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IMOCO4.E

iMOCO4.E

KEY FACTS

Acronym: IMOCO4.E
Full name: Intelligent Motion Control under Industry4.E
Coordinating institution: Sioux Technologies B.V.
Project coordinator: Arend-Jan Beltman
GA No.: 101007311 - H2020-ECSEL-2020-2-RIA
Start date: 1st September 2021
Duration: 36 months
Consortium: 46 Partners from 13 countries

This issue provides a grasp of the main project developments during *May 2023 – August 2023*. It also provides facts on the results achieved, as well as links to the latest dissemination activities.

IMOCO4.E Highlights

During the reference period, the consortium continued developing the IMOCO4.E concept and methodologies, with extremely promising results. These results were extensively presented at the two-day M22 Consortium meeting that took place virtually on 12th and 19th of June. Besides the presentation of the technical progress of the IMOCO4.E Pilots, Demonstrators and Use cases. IMOCO4.E partners also discussed the implementation and the progress of the IMOCO4.E technical videos.

WHAT HAS BEEN DONE?

WP2

WP2 disseminated the IMOCO4.E reference framework with an accepted peer-reviewed paper in the ETFA 2023 conference and actively participated in steering the adoption of the IMOCO4.E reference framework concepts within the consortium.

WP3

The WP3 partners have completed their deliverables D3.3-D3.6, which have been the primary focus over the past few months. These deliverables present concrete outcomes from various building blocks, detailing the developmental progress of numerous technologies within the IMOCO4.E framework's Layer 1.

- D3.3 introduces six innovative, real-time, low-power sensors and their applications in the project's demonstrators, pilots, and use cases. It also highlights how these sensors meet the criteria previously set in WP2 and WP3.
- D3.4 discusses the SoC/FPGA and other platforms developed in T3.3, which are designed for intelligent control as well as smart signal and data processing.
- D3.5 focuses on the advancements in AI-driven high-speed perception and vision solutions.
- D3.6 elaborates on the high-performance servo drives.

While the developments outlined in these deliverables are ongoing, the upcoming phase will concentrate on creating demonstrators and other presentation materials for the project meeting in November.

ToC

What has been done

WP4

WP4 has covered the development stage of smart control algorithms and AI and vision compatible hardware and, although partial tangible results are already available, it is facing the implementation and validation stage. Task 4.2 has been recently closed with the definition of a common XiL methodology for control system design based in Digital Twins based in current approaches used by IMOCO4.E partners. Partners involved in Tasks 4.3 and 4.4 are deeply working in the implementation and validation of the smart control algorithms that will contribute to IMOCO4.E Building Block 5. Recent highlights are the integration of a real time absolute position compensation of an industrial robot, in the scope of IMOCO Use Case 2, and the application of offset free Model predictive Control for position tracking in a Stewart platform. Task 4.5, connected with IMOCO4.E Building Block 10, continues working on path planning, route optimization, and decision making (collision avoidance) of mobile robots. Developed technologies are being implemented in three major IMOCO4.E scenarios: Pilot 4, Pilot 5 and Demonstrator 3. Finally, partners in Task 4.6 continue working in different multi-core edge platforms as well as required development framework that includes vision and Artificial Intelligence workload as well as TSN communication. Partners involved in Tasks 4.3 to 4.6 worked together in respective reports of the developed technologies, submitting the respective deliverables for BB technological description in M21. As a complement, BB owners are working in dissemination material, like videos and posters, for comprehensive presentation of their technologies. Following with dissemination actions, several WP4 key partners have participated in the organization and as contributors to a IMOCO4.E workshop at the ETFA conference 2023, celebrated in the 12th of September in Sinaia (Rumania).

WP5

The start of this period was hectic for all the partners in WP5. There were five deliverables to be provided in month 21 of the project. Two reports and three demonstrators. The demonstrators were prepared in the form of reports proving the existence of the components belonging to individual building blocks. Special thanks go mainly to task leaders and all involved partners for their outstanding efforts. All these deliverables were prepared in time, internally reviewed, and corrected, and they are now uploaded to the EU portal. After that, there was a short time for the relaxation during the summer holidays. Discussions on testing the components have been executed right after that, and the preparation of the demo videos has started.

