UNIVERSITÀ
POLITECNICA
DELLE MARCHE

Human centred automation of shoe processing

Supervisor: Prof. Massimo Callegari

Department of Industrial Engineering &
Mathematical Sciences - https://diism.univpm.it/

UNIVERSITÀ POLITECNICA DELLE MARCHE

Supervisor: Prof. Massimo Callegari

Prof. Massimo Callegari (Full Professor of Machine Mechanics)

Past job positions: ▪ Associate professor at University of Ancona ▪ Researcher at University of Genova ▪ System engineer & project manager at Elsag S.p.A. (Genova) and SEIAF S.p.A. (Genova)
Research interests: Robotics; Mechatronics; Mechanical design; Human-machine cooperation & Human-Centred Manufacturing; Automation; Artificial Intelligence
Research grants: ▪ 2023-2025: Coordinator of the local research unit of the PRIN22 project "DYNamic Assessment and Mitigation of the Impact of Collaborative Applications" by the Ministry of Research and University ▪ 2023-2025: EDIH4Marche European Digital Innovation Hub for the digital transitions of SME's ▪ 2018-2022: Scientific coordinator of the regional HD3FLAB project on the introduction of Industry 4.0 technologies (9 million € budget)

Teaching activity: ▪ Classes of Machine Mechanics, Mechanical design and Robotics at the Universities of Genova and Ancona ▪ Supervisor of more than 200 BSc. final degree projects or MSc. dissertations ▪ Supervisor of 13 Ph.D. students and many post-doc grants ▪ Member of the Executive Committee of the Ph.D. program of national relevance "DRIM Ph.D. in Robotics and Intelligent Machines" ▪ Coordinator of the masterclass in "Architectures, Processes and Technologies for the Digital Transition of Industry" ▪ Chairman of the board of teachers of the Mechanical Engineering degrees at the Polytechnic University of Marche
Academic duties: ▪ 2019-pres.: Coordinator of the Marche node of the Competence Center Artes 4.0 network ▪ 2022-pres.: President of i-Labs Industry, innovation infrastructure

Full CV and list of publications at ORCID

UNIVERSITÀ POLITECNICA DELLE MARCHE

Machine Mechanics Research Group

Daniele Costa

Luca Carbonari

Giacomo Palmieri

Cecilia Scoccia

Matteo Palpacelli

- 6 Faculty staff, 3 research associates and 6 Ph.D. students
- Research subjects: Robotics, Human-robot collaboration, Underwater robotics, Rehabilitation robotics, Motion analysis and simulation, Machine design, Parallel and reconfigurable machines
- MIR-Mechatronics and Industrial Robotics, fully equipped research and teaching laboratory
- Access to i-Labs Industry and Artes 4.0 Laboratory facilities
- National and international cooperations with outstanding research institutions
- Teaching in 10 engineering degrees
- More info at: https://mdm.univpm.it/

UNIVERSITÀ POLITECNICA DELLE MARCHE

The Department of Industrial Engineering & Mathematical Sciences

Director: Prof. Michele Germani

- *45 Labs*
- *52 professors, 21 technical and admin staff*
- *about 100 active researchers*
- *8 B.Sc. and M.Sc. degree courses*
- *Doctoral School in Engineering Sciences*
- *78 PhD's awarded and more than 1600 students graduated in last 5 years*
- *11 European projects under Horizon Europe*
- *3 European Digital Innovation Hubs*
- *B+ National Laboratory of Excellence on rapid prototyping technologies*

DEPARTMENT OF INDUSTRIAL ENGINEERING AND MATHEMATICAL SCIENCES

UNIVERSITA POLITECNICA DELLE MARCHE – ANCONA, ITALY, VIA BRECCE BIANCHE 12

RESEARCH GROUP AFFILIATION

THE UNIVERSITY

INDUSTRIAL SECONDMENT

i-Labs Industry
Via Guerri, 7
Jesi (I)

UNIVERSITÀ POLITECNICA DELLE MARCHE

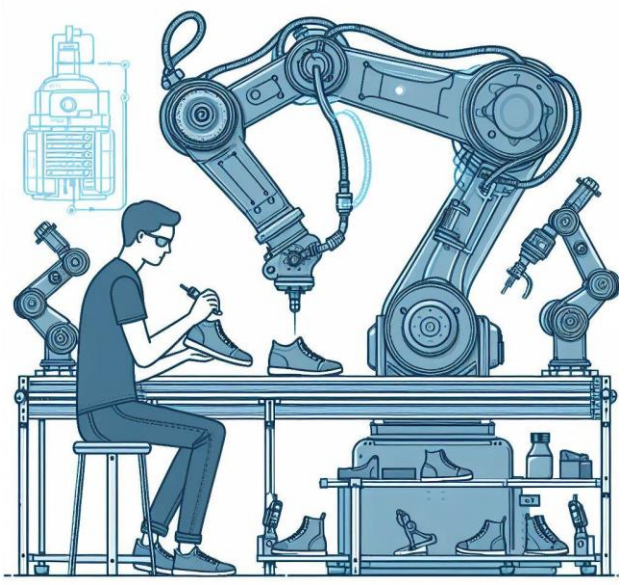
Project idea: develop methodologies and tools to automate shoe production by keeping the human operator in the loop

Background: The focus in the shoe market is mainly on product quality and customization possibilities, two areas in which Italian creativity and know-how are unmatched in the world. Therefore the digital transition of small companies in this sector must combine the potential of emerging technologies with the exploitation of the human capital and know-how available in the workshops, according to the guidelines of the Industry 5.0 paradigm.

Project objectives:

Development of collaborative robotic processes for shoe making and finishing by:

- advanced human-cobot interfaces
- ergonomic evaluation of operator-robot cooperation
- motion tracking, reactive control and dynamic task planning
- smart end-effectors, exploiting IIoT capabilities and developed for specific applications
- modelling of behaviour of human operator
- programming in virtual environments (human-in-the-loop)



Drivers

- Human-centred automation of craft processes
- Social and environmental sustainability of production
- Safety of craft manufacturing

Enabling technologies

- Collaborative robotics, VR/AR, Artificial Intelligence, 3D sensing and artificial vision