CITADELS

TESTBED DESCRIPTION

Cultivating Industry 5.0 Talents: Academia-industry collaboration and empowerment through accessible DEep technoLogieS

Project acronym:	CITADELS
Project topic:	HORIZON-WIDERA-2024-TALENTS-03-01
Project number:	101217281
Type of action:	HORIZON-CSA
Project starting date:	1 September 2025
Project duration:	48 months
Dissemination level	PU

1 LaserFlex Robotic Laser Welding Cell

TestBed title	LaserFlex Robotic Laser Welding Cell

1.1 Short summary

The LaserFlex TestBed is a robotic laser welding cell designed for precise and automated welding processes in industrial environments. The system integrates a robotic platform with laser welding technology, enabling high-precision welding with minimal thermal distortion and consistent quality. The key technological focus lies in robotic laser processing, advanced manufacturing, and flexible automation. The system supports efficient execution of welding tasks across different materials and geometries, making it suitable for both prototyping and small- to medium-scale production. LaserFlex enables controlled and repeatable welding operations while supporting safe and structured integration into industrial workflows. Its flexible configuration allows adaptation to different production requirements and use cases. The TestBed is relevant for Industry 5.0 applications, particularly in the context of high-precision manufacturing, process reliability, and the adoption of advanced robotic welding technologies.	
Principal Investigator Name	Anita Gjerek
Position / institutional role	Director of the Robotics department
Email	For access through CITADELS project please contact Pomurje Technology Park at info@p-tech.si or marko@p-tech.si
Phone No.	+386 2 530 82 00
ORCID persistent identifier (PID)	N/A
TestBed Responsible Name (if different from PI)	N/A
Funding source(s) for TestBed's acquisition	VIRS d.o.o.
Relevant Keywords	Robotic laser welding, laser processing, industrial robotics, precision manufacturing, flexible manufacturing, advanced manufacturing

1.2 Hosting Institution

Name of Host Organization	VIRS d.o.o.
Department or Lab	N/A
Name of Building	N/A
Physical Address	Industrijska ulica 4 B, 9220 Lendava, Slovenia
Website Links	https://www.virs.si/en/
Institutional contact name	For access through CITADELS project please contact Pomurje Technology Park
Institutional contact email	info@p-tech.si or marko@p-tech.si

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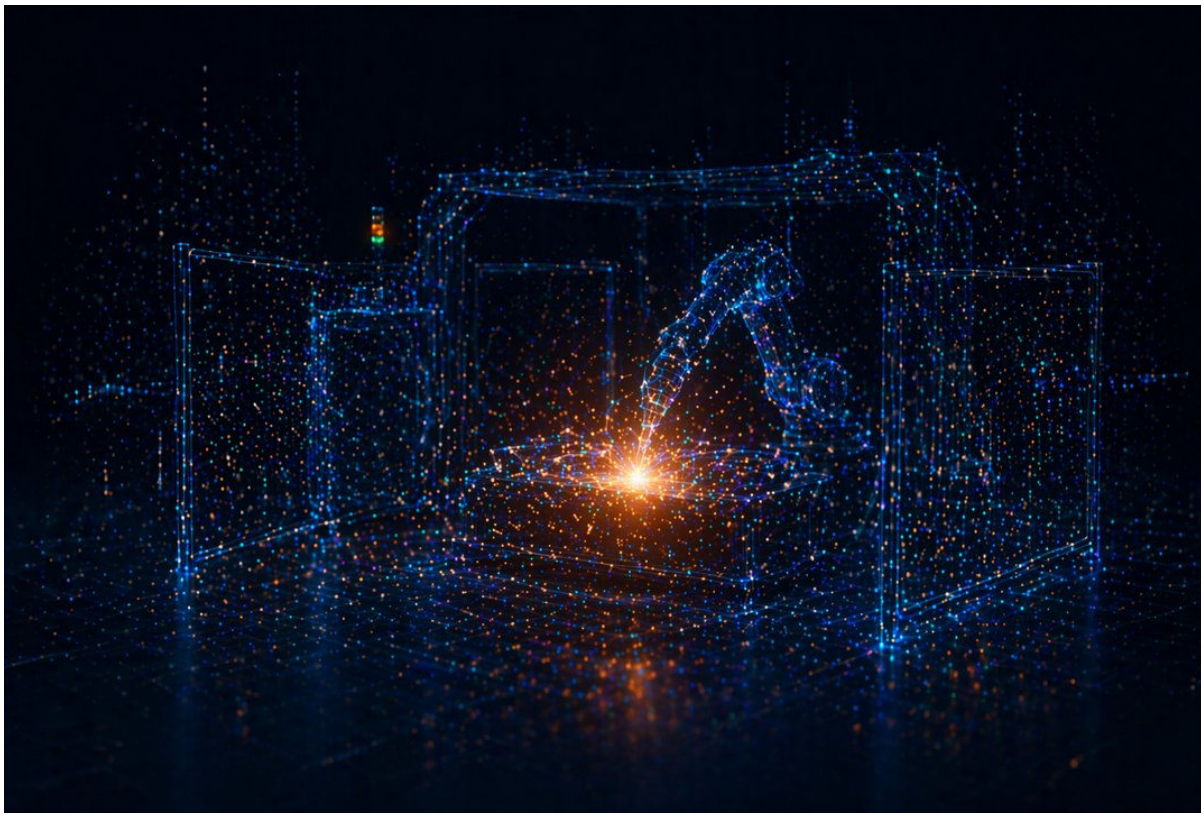
1.3 Photos/videos

