



DIMOFAC

# Flexible Processing & Assembly Robotic Framework



LMS

Laboratory for  
Manufacturing Systems  
& Automation

## LMS IN A NUTSHELL

**Founded:** 1994

**Location:** Patras, Greece

**Technology:** Machining, Milling

**Industry:** Manufacturing

**Website:**

<https://lms.mech.upatras.gr>



## ABOUT LMS

Laboratory for Manufacturing Systems & Automation (LMS) is oriented on research and development in cutting edge scientific and technological fields. LMS has been involved in a number of research projects in a variety of disciplines funded by the EC and European industrial partners. Particular emphasis is given to the co-operation with the European industry as well as with a number of "hi-tech" firms. LMS currently employs approximately 70 researchers organized in three different groups: a) Innovative Manufacturing Processes, b) Robots, Automation and Virtual Reality in Manufacturing and c) Production Systems Planning, Control & Networking.

## LMS PILOT LINE

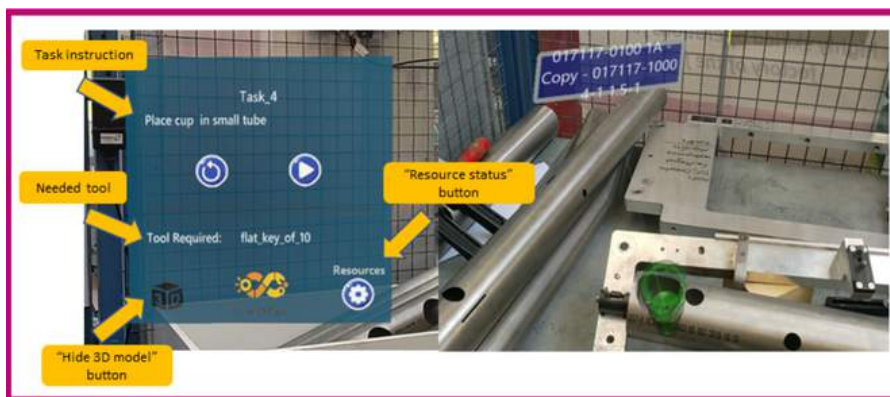
**FPARF - Flexible Processing & Assembly Robotic Framework** by LMS (EL), owning a number of conventional and non-conventional process modules (CNC milling, turning, welding, EDM, Additive Manufacturing) as well as multiple industrial, cooperative and mobile robots. For demonstrating and training people interested to the DIMOFAC solution and its related developments, the following modules have been selected, based on which, several services are offered:

### 1.AR Instructions for Operator Support module

The development focuses on the implementation of an AR application to support human operators during various production phases. Main focus is given on providing virtual instructions regarding the task to be performed through the AR Glasses both in terms of text instructions as well as holograms of the parts to be handled that superimpose the operator's field of view. Target of this is to minimise training needs for the human operators when introduced to new tasks or new product variants while also reducing the scrap rate by reducing the possibility of errors during process execution.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870092.



## List of Services:

- **Consultancy:** Feasibility study on AR applications utilisation - 100 EUR/application
  - Provide insight regarding the implemented system (added value, requirements, etc.)
- **Training:** AR workshop – 500EUR/applicant
  - AR utilisation
  - Unity familiarization
  - Create digital instructions
  - Load and generate digital models/animations

## 2. Small parts assembly module

The development focuses on the implementation of a highly flexible and reconfigurable module that include all the required skills to perform assembly of small parts. The operation of the deployed robots is enhanced by the use of a Digital Twin for real time sensor data gathering and exchange. This information is used for the real time robot motion planning eliminating the need for preprogramming the robots. In terms of scheduling and orchestrating the actions of the robots, a scheduling algorithm is utilised that exploiting the DIMOFAC CIM-based modelling of the production entities in ISA-95 compatible format (JobOrder, JobResponse, Equipment modelling, etc.) produces the detailed Production schedule to be executed by the robots. This scheduling system exposes the outcome via the AAS for the Process Orchestrator (the DIMOFAC orchestration systems) to consume it and manage the schedule execution by communicating the actions to be performed to the assigned robotic resources.



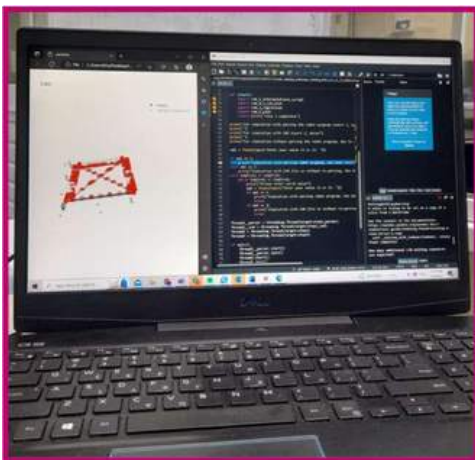
## List of Services:

- **Consultancy:** Feasibility study on multi-robot assembly utilisation - 200 EUR/application
  - Provide insight regarding the implemented system (added value, requirements, etc.)
- **Training:** Reconfigurable multi-robot assembly Workshop – 500EUR/applicant
  - ROS framework familiarization/DT implementation
  - Object detection methods/techniques



## 3.Laser Welding module

On this module, the developments focused on creating add-on functionalities for the reconfiguration of the laser welding module. Trainees may get in touch with a non-invasive gap detection system, responsible for measuring the gaps between parts before welding, and with a rapid simulation tool responsible for calculating the weld bead dimensions achieved by the selected process parameters. The simulation is mostly automatically performed, through parsing the robot welding program.



## List of Services:

- **Consultancy:** Consultancy: Feasibility study on zero-defect laser welding applications – 200EUR
  - Provide insight regarding the implemented system (added value, requirements, etc.)
- **Process Development:** Process parameters selection for mass customizable laser welded products – 4000EUR per material
  - Process development on client's application, for optimizing the process parameters selection
- **Training:** Zero-defect laser welding Workshop – 500EUR/applicant
  - Gap detection system operation/setup
  - Laser welding simulation operation/setup



#### 4. Milling Module

In the milling module, the main focus is the digitalization of milling process and the milling machines enabling its monitoring and control. For the control, the chatter is investigated throughout this module, while the workflow followed provides useful information for controlling other milling phenomena.



#### List of Services:

- **Consultancy:** Feasibility study on machining digitalization- 2000 EUR
  - Provide insight regarding the implemented system (added value, requirements, etc.)
- **Training:** Digital Machining Workshop– 500EUR/applicant
  - Integration of the implemented system on interested party's premises
  - Operation/use of the implemented system on interested party's premises
  - Communication with high-level software (such as MES etc.) through the AAS.

## BENEFITS

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1. Digitalisation in machining
2. Monitoring and control of chatter in milling
3. Retrofitting existing machines with digital technologies
4. Laser welding process understanding and simulation
5. Easy robot-based assembly module reconfiguration – new product variants introduction
6. Reduced human operators training requirements
7. Reduced scrap rate – production delays due to human errors