HORIZON 2020

High versatility and accurate tooling set produced in All-In-One machine for the cost efficiency Sub-Assembly, Functional Checks and Transport of the Morphing Winglet and Multifunctional Outer flaps.

Results in Brief

A novel tooling set with laser tracking keeps error small during assembly of large prototypes

Positioning and using the ‘tools’ that put together the large prototypes of aerospace structures is a feat on its own. A novel laser-integrated robotic tooling system promises to reduce time and cost while enhancing accuracy through a human-robot collaboration.

INDUSTRIAL TECHNOLOGIES

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Like many other products, design and manufacture of aircraft includes a prototyping stage in which components must be built and assembled to test the ‘real thing’. Unlike most other products, the components to be assembled into the final prototype are huge – like 3 m x 8 m huge. You cannot simply lay them out on a workbench and pull out your screwdriver and drill.

Funded under the EU’s Clean Sky 2 Joint Technology Initiative, the WINBOXTOOL project developed an all-in-one machine and additive manufacturing technology to reduce the time and cost and enhance the modularity associated with the assembly

and transport of the morphing winglet and multifunctional outer flaps of the next generation optimised wing box. It will be equally applicable to other large structures such as wind turbines or trains.

Robotic cell hits the bull's eye with laser tracking

Tooling refers to the manufacturing components and machines needed to manufacture a product and includes cutting tools, dies, jigs, and moulds. Its performance is critical to the end-product's quality and acceptance. As project coordinator José Antonio Dieste explains, "WINBOXTOOL has delivered an all-in-one robotic cell able to hold and position any tool with very high accuracy, repeatability, and flexibility in large part thanks to laser tracking and real-time correction algorithms. The novel tooling concepts and high-accuracy robotic tooling assembly minimise cost and time."

Reflectors both in the robotic cell and on the surface of the prototype tooling set are used to automate manual tasks as well as to track large components throughout the process and correct for errors. In the former, an operator 'trains' the robotic system by simulating the use of tools equipped with position sensors. The laser system tracks the tool and stored data facilitates development of trajectories and real-time correction algorithms such that the robot can take over the previously manual labour with high accuracy. In the latter case, permanent tracking during assembly of medium and large parts enables creation and use of a computer-aided design of the machine-assembly tool group for the prototype assembly production and for the manufacturing of the assembly tool.

Finally, the novel all-in-one robotic machine ensures holding and positioning of any tool. All the tools to be assembled have a male connector while the flange of the robotic cell has a female connector. Dieste elaborates: "The high-accuracy tool changer system allows assembling any kind of device on the robot tool centre point (TCP) as well as holding a drill or welding torch. The TCP can be positioned on its workpiece with an error of less than 50 microns and less than 100 microns even when subject to high-speed milling and cutting forces."

Wings and beyond

Dieste summarises: "WINBOXTOOL exploits human-robot cooperation in an affordable solution for versatile, precise, and cost-efficient assembly and transportation of large parts. In addition to its relevance to the aerospace and defence sectors, this opens a path for application to industries including automotive and railway, construction, and energy and infrastructure." Cutting the time and cost of projects in these sectors will benefit both manufacturers and EU citizens, making more money available for other projects and valuable products available faster.

Keywords

WINBOXTOOL, tool, assembly, robotic, tooling, accuracy, laser, manufacturing, prototype, aerospace, TCP, flange, trajectories, sensor, morphing winglet, wing box, tool centre point, computer-aided design, additive manufacturing

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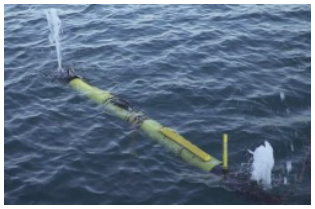

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