Main photo:



1.4 DeepTech Area and Application Domain

DeepTech Area	Check all that apply	Check ONE main area
Extended Reality	☐	
Robotics	✓	✓
Artificial Intelligence	☐	
Human Machine Interfaces	✓	
Biotechnology	☐	
Other	☐	

The main DeepTech area of this TestBed is Robotics, as the system integrates a robotic platform with laser welding technology for automated and high-precision manufacturing processes. The robotic system enables programmable motion, repeatability, and controlled execution of welding tasks. Additionally, the TestBed includes Human–Machine Interfaces through operator interaction for system setup, monitoring, and control.

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Application Domain	Check all that apply
Manufacturing 	✓
Healthcare 	☐
Logistics 	☐
Agriculture 	☐
Maintenance & inspection 	☐
Other	☐

1.5 Potential Stakeholders and Exploitation Scenarios

Non-academic stakeholders	
Industrial Partners	✓
SMEs	✓
Startups	✓
Government Bodies	☐
Professional Associations	✓
Community	☐
Others 1 (comma-separated)	
Academic stakeholders	
Undergraduate students	✓
MSc students	✓
PhD students	✓
Researchers	✓
Others 2 (comma-separated)	
Other types of stakeholders	

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Others 3 (comma-separated)	

	Check all that apply	Short notes (optional)
Internal academic research only	☐	
Collaborative research with external academic partners	✓	
Contract research / Proof-of-Concept for industry	✓	
Pilot / DeepTech Deployment in operational environment	✓	
Training services (courses, workshops, certification)	✓	
Service provision (testing, benchmarking, validation)	✓	
Open access for walk-in users (e.g. open days / hackathons)	☐	
Other (specify): _____	☐	

1.6 Formal Access Conditions

Type of partner asking for access	Type of contractual relationship	Check all that apply
Academic partners	No contract (direct access)	☐
	Direct contract between parties (e.g., research agreement)	✓
	Indirect contract between parties (e.g., project framework)	✓
	Other / Describe	☐
Industrial	No contract (direct access)	☐
	Direct contract between parties (e.g., research agreement)	✓
	Indirect contract between parties (e.g., project framework)	✓
	Other / Describe	☐

Type of prerequisites	Description of prerequisites	Check all that apply
Agreements	Confidentiality agreement for proprietary algorithms	☐
	Data sharing agreement for datasets generated	✓
	IP agreements	✓
	Other / Describe	☐
Insurance	Users must have appropriate liability coverage through their home institution	✓
	Other / Describe	☐

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1.7 Training and Safety

Mandatory technical training	Operator training provided by the system supplier, including operation of the robotic laser welding cell, laser process setup, and basic robot programming.
Recommended technical training	Technical background in manufacturing, welding, or mechanical engineering, with basic understanding of industrial robotics and automated systems.
Mandatory safety requirements	Use of appropriate personal protective equipment (PPE) and adherence to laser safety procedures.

