

E-VOLVE EV FOR LIFE, VALUE, EFFICIENCY



NEWSLETTER 12/23

Well, 2023 is coming to an end and we can't find a better way to celebrate this year than by publishing a further E-VOLVE cluster newsletter. Looking back at the beginning of the year, the cluster welcome a number of new projects joining and it's great we can close the year by doing the same; welcoming a new project. It's our honour to welcome the MAXIMA project on board and we are introducing the project and the consortium to you in this edition.

What else happened since the last edition? Have a read on our report on the Webinar "Sustainable Drives: Exploring Innovations in Green Vehicle Propulsion", the E-VOLVE cluster presentation at the Eco-Mobility 2023, a report from the project Multi-Moby that completed its final phase and many more.

WELCOME NEW MEMBER



MAXIMA: Modular AXIal flux Motor for Automotive

MAXIMA aims to create a low-cost modular permanent magnet axial flux electrical machine with improved performance, and with a low environmental impact that caters specifically to the needs of the automotive market.

To achieve this, MAXIMA will develop an advanced multiphysics design procedure that includes new thermal management concepts. A digital twin will also be built to develop an optimal control strategy to operate the electrical machine up to the limit.

The end-of-life of the electrical machine will also be considered, with a focus on recycling the permanent magnet made from critical raw materials. MAXIMA will conduct a life cycle

assessment for every solution, analyzing its impact throughout the lifecycle, with the goal of minimizing the environmental impact.

At the end of the project, prototypes will be manufactured for testing, assessment, and validation of the new concepts addressed in MAXIMA related to the modular design of the electrical machine, the optimal control based on the digital twin and the manufacturing/recycling process flow.

The E-VOLVE cluster on behalf of all members herewith welcomes the MAXIMA project to the cluster and we are looking forward to the further cooperation!

Follow the project
MAXIMA





NEW REPORTS



Multi-Moby

safe, secure, high performing,
multi-passenger and multi-use
affordable electric vehicles

Multi-Moby



*Safe, Secure, High Performing Multi-Passenger
and Multi-Commercial Uses Affordable EVs*

On Antilock Braking Systems With Road Preview Through Nonlinear Model Predictive Control

In the context of the European Horizon 2020 Multi-Moby project, we share our latest research article published on the prestigious IEEE Transactions on Industrial Electronics and titled: “On Antilock Braking Systems With Road Preview Through Nonlinear Model Predictive Control” authored by G. Tavolo, K. M. So, D. Tavernini, P. Perlo and A. Sorniotti.

The research shows how the information on the tire–road friction conditions ahead, considered to be obtained from a V2X connectivity system, can be used to enhance wheel slip control performance, especially during abrupt friction level variations. A novel pre-emptive antilock braking system (ABS) was developed by University

of Surrey in collaboration with I-FEVS, which enhances the control of the wheels dynamics and steerability of the Multi-Moby demonstrator vehicle. This is especially important during emergency manoeuvres. Fig. 1a shows how an experimental demonstration has been performed on high-to-low-friction surface within the project.

The electric vehicle prototype was equipped with wheel speed sensors, a Kistler optical sensor to measure the longitudinal and lateral velocity components (see Fig. 1a), an integrated PCAN global positioning system with IMU, a dSPACE MicroAutoBox II system for the rapid control prototyping of the controllers, a modified commercial vehicle stability control (VSC) unit, (see Fig. 1b). The electronic control unit of the commercial VSC was replaced by a connection to the dSPACE board via relays to enable independent control of each digital solenoid valve and the motor pump in the hydraulic circuit from the dSPACE system. To allow feedback control of the individual callipers, pressure sensors were installed at the output ports of the VSC unit, as well as one of the input ports connected to the tandem master cylinder (TMC).

