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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 *November 2022 – February 2023*. It also provides facts on the results achieved, as well as links to the latest dissemination activities.

IMOCO4.E Highlights

During the past 3 months, the consortium continued developing the IMOCO4.E concept and methodologies, with extremely promising results. These results extensively presented at the 1st Review Meeting in Brussels on November 15th, 2022 where each IMOCO4.E WP leader presented extensively to the project officer and technical reviewers the technical progress, the project tangible results as well as the short-term plans preparing the upcoming work and deliverables. As an outcome, the Review meeting ended up smoothly with positive feedback from the reviewers!

WHAT HAS BEEN DONE?

WP2

WP2 has presented the progress and updates during the first-year review meeting in Brussels. The reviewers responded positively to the efforts of the WP with helpful feedback for improvements. The reviewers accepted the WP2 deliverables D2.2 'Needs for future smart production in Europe from the mechatronics and robotic point of view' and D2.3 'Overall requirements on IMOCO4.E reference framework' and suggested revisions for D2.1 'State-of-the-art methods in Digital Twinning for motion-driven high-tech applications'. In addition, Task 2.3 has been active during this period for the general design and specification of the IMOCO4.E reference framework. The deliverable D2.4 'General specification and design of IMOCO4.E reference framework' was uploaded to the EU portal on January 31. With this, the technical tasks of WP2 have officially ended.

What has been done

WP3

WP3 partners continued the work on all five tasks of the work package. In T3.1 partners actively contributed to the deliverable D3.2, and most of the needed information is already collected. Thus, the final iteration of "Perception and instrumentation Layer requirements and specifications" will be ready in February. Meanwhile, technical development of different solutions in tasks T.3.2-T3.5 have continued, while preparation work has begun on the following deliverables related to each of those tasks. Most of the 23 solutions in T3.2-T3.4 now have a clear connection to use-cases, demonstrators, and pilots. Also, final connections to building blocks were clarified, for example, in T3.4 most of the solutions have defined their subcomponents that appear in the project's software catalog. Partners also clarified which building blocks these components are a part of and how they are connected to other building blocks in specific applications. Meanwhile, in Task 3.5 servo drives are being improved and prepared for testing.

WP4

WP4 has entered a critical period as, after requirement definition and preliminary technology developments, partners need to finalize and validate the proposed functionalities during this new year. In Task 4.1, after preliminary definition of the control technologies to be developed and their corresponding requirements in the deliverable D4.1, partners are working in the second iteration that will lead to the final requirement definition in M17. WP4 partners continue developing technologies within tasks 4.2 to 4.6 to fulfil the defined requirements. Task 4.2 is working in 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 in volved in Tasks 4.3 and 4.4 are deeply working in the development and implementation of smart control algorithms, that will contribute to IMOCO4.E Building Block 5. Some highlights within these tasks are the development and implementation of a real time compensator of industrial robot TCP position using online laser tracker measurements and Gaussian Process Repetitive Control implementation in PLC systems for improved lift control. Additional relevant activities linked with data driven learning control, parameter varying feedforward and multi-rate control are being presented in reference conferences around the world. Task 4.5, linked with IMOCO4.E Building Block 10, goes on with path planning, route optimization, and decision making (collision avoidance) of mobile robots focused in three of IMOCO4.E's Pilots and Demos. For example, simulation based collision free path generation for boom robots, Model predictive Control based path generation for medical robots and fleet level control of AGVs for warehouse logistics. Finally, partners in Task 4.6 are 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

WP5

WP5 partners have been preparing the second iteration of the requirements definition in deliverable D5.2 (task T5.1). It will be provided in M18 of the project (February 2023). The work in all tasks was running smoothly with active collaboration between partners. Task T5.2 initiated the discussion about the project's centralized cloud infrastructure. The issue is still open, but it seems that P/D/UC owners will use their own clouds for the demonstrations. In T5.3, partners were working on machine learning methods for predictive maintenance and on the preparation of NN models. In T5.4, groups of partners were cooperating on XIL solutions for electrical drives, virtual commissioning of complex PLC/CNC projects, and algorithms for identification and learning for complex motion systems. Activities in T5.5 are subdivided into two subtasks, Model specification, and Modelling methods. During the regular teleconferences, partners presented their results in creating models for digital twins. Development of several digital twins with the support of augmented and virtual reality was running in T5.6. In

T5.7, research activities on the verification of Recurrent NN and Deep NN, the development of ML models, and the preparation of datasets was in progress. Task leaders in WP5 have already started with the preparation of the templates and the content for deliverables to be provided in M21 (May 2023). Three of them (D5.3, D5.4, and D5.7) will be demonstrators, and the other two (D5.5 and D5.6) will be reports.

