

CONVERGING

Welcome to the 4th issue of the CONVERGING newsletter!

In this issue		_ •
	Recent Developments across modules	Highlights & Achievements
News and Events	· · · · · · · · · · · · · · · · · · ·	

We are pleased to announce the publication of the third issue of the **CONVERGING** newsletter. If you are interested in industrial collaborative environments integrating AI, Big Data and Robotics with wide applicability in manufacturing environments, you are at the right place!

CONVERGING project by bringing together 16 high-profile partners from several EU and Asian countries aims to develop, deploy, validate, and promote smart and reconfigurable production systems including multiple autonomous agents (collaborative robots, AGVs, humans) that are able to act in diverse production environments.

STAY TUNED

Stay updated on all our latest news, developments, research, and general information regarding the **CONVERGING** project.

Stay tuned@ https://www.converging-project.eu/

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PROJECT OVERVIEW



Global economic crises and the COVID-19 pandemic have dictated manufacturing firms to rethink their production and business models. Production systems need to adopt both human and automated resources that can work together seamlessly. As a response, **CONVERGING** aims to Develop, deploy, validate and promote smart and reconfigurable production systems including multiple autonomous agents (collaborative robots, AGVs, humans) that are able to act in diverse production environments.

The diversifying factors will be a multi-level AI-based cognition (line, station, resource levels) which will exploit the collective perception (Digital Pipeline) of these resources, allowing them to interact with each other and seamlessly coexist with humans under a "social industrial environment" that ensures trustful, safe and inclusive user experience.

The project proposes the development of systems that can:

- 1. Perceive: The ability to identify and understand processes, resources, and environments and their status through the use of Big Data, Real Time Integration & Communication Architecture, Digital Twins and Human in the Loop techniques.
- **2. Reason:** Analyze the production system status and independently form plans using AI, Planning and Reconfiguration Algorithms as well as Resource Autonomy solutions.
- **3.** Adapt: Automatically modify hardware and control systems to implement formulated plans using Robotics and Autonomous Systems, Smart Devices and Adaptable Mechatronics.
- **4. Collaborate:** Work seamlessly with humans or other resources, creating a social industrial environment which exploits Smart Human Machine Collaboration, User experience assessment and User centric workplace design.
- **5. Innovate:** Expand its capabilities and Openness via an Open Pilot Network as well as links to local and international innovation ecosystems.

RECENT DEVELOPMENTS ACROSS MODULES



HCR Module

A **ROS2** version of the **HCR interface** was developed to simplify the system's structure for easier future enhancements. Robot grippers were redesigned to ensure robustness in handling workpieces, enhancing reliability.

Kinematics & Virtual Reality

A kinematic model of the **NEXTAGE** robot was created to enable precise tool positioning in the Visual Components software. Additionally, a Virtual Reality environment simulating the **Electrolux assembly** task was developed, providing immersive training capabilities.

Safety & Monitoring

A thorough study on safety concepts for the **Electrolux open-pilot** has been completed. This includes the integration of safety sensors and optimizing gripper designs. A prototype safety cover for the robot gripper and an external device for monitoring the end-effector's speed were also developed.

Open-Pilot Integration

Components such as the gripper, magazine, and vision system were integrated into the **NEXTAGE** robot, resulting in a preliminary open-pilot prototype. The **ROS1** version of the **HCR** interface was further refined to ensure smoother robot movements.

Future Plans for the Open-Pilot

The team plans to implement the newly developed safety concepts, including grippers and sensors, into the next open-pilot prototype. Additionally, further refinement of **human-robot task sharing**, **cell layout**, and **technology specifications** will be carried out at the Electrolux site to finalize the open-pilot system.

HIGHLIGHTS & ACHIEVEMENTS



The CONVERGING project has reached a major milestone with the successful integration of the first prototype of equipment tailored for the Electrolux use-case. This system has been seamlessly integrated with the **NEXTAGE** robot at IPK premises. Additionally, several modules were successfully interfaced with the **HCR** module software, allowing for **effective robot monitoring and control**, enabling its core functionalities.

CRC – Collaborative Robot Control

Developments

The integration of the Kawada robot with the **PAM** and **AISC** modules has been finalized, alongside advancements in online planning methods. These enhancements include **adding orientation and velocity limits**, which significantly improve control precision.

Achievements

The team successfully demonstrated dynamic goal adjustments based on human occupancy and online re-planning based on human poses. These capabilities were showcased on the Kawada robot for the **Electrolux use-case**, demonstrating the system's adaptability to human movements.

Future Plans

Moving forward, the focus will be on increasing the **execution speed** and improving the **smoothness of trajectory updates** for the Kawada robot, aiming for more efficient and responsive robotic operations.