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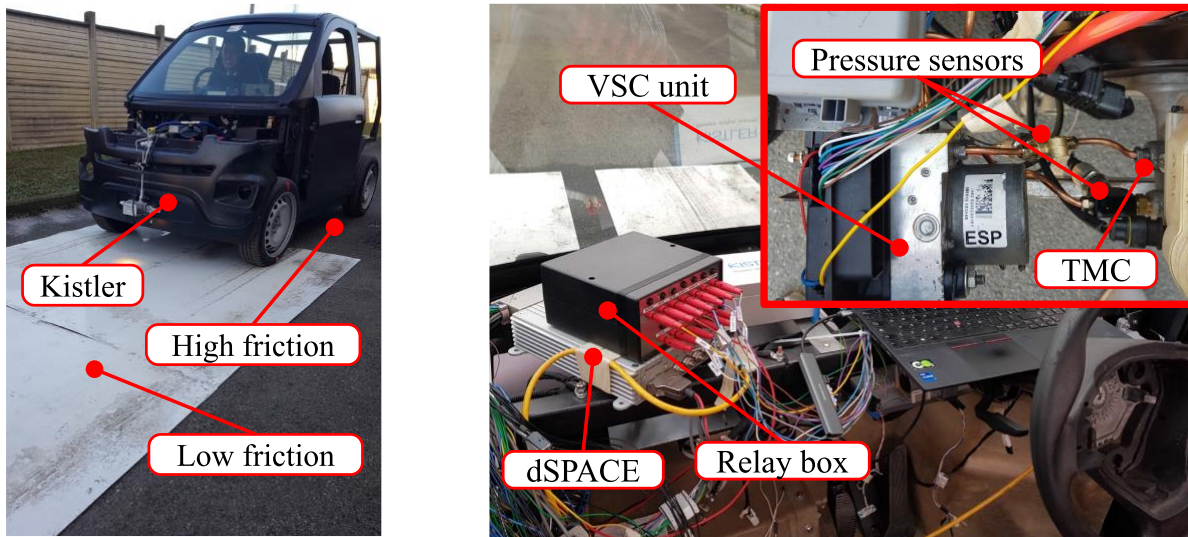


Fig. 1. a) Prototype EV during a step change from high (dry tarmac) to low (water on white plastic boards) friction conditions; and b) Hardware components, including dSPACE MicroAutoBox II unit, custom-made relay box, and in the inset: modified VSC unit, pressure sensors, and TMC, located above the front axle. Figure from: G. Tavolo, K. M. So, D. Tavernini, P. Perlo and A. Sorniotti, "On Antilock Braking Systems With Road Preview Through Nonlinear Model Predictive Control," in *IEEE Transactions on Industrial Electronics*, doi: 10.1109/TIE.2023.3314917

Fig. 2 shows the experimental results of the proof-of-concept tests in terms of slip ratio of the front right wheel ($\sigma_{x,FR}$). The green line refers to the passive test: without ABS intervention the monitored wheel is completely locked already in high friction. The slip ratio for the non pre-emptive (and pre-emptive not aware of the actuation dynamics, red line) controllers rapidly

reaches the -0.6 to -0.8 range in the low friction area. The blue line shows the slip ratio for the controller with preview capabilities and awareness of the actuation delay. The algorithm pre-emptively reduces the braking pressure before the step change in friction and the slip ratio respects the threshold represented by the black dashed line.

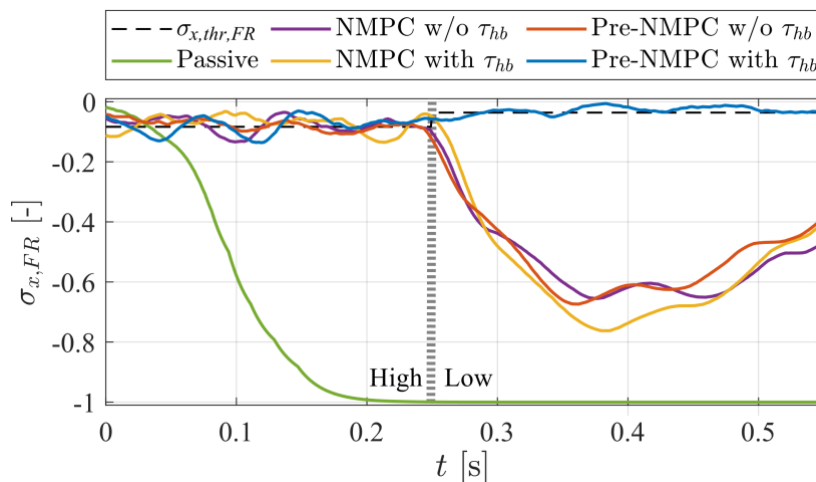


Fig. 2. Experimental test results along the high-to-low friction ABS test from 40 km/h: $\sigma_{x,FR}$ profiles for all configurations, together with the corresponding $\sigma_{x,thr,FR}$ time plot. Figure from: doi: 10.1109/TIE.2023.3314917

More information on the Multi-Moby project:



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THROWBACK WEBINAR “SUSTAINABLE DRIVES”

Upon invitation from our new cluster member project MAXIMA, the projects MAXIMA, EM-Tech, HEFT and VOLT CAR joined for a webinar titled "Sustainable Drives: Exploring Innovations in Green Vehicle Propulsion" this workshop brings together four pioneering European projects dedicated to transforming the automotive industry's approach to electrification.