WP6

WP6 is still navigating a crucial phase of the project with remarkable success. Following the structured "W-approach," our component clusters are now in execution of the initial iterations of our pilot, demos, and use case implementations. We finalized the process of defining comprehensive verification, validation, and testing plans for each component and cluster. Moreover, WP6 is diligently carrying on with its efforts in supply chain risk monitoring and the collaborative sharing of methodology viewpoints. Additionally, we are excited to share that first iterations of our four use cases are already reported in project deliverables.

WP7

WP7 is about the pilots and demonstrators. Comparable to the earlier periods, monthly the status has been discussed in the WP7 meeting. Mainly the status of the SW and HW components, but also the applicable digital twins and the relation to building blocks are determined to be important. Partners worked together within the pilots and demo's, for instance on VR simulation, model development, fault detection, data security and management and sensor development. Before the review meeting in November, one deliverable per each pilot and demonstrators is due. The template for these deliverables is discussed and decided. The content is input for the review meeting too.

Dissemination & Communication

IMOCO4.E values the importance of networking, exchanging ideas and knowledge with other similar EU projects. The consortium has managed to generate discussions with H2020 TIBCO, METIS and MADEin4 aiming at the co-organization of special sessions as well as boosting joint dissemination activities.

Liaison activities are in progress

IMOCO4.E partner, Unimore, participated to the JSSPP 2023 in Florida, USA during May 15th – 17th 2023. (Representative partners: Unimore). More details here

IMOCO4.E partner, Unimore, participated to the conference SPAA in Florida, USA during June 17th – 19th 2023. (Representative partners: Unimore). More details here

IMOCO4.E project attended European Conference Control (ECC2023) in Bucharest, Romania during June 13th-16th 2023. (Representative partner: Siemens_RO). More details here

IMOCO4.E project at 3D & Systems Summit in Dresden, Germany during June 26th - 27th of June 2023. (Representative partner: SEMI). More details here

IMOCO4.E partner, TU/e, participated to the 22nd World Congress of IFAC in Japan, Yokohama during July 9th – 14th 2023. (Representative partners: TU/e). More details here

IMOCO4.E partner, Emdalo, participated to the FPGA conference on Tuesday, 5th July in Munich, Germany. (Representative partners: Emdalo). More details here

During the reference period, the partners intensively disseminated the project results by spreading knowledge and creating good networking opportunities with industrial and scientific peers. The IMOCO4.E partners have focused to widen up the network of scientific experts of the project and transferred valuable scientific results by participating in multiple online and physical conferences and workshops. Visibility of the project and transferability of the project outcomes has been promoted through the update of the promotional material and by regular dissemination to the public through social media channels.

During the past 3 months and in the context of WP8 activities, IMOCO4.E participated in the several events, such as:

In addition, IMOCO4.E partners plan to participate in:

- Eurosensors 2023, 10-13 Sep 2023, Lecce, Italy – Event Link
- ETFA 2023, 12-15 Sep 2023, Sinaia, Romania – Event Link
- EEAI 2023, 17-19 Oct 2023, Athens, Greece – Event Link
- EU Digital Future Forum, 6 Nov 2023, Online – Event Link
- SEMICON Europa, 14-17 Nov 2023, Munich, Germany – Event Link

Prerecorded videos

Coming Soon!!

Although the outreach activities continue with weekly posts on social media platforms (LinkedIn and Twitter), the IMOCO4.E team plans to increase knowledge and visibility of the project by raising awareness of the benefits of the IMOCO4.E platform on specific use cases and demonstrators via prerecorded videos!

IMOCO4.E interim (M22) consortium meeting has been successfully completed!

The two-day IMOCO4.E M22 Consortium meeting took place virtually on 12th and 19th of June. The meeting slots were dedicated to the IMOCO4.E Pilots, Demonstrators and Use cases and the overall scope of this meeting was mainly focused on the presentation of the technical progress of these project results. Besides the presentation of the actual achievements, IMOCO4.E partners also discussed the implementation and the progress of the IMOCO4.E technical videos.