1.8 Technical description

Hardware	• Robot: Enables precise and repeatable welding processes
	• Laser welding head: Integrated motorized lenses enable movement of the laser beam within a 48 × 48 mm working area without moving the robot
	• Clamping system: Enables fixation of workpieces of different sizes and shapes
	• Welding positioner: Positions the workpiece into an optimal welding position; adapted to the geometry and size of parts
	• Control panel: Enables system control and operation
	• Protective enclosure: Passive protective cabin compliant with ISO EN 60825-4, ensuring a high level of operational safety
	• Fast lifting door: Equipped with safety optical sensors; remains closed during the welding process
	• Display screen: Provides visualization of the welding process via integrated cameras (Wi-Fi connection)
	• Laser source: Equipped with Power Control function; adjusts output power and ensures uniform processing; power range from 500 W to 12 kW
Software needed to run the TestBed	• Roboguide: Offline programming of the robot
	• WeldCockpit AI: Monitoring and documentation of welding process parameters
Standards that apply	• ISO EN 60825-4: Safety of laser products – protective housings for laser processing equipment

1.9 Existing Software Assets (i.e. in GitHub)

Link:	Short description:
N/A	N/A

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1.10 TestBed documentation

Type	Short description:	Name and source (link):
Documentation	LaserFlex product webpage	LaserFlex – VIRS official website, https://www.virs.si/en/laserflex

1.11 Application cases

Application case:	Short description:	Photo of the Application case
Robotic laser welding of metal components	Execution of laser welding processes using a robotic system, enabling precise and repeatable welding of metal components. The system supports controlled welding operations within a protected enclosure.	N/A
Welding of geometrically diverse workpieces	Use of the clamping system and welding positioner to process workpieces of different shapes and sizes. The system enables adaptation of the welding process to specific geometries and positioning requirements.	N/A
Optimization of welding positioning	Application of the welding positioner to place workpieces in an optimal position for laser welding. This supports consistent process execution and accessibility of weld seams.	N/A
Monitoring and visualization of welding processes	Use of integrated cameras and display system to monitor the welding process in real time, enabling visualization of operations during execution.	N/A

Possible TRL application range	TRL4	☐
	TRL5	☐
	TRL6	☐
	TRL7	☐
	TRL8	✓

1.12 Funding source

Funding source acknowledgements
The creation of this TestBed was supported by VIRS d.o.o., Industrijska ulica 4 B, 9220 Lendava, Slovenia.

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1.13 Ethical and societal aspects

Ethical and societal aspect:	Short description:
Improved worker safety	The TestBed supports safer welding operations through the use of a laser welding system enclosed within a protective cabin compliant with ISO EN 60825-4. The enclosed design and integrated safety features reduce direct operator exposure to laser radiation and welding processes. Automated operation within the cell minimizes the need for manual intervention during welding, contributing to safer working conditions.
Improved ergonomics and working conditions	The TestBed contributes to improved working conditions by automating welding tasks and reducing physically demanding manual operations. The use of robotic welding and positioning systems enables more ergonomic task allocation, where the operator focuses on setup, supervision, and quality control. This reduces physical strain and supports efficient workflow organization.
Human-centred industrial automation	The TestBed supports human-centred automation by combining automated laser welding processes with operator supervision and intuitive control interfaces. Integrated monitoring via cameras and display systems enables operators to safely observe and control the process without direct exposure. This is particularly relevant for SMEs adopting advanced welding technologies.

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