WP6

WP6 is on the full speed in the key project period. HW and SW catalogues are further processed into component clusters which are necessary for successful pilot/demo/use-case execution. WP6 serves now as a key coordination point for building block developers. Under the scope of WP6, building block workshops were organized. WP6 is responsible also for supply chain risk monitoring. Four technical use-cases are being developed within WP6. Those cover robotic and motion control system aspects of commercial products.

WP7

In **WP7**, partners worked in M15 to M17 (November 2022 - January 2023) on their respective pilot or demonstrator. Monthly there was a WP7 meeting, combining both tasks 7.1 and 7.2. The presentation of WP7 held at Brussel and the comments from this review meeting in Brussel were shared and discussed. Updates of the pilots and demonstrators were reported, the plan towards the next deliverables was made and discussed was which physical meetings we should have in the coming meeting in Bilbao. Interactions to other WP's and the Building blocks were also addressed.

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

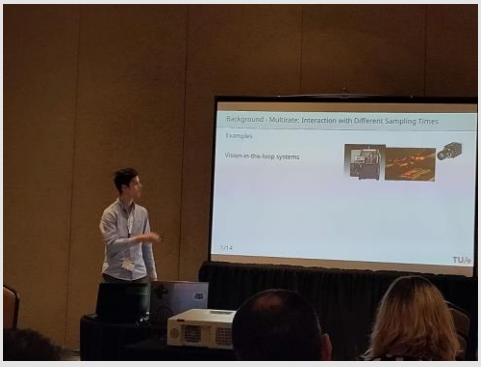
During the reference period, the partners intensively disseminated the project results by spreading knowledge and creating good networking opportunities with industrial and scientific peers. The IMOCO4.E partners have focused to widen up the network of scientific experts of the project and transferred 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:

IMOCO4.E partners attended SEMICON Europa 2022 event in Munich during November 15th-17th. (Representative partners: SEMI, ITEC, DTT, EDI).
More details here

The IMOCO4.E project was featured as an exhibitor at the EFECS 2022 in Amsterdam on November 24 and 25 positioning itself as a key initiative shaping the future of Industry 4.0 manufacturing in Europe.
(Representative partner: ITML, GNT, UWB).
More details here

During the Conference on Decision and Control (CDC2022) 2022 in early December, an IMOCO4E paper about multirate system identification is presented.
(Representative partners: TUE).
More details here



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

- ECS Brokerage, 7-8 Feb 2023, Brussels, Belgium– Event Link

Special Podcast Sessions

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 special podcast sessions and prerecorded videos!

Consortium/Review Meetings, Publications & Submitted Deliverables

The IMOCO4.E 1st Review Meeting has been successfully completed on Nov 15th, 2022.

The Review Meeting took part in European Commission's premises in Brussels and online! It started with a short pitch of the IMOCO4E coordinator, Arend-Jan Beltman from Sioux and then, each IMOCO4.E WP leader presented extensively to the project officer and technical reviewers the technical progress, the project tangible results as well as the short-term plans preparing the upcoming work and deliverables.

As an outcome, the Review meeting ended up smoothly with positive feedback from the reviewers!

Consortium in now preparing for the 3rd Consortium meeting, which will be held in Bilbao, Spain on 28th-30th of March 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:

- "Gaussian Process based Feedforward Control for Nonlinear Systems with Flexible Tasks: With Application to a Printer with Friction", Modeling, Estimation and Control Conference 2022
- "Time-Sensitive Autonomous Architectures", Real-Time Systems from Springer
- "Synthetic data generation for visual detection of flattened PET bottles", MDPI journal "Machine Learning and Knowledge Extraction"
- "Simultaneous Active Jobs Upper-Bounding", Real-Time Networks and Systems 2023

Submitted Deliverables

- D2.4 - "General specification and design of IMOCO4.E reference framework"
- D6.1 – "Guideline of IMOCO4.E methodology and toolchains"

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