IMOCO4.E Consortium will meet again in M24 Brno F2F meeting during 5-7 September 2023.

IMOCO4.E Publications

The IMOCO4.E project also tries to have an active performance via conference paper publication by presenting the research work carried out in the frame of the project. The list of upcoming presented articles is shown below:

- “Dynamic Accuracy Optimization for NC controlled Industrial Robots”, ETFA 2023, Sinaia, Romania
- “An Autotuning Procedure for Motion Control Systems: Method and at-the-edge Implementation”, ETFA 2023, Sinaia, Romania
- “Verification of NNs in the IMOCO4.E Project: Preliminary Results”, ETFA 2023, Sinaia, Romania
- “The IMOCO4.E reference framework for intelligent motion control systems”, ETFA 2023, Sinaia, Romania
- “Beyond Nyquist in Frequency Response Function Identification: Applied to Slow-Sampled Systems”, L-CSS 2023
- “Leveraging SMT Solvers for Verification of Neural Networks in Predictive Maintenance Applications”, Information Journal
- “Vector Reconstruction Error for Anomaly Detection: Preliminary Results in the IMOCO4.E Project”, ETFA 2023, Sinaia, Romania
- “Simulation Model and Validation Method Analysis of an Electric Passenger Elevator”, ETFA 2023, Sinaia, Romania
- “Condition Monitoring of Industrial Elevators Based on Machine Learning Models”, ETFA 2023, Sinaia, Romania
- “Deep reinforcement learning for optimal planning of assembly line maintenance”, Journal of Manufacturing Systems
- “Detection of Component Degradation: A Study on Autoencoder-based Approaches”, IEEE eScience 2023, Limassol, Cyprus
- “A Structured Inference Optimization Approach for Vision-Based DNN Deployment on Legacy Systems”, ETFA 2023, Sinaia, Romania
- “Maintenance Reduction of Medical Robotic Manipulators through Automatic Data-Driven Updates of Feedforward Control”, ETFA 2023, Sinaia, Romania
- “Robust and optimal design of fixed structure controllers in collocated motion systems”, ETFA 2023, Sinaia, Romania
- “Using the Intelligent Edge for Real-Time Teleoperation System”, ADI ETC ’23

Submitted Deliverables

- D3.3 – "Novel low/self powered real-time sensors (BB3)"
- D3.4 – "New SoC+FPGA and multi-many core platforms for AI and smart data processing (BB1)"
- D3.5 – "AI based high speed perception and vision (BB2, BB8)"
- D3.6 – "High Performance servo drives, variable speed drives (BB7)"
- D4.3 – "Design report on intelligent motion control algorithms"
- D4.4 – "Report on multivariable motion control and data-driven learning"
- D4.5 – "Development guideline report on path planning, collision avoidance, and navigation"
- D4.6 – "Software for predictable multi/many core edge platforms"
- D5.3 – "Trustworthy and Secure Dataset management, storage and processing tools"
- D5.4 – "Algorithms for condition monitoring, predictive maintenance and self-commissioning of industrial motion control systems"
- D5.6 – "Augmented and virtual reality through digital twins"
- D5.7 – "AI methods for monitoring and predictive maintenance at higher IMOCO4.E layers"
- D5.5 – "Modelling and simulation of complex multi-axis systems"
- D6.11 – "Platform deployment with commercial products and robotic platforms (first version)"
- D6.3 – "Test benchmarking and strategy"

Upcoming Events

IMOCO4.E will participate to the IEEE ETFA 2023 on Emerging Technologies and Factory Automation with a dedicated IMOCO4.E workshop, 12th-15th Sep 2023, Sinaia, Romania
More details here

IMOCO4.E will attend EEAI 2023 conference with a dedicated IMOCO4.E presentation, 17th -19th Oct 2023, Athens, Greece
More details here

IMOCO4.E will participate to the EU Digital Future Forum with a dedicated IMOCO4.E session, 6th Nov 2023, Online
More details here

IMOCO4.E will attend SEMICON Europa with a dedicated IMOCO4.E session, 14th – 17th Nov 2023, Munich, Germany
More details here

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ECSEL Joint Undertaking

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