ARBA – Autonomous Robot Behavior Adjustment

Developments

A shift to a data-driven approach was made by employing an **autoencoder** for task modeling, specifically for plug insertion. The team completed data collection and processing, developing an autoencoder-based network that learns from task demonstrations.

Achievements

The new model has already shown promise by enhancing plug insertion techniques within the **Electrolux use-case**, leading to improved accuracy and efficiency in **task execution**.

Future Plans

The next phase involves leveraging the module to **optimize the speed of cabling tasks**, ultimately boosting **efficiency** in the assembly process.

UXE – User Experience Evaluation

Developments

Significant progress has been made in developing an online ergonomic evaluation system using human pose estimates captured through the **PAM** camera system. Additionally, methods have been developed to optimize the robot's pose, ensuring that parts are presented to operators in **ergonomically favorable positions**.

Achievements

The system was successfully integrated and tested within the **PRIMA use-case**, validating improvements in ergonomics. Demonstrations showcased the real-time estimation of human joint angles and the calculation of ergonomic scores, ensuring a **safer and more comfortable work environment**.

Future Plans

A **comprehensive publication** on the developed ergonomic evaluation approach, including validated results, is currently being prepared to share with the wider research community.



NEWS & EVENTS



CONVERGING Project at Science Agora 2024

On October 26-27, **Kawada** participated in Science Agora 2024, held at the Miraikan-National Museum of Emerging Science and Innovation - in Tokyo, Japan. Science Agora, a **premier science event**, brought together global innovators and curious minds, providing an excellent platform to showcase the CONVERGING project at the European Union booth.

Read more

CONVERGING had its 1st First Review Meeting in San Sebastian

The CONVERGING project recently reached a **major milestone** with its first review meeting, held April 16th to 19th at the **TECHNALIA** facilities in San Sebastian, Spain. This meeting brought together the project consortium, the Project Officer, and the reviewers to assess the recent developments and the progress archived over the last 18 months.

Read more





CONVERGING at the BIEMH 2024

BIEMH 2024 held its 32nd edition from June 3 to 7 at the **Bilbao Exhibition Centre**. The **Machine-Tool Biennial** is a leading international event that brings together experts from the technology sector, robotics, automation, machinery, quality control, and other fields related to industrial innovation. Visitors can learn firsthand about the latest advancements that drive greater competitiveness in the sector.

Read more

CONVERGING: Decoding Human-Robot Collaboration - Insights from the ERF 2024 Panel Discussion

During the European Robotics Forum (ERF) 2024, the CONVERGING project had the opportunity to co-organize together with the sister projects <u>AI-PRISM</u>, <u>COGNIFOG</u>, <u>FELICE</u>, and <u>FLUENTLY</u> a workshop entitled "HRC and AI, Hype or reality? From pilots to best practices.". This session focused on a topic critical to CONVERGING and **AI-PRISM** projects: the human element in Human-Robot Collaboration (HRC).

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CONVERGING Takes Center Stage at the European Robotics Forum 2024

The CONVERGING project was a prominent presence at the recent European Robotics Forum 2024 (ERF 2024) held in Rimini, Italy, from March 13th to 15th, 2024. Organized under the scientific responsibility of the University of Bologna, ERF brings together leading minds in robotics from across Europe, fostering collaboration and innovation in the field.

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CONVERGING at COP28: A Human-Centric Approach to Additive Manufacturing

The recently concluded <u>COP28</u> event brought together global leaders to tackle climate change. The CONVERGING project was prominently featured, with Hadea's president participating in a session focused on "<u>Human-Centric Industry for the Twin Transitions.</u>"

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CONVERGING at iREX 2023: A Glimpse into the Future of Robotics

The CONVERGING project was recently in the spotlight at the prestigious **iREX** 2024 (International Robot Exhibition) held in Japan! We were thrilled to share our work alongside the industry leader and partner in the CONVERGING project, KAWADA ROBOTICS CORPORATION, at their booth.

Read more



A GLIMPSE INTO CONVERGING BLOG POST



Delve into our Blog Post Section, and be informed about the latest news, landscape of HRC in industry, challenges, innovation, and opportunities.



Transforming Aircraft Maintenance: How the Aeronautics Open Pilot Line (OPL) is Shaping the Future

Exploring Additive Manufacturing Open Pilot Line (AIMEN's OPL)

On-the-Fly Polishing: An Advanced Automated Die Polishing System Without CAD Models and Part Registration

CONVERGING: How Cobots are Reshaping the Industry



The EU-funded **CONVERGING** project brings together 16 high-profile partners from several EU and Asian countries consisting of 5 research organizations and 11 industrial partners.







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