The automotive industry is undergoing a profound shift towards electric mobility to combat climate change. However, challenges such

as high manufacturing costs, environmental impact, and resource scarcity still persist. This workshop showcased the innovations proposed by four EU-funded projects that are shaping the future of EV propulsion.

The webinar brought together 60 participants who engaged in vivid discussions. In case you missed it, you can access all presentations at the MAXIMA website and Youtube channel:



HEFT Novel concept of a low-cost, high-power density and highly efficient recyclable motor for next-generation mass-produced electric vehicles.

Presented by Dr. Javier Poza, Mondragon Unibertsitatea



EM-Tech Innovative e-motor technologies covering e-axes and e-corners vehicle architectures for high-efficient and sustainable e-mobility. Presented by Dr. Eric Armengaud | Armengaud Innovate GmbH



VOLT CAR Design, manufacturing, and validation of ecocycle electric traction motor
Presented by Dr. Jenni Pippuri-Makelainen, VTT – Technical Research Centre of Finland



MAXIMA Modular AXIal flux Motor for Automotive
Presented by Prof. Stéphane Clenet, Arts et Métiers-Institute of Technology

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THROWBACK ECO-MOBILITY 2023



How to achieve 100 % sustainable mobility? Circular Economy – from Cradle to Grave and back to Cradle

On November 16 and 17, the 18th A3PS- Austrian Association for Advanced Propulsion Systems Conference Eco-Mobility 2023 took place in Vienna and the E-VOLVE cluster and all partner projects have been presented by Eric Armengaud, leading the working group “industrialization and exploitation” of the cluster.

This year’s theme of the conference was “How to achieve 100 % sustainable mobility? Circular Economy – from Cradle to Grave and back to Cradle” and provided excellent keynote speeches and ground breaking input in the thematic sessions provided by the international participants.

The E-VOLVE cluster presentation was part of the session “AVC Advanced Vehicle Concepts” and

focused on presenting the cluster as well as the projects and their innovative approaches as contribution to the European R&D landscape. Chaired by Brandstätter Bernhard from Virtual Vehicle Research GmbH and lead of the cluster working group “Scientific Board”, the session concluded with a panel discussion with Christian Kurzböck from Virtual Vehicle and a vivid exchange among the participants of the session.

We would like to thank A3PS and Conference Chair Dr. Michael Noest, MBA in representation of the organizers for the invitation and excellent organization and all participants for the fruitful discussions. We are looking forward to further exchange.

The presentation is available for download at the E-VOLVE Cluster [Zenodo Platform](#).

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COMING UP: RTR 2024



From February 05 until February 07 2024, the RTR Conference on Results from Road Transport Research will take place in Brussels, Belgium. It is the 7th edition and 400 participants are expected to learn about Horizon 2020 and Horizon Europe projects' results and expected impacts and what

the next research steps are in essential areas for road transport. Registration for the event is open and in case you cannot participate in person, online participation is possible as well. The following E-VOLVE cluster members will be presented:



February 6, Parallel Session 7B
“Next generation electrified vehicles for urban and suburban use”(10:50 – 11:50)



February 7, Parallel Session
“Next generation of power electronics” (09:30 – 10:00)



February 7, Parallel Session “Next generation of power electronics” (09:30 – 10:00)



February 7, Parallel Session “Next generation of power electronics” (09:30 – 10:00)



February 7, Parallel Session 18B
“Next generation of power electronics” (11:30-12:30)

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COMING UP



Next Cluster Meeting

January 12th 2024



HighScape project meeting in Torino, IT

January 24th -25th 2024



EM-TECH

EM-TECH project meeting in Torino, IT

January 25th -26th 2024



RTR Conference in Brussels, Belgium

February 05th – 07th 2024



Next Edition of the E-VOLVE Newsletter

March 2024



EARPA Spring Meeting 2024 Brussels, Belgium

March 05th – 06th, 2024



Final Event, online

Spring 2024



TRA – 10th Conference in Dublin

April 15th-18th 2024



SAE WCX, Detroit

April 16th – 18th 2024

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