

# New concepts for a robotized cell for the assembly and control of composite fuselage panel components

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### Introduction

- Loccioni presentation
- LABOR Project overview
- LABOR Project objectives
- The LABOR Project
  - LABOR Cell overview
  - Self-adaptive processing tools
  - Smart Inspection Tools
  - Distributed Intelligence Architecture
  - LABOR Cell Operation
- Conclusion







#### LOCCIONI

**Established** 1968 by Enrico & Graziella

#### **Ownership** Loccioni Family

**Business** 110 M EUR turnover Installations in 45 Countries

#### **Global presence**

Angeli di Rosora, Italy Washington, United States Stuttgart, Germany Shanghai, China Nagoya, Japan New Delhi, India

#### People

450 collaborators45% of University graduates34 average age1 out of 9 dedicated to research5% of personnel cost invested in training

#### Innovation

5% of sales turnover 5 R&D Labs 1 Research for Innovation Lab 20 patents families

#### Community

9.000 visitors per year Smart sustainable community

#### www.loccioni.com

## **Project Overview**



The LABOR project is a European Commission H2020 Project under the *Clean Sky 2 JU*.

#### Lean robotized AssemBly and cOntrol of composite aeRostructures



The project started the 1<sup>st</sup> of March 2018 and it will last 36 months.

Partners
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One of the most important challenges for the next aircraft assembly lines is the increase in the level of automation to guarantee:

- high-quality standards  $\rightarrow$  in
- high production rates
- $\rightarrow$  improve quality
- $\rightarrow$  boost productivity
- high production flexibility  $\rightarrow$  reduce costs

For this reason, main aeronautic manufacturers are heavily investing in robotic systems.



The Labor project aims at developing a new concept based on Self-Adaptive Robotic Cell with four main objectives:

- 1. Development of a robotized cell based on *small/medium size robots* to provide higher capability of adaptation and easy integration.
- 2. Development of a *self-adaptive processing tools* able to perform an automated drilling and fastener insertion, based on robotized systems for composite structures.
- 3. Development of *smart inspection tools* in order to reference the robots and check the quality of the work performed.
- 4. Development of *distributed intelligence architecture* in order to build a more flexible solution and a *Human-Robot Collaboration* functionality.



### LABOR Cell Overview





### LABOR Cell Overview





## Self-adaptive processing tools

### Self-adaptive processing tools - External Robot



### **DRILLING TOOL**

- Normality Alignment
- Panel stack Clamping
- Hole and Countersink Drilling
- Hole and Countersink Measurement

### **FASTENING & SEALING TOOL**

- Fastener selection from warehouse
- Sealant application around the fastener
- Fastener Installation
- Fastener Flushness Measurement



## Self-adaptive processing tools

#### Self-adaptive processing tools - Internal Robot





- Robots Referencing
- Installed Fastener Measurements



### **COUNTERTHRUST TOOL**

• Panel stack Clamping (on internal side)



## Self-adaptive processing tools









## **Smart Inspection Tools**

#### **Smart Inspection Tools – 2D Tool**



- Camera, Telecentric Lens, 4 bar LEDs
- Hole Diameter Measurement
- Countersink Diameter Measurement





## **Smart Inspection Tools**

#### Smart Inspection Tools – 3D External Tool







- Profilometer
- Camera, LED pattern projector
- Installed fastener measurements:
  - Flushness
  - Collar height
  - Stem protrusion







## **Smart Inspection Tools**

#### Smart Inspection Tools – 3D Internal Tool





- Profilometer
- Two Cameras, LED pattern projector
- Installed fastener measurements:
  - Sleeve diameter
  - Sleeve height
- Robot referencing on panel shear tie









## **Distributed Intelligence Architecture**

In order to have a *flexible* and *modular* solution a new HW and SW architecture will be developed. It will not be based on a monolithic and centralized solution, but instead on a *distributed intelligence*, based on several embedded systems for each of the main tools. This architecture will simply the insertion of new components in the system and the programming of the complete system.



EAP (EtherCAT Automation Protocol) and OPC-UA are the field bus that allow communication between modules.



## **Distributed Intelligence Architecture**





## **Distributed Intelligence Architecture**



Modular approach has been applied also on software architecture to maximize flexibility and reusability. Software architecture is Task-based and composed of several functionalities: hardware tasks, logic tasks, control tasks and communication tasks.



18



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20

- The LABOR project represents a new approach toward automatic robotic applications in Aerospace Manufacturing.
- Thanks to small-medium scale robot, Self-adaptive processing tools, Smart Tools and a Distributed Intelligence Architecture allow reducing investment cost and increase system flexibility.
- The cell commissioning is ongoing, pre-acceptance tests have been almost completed and the cell will be installed at Leonardo plant within few months.
- All the functionality presented have been positively tested and demonstrated while activity related to performance optimization are still ongoing.



# Thank you



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21