-up was performed fully automated and the option to remove intermediate debulking steps was confirmed. As a result, the project team reached the initial goal to significantly speed up the lay-up process. **The lay-up of the skins shows the potential to increase the lay-up rate by factor >7x,** from 1,5-2 m^2/h (reference process) to 14,5 m^2/h **by using FPP equipment.** Additionally, the critical stiffness was increased by 25% with only slightly increased material usage. By making the technologies and strategies developed in this project available to FPP users, this project can serve as a blueprint for further automation activities within legacy aircraft programs as production rates continue ramp up.

Our Offer | **Automate your complex (sandwich) part beyond limits of an AFP process? Contact us for a personal consultation with our experts!**

cevotec
www.cevotec.com
advantages@cevotec.com

The HTP fairing demonstrator has been developed in the research project MAI ACoSaLUS (Automated Composite Sandwich Lay-Up System), supported by a grant of the Bavarian Ministry of Economics, Regional Development and Energy (FKZ: LABAY113C).

Gefördert durch
Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie