E-VOLVE
EV for Life, Value, Efficiency

E-VOLVE Cluster Newsletter

December 2021

The EVolve future is now!

The virtual E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster is realizing and monitoring synergies between eight projects from the (EV) Horizon 2020 programme to execute joint dissemination, exploitation and standardization activities.

This 6th Newsletter comes together with a new project member: Multi Moby!

Cluster expansion: The Multi-Moby Project!

Future urban electro-mobility requires the development of a new generation of light, affordable and functional electric vehicles, including smart solutions for enhancing user experience. This topic is addressed by Multi-Moby, which is an ambitious Horizon 2020 project aiming at quickly finalising the results of a cluster of previous and ongoing European projects addressing the development of technologies for safe, energy-efficient and affordable urban electric vehicles.

Figure 1: Multi-Moby passenger vehicles and multi-purpose vans by I-FEVS

The passenger vehicles and multi-purpose commercial vans of Multi-Moby will assure:

- Best-in-class safety for occupants, and vulnerable road users (VRUs) protection as required by the M1/N1 regulations
- Driving automation capabilities by adopting the most extensively tested sensing and computing platforms, with the addition of low-cost scanning and night vision functionalities
- Highly efficient 48 V and 100 V powertrains
- Robust battery packs based on hybrid cells with specific energy close to 200 Wh/kg at the pack level
- Efficient AC charging through an on-board charger integrating a DC/DC converter optimized for the two voltages of interest
- DC charging at 48 V and 100 V
- Advanced electric and electronic (E/E) architecture with secure procedures for remote updates and upgrades of the firmware, and predictive maintenance, by applying advanced artificial intelligence (AI) methodologies
- Application of low-cost, flexible, agile and lean manufacturing through a low-investment micro-factory concept
- Competitive price positioning with respect to existing and forthcoming fully electric urban passenger and commercial vehicles.

In the last 6 months Multi-Moby has achieved several important results, e.g.: i) experimental assessment of the pre-emptive braking control function on the ZEBRA vehicle of the University of Surrey; ii) experimental assessment of the pre-emptive traction control function, based on the knowledge of the tyre-road friction profile ahead, on the ZEBRA vehicle and the Multi-Moby prototype vehicle by I-FEVS; and iii) full-scale Multi-Moby vehicle crash tests, carried out at the CIDAUT facilities.

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Figure 2: ZEBRA (a) and TELL/Multi-Moby (b) demonstrator vehicles during traction control tests with suddenly varying tyre-road friction conditions, while using the V2X-enabled pre-emptive traction controller.

Below, an example of proof-of-concept experimental traction control test results on the Multi-Moby demonstrator vehicle by I-FEVS, in terms of profiles of the tyre-road friction level, front motor torque demand and actual torque, vehicle and front wheel speeds, and tyre slip ratios: comparison of the vehicle without traction control ('Passive'), the vehicle with a state-of-the-art non-pre-emptive nonlinear model predictive traction controller ('NMPC'), and the vehicle with the proposed pre-emptive traction controller ('Pre-NMPC') benefitting from V2X information.

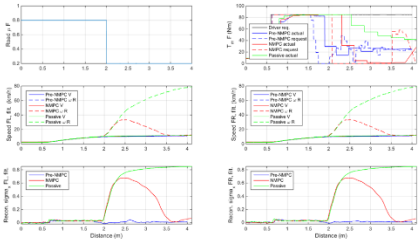

Figure 3: proof-of-concept experimental traction control test results

For more information:

- Visit our project web page: **https://www.multi-moby.eu/**
- Follow us on Twitter: **@MobyMulti**

Learn more about Multi-Moby.

The Project Members

ACHILES, SELFIE, FITGEN, CEVOLVER, SYS2WHEEL, EVC1000, TELL and MULTI-MOBY are the members of the E-VOLVE Cluster.

Interested in learning more about our Cluster members? Visit our website!

PROJECT NEWS

ACHILES: Testing plan to validate demonstrator

The ACHILES vehicle has been equipped with a newly designed e-drive (Elaphe) with high heat dissipation ability and novel lightweight wheel brake prototypes and fluid-free brake actuators (Continental). The modular ACHILES centralized computer platform with multi-host approach and deterministic ethernet switch (TTTech) was also finalized into the full vehicle. All subsystems have been tested and the physical integration into the prototype is being finalized (Tecnalia).
Tests have been carried out at several partners' premises and the results show that the ACHILES vehicle is 19 kg lighter than the baseline Q2 BEV.

Figure 4: Electric motor pair coupled with off-the-shelf inverters with newly developed software to support "out of phase" braking.

The ACHILES design also contributed to emission reduction (60% reduction of particles with 2.5 µm diameter and 72 reduction of particles with 10 µm diameter), when compared to the baseline vehicle. Furthermore, it was proved by tests that the developed novel chassis control, combined with the brakes and drivetrain leads to enhanced safety (e.g. in the event of failure of wheel break or during lane change).

Figure 5: ACHILES brake system

Learn more about ACHILES.

TELL: Prototype and vehicle controller testing

The TELL project addresses the optimisation and large-scale manufacturing of low and medium voltage electric powertrain solutions, with focus on high efficiency, compact packaging and low cost. Three main applications are targeted: i) Small-to-medium segment electric cars; ii) Hybrid electric cars with a low voltage add-on electric propulsion system; iii) The lightweight urban mobility sector, e.g., electric quadricycles. In the last 6 months TELL has achieved several important results, e.g.,: i) installation and testing of the VALEO 48V system using Si Mosfets on the TELL vehicle demonstrators and development of power module based on GaN transistors; ii) installation and testing of the DANA TM4 Medium-Voltage (100Vdc) powertrain including an innovative inverter and a novel synchronous reluctance electric motor assisted by permanent magnets; iii) energy efficiency experimental testing of the TELL vehicles designed and

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manufactured by I-FEVS, including the different powertrain solutions, and completed by the Infineon chips and sensors; iv) experimental testing of the state-of-the-art vehicle dynamics control strategies (including pre-emptive traction control and axle torque vectoring) developed by University of Surrey.

Figure 6: VALEO 48V system for special purpose urban electric vehicles and mild hybrids up to 35kW

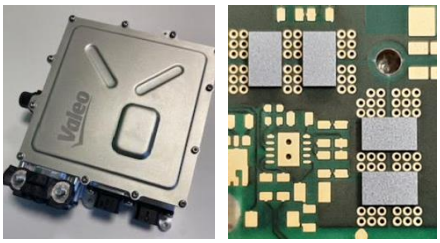

Figure 7: VALEO inverter including: (left) Power circuit based on Si Mosfets and (right) Power circuit based on GaN transistors

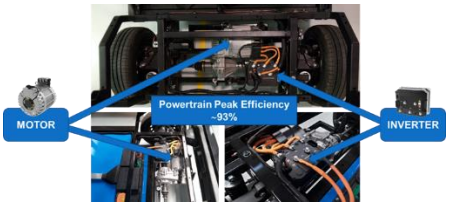

Figure 8: DANA TM4 highly efficient and cost effective medium-voltage (100Vdc) power train integrated in the TELL vehicle

Figure 9: Energy efficency testing of the TELL vehicle on the rolling road at I-FEVS

Figure 10: Testing of the state-of-the-art vehicle dynamics controllers developed by University of Surrey

For more information:

- Visit our project web page: **https://horizon2020-tell.eu/**
- Follow us on our LinkedIn page: **www.linkedin.com/company/eu-project-tell**
- Follow us on Twitter: **@eu_tell**

Lean more about TELL

SYS2WHEEL

SYS2WHEEL is about to finish the 2nd year of the pandemic and it became evident in Spring that some delays could not be recovered anymore. This led the consortium to asking the commission for a prolongation of 9 months, which was excepted. Thus, the SYS2WHEEL project will now last until September 30th, 2022.

Despite all difficulties SYS2WHEEL made good progress in advanced vehicle control – or more precisely advanced torque vectoring and hitch angle control that has been presented at the AEIT online conference 17th-19th November 2021.

The N1-category demonstrator vehicle with integrated in-wheel system and special dampers that allow increased space for cargo and/or battery will be finalized end sent to Spain for independent testing beginning of 2022.

The e-axle for the N2-category vehicle has been assembled in Summer 2021 for integration into the demonstrator vehicle. Tests on this vehicle are foreseen during the summer months of 2022.

Figure 11: The e-axle for the N2-category vehicle

Learn more about SYS2WHEEL.

SELFIE: Prototyping of the battery pack

The project is approaching the completion of its 3rd year of research. One of the upcoming milestones of the project is the finalization of the prototyping of all the components of the battery pack by end of 2021. The manufacturing of the battery housing has been already completed (Figure 1). The walls of the housing consist of a lightweight sandwich structure with foam core and carbon fibre/epoxy face sheets. This

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sandwich structure provides maximum stiffness and excellent thermal insulation properties. All the components will be shipped to IMECAR where the battery pack will be assembled, followed by the integration of the battery pack in the demonstrator vehicle (Fiat Doblo).

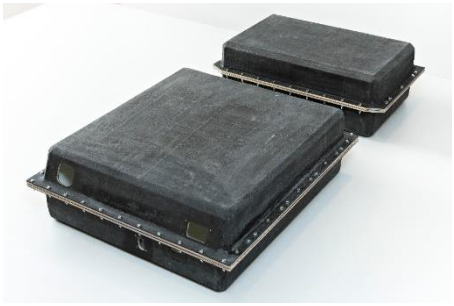

Figure 12: Large and small box of the battery housing

Meanwhile, an experimental setup was designed and developed by VUB to investigate the thermal performance of the battery module at lab level. The initial results show that the developed battery module for SELFIE project application provides efficient thermal management and maintains the battery operating temperature in optimum range as expected. Further experimental results along with numerical simulations are expected to provide deeper insights.

- Read here about "foxBMS": the most advanced open source Battery Management System (BMS) platform developed by Fraunhofer IISB within SELFIE project.

Learn more about SELFIE.

H2020 FITGEN project midterm results

FITGEN aims at developing a functionally integrated e-axle ready for implementation in third generation electric vehicles. It is delivered at TRL and MRL 7 in all its components and demonstrated on an electric vehicle platform designed for the European market (A-segment reference platform). At present (November 2021, project month #35), the e-axle components (i.e. e-motor, inverter, DC/DC converter and transmission) are designed, prototyped and assembled, and are undergoing a testing campaign to characterize the performance KPIs before proceeding with e-axle integration on the demonstrator vehicle (i.e. FIAT 500-electric). Earliest results indicate that the motor is capable of 5.2 kW/kg at 23,000 rpm of maximum rotational speed (27,600 rpm of sustained overspeed), while the inverter is capable of 26 kW/litre, exceeding the initial targets of the project. A picture of the e-axle in reported below.

Figure 13: FITGEN e-axle

Learn more about FITGEN.

EVC1000: EVC1000 presented at SAE and FISITA congresses

EVC 1000 has been up to many dissemination activities in the past few months. One of the most remarkable events was the participation in the common session organised at SAE 2021, the International Congress & Exposition of Automotive Design Engineering where companies and organization of the automotive world meet.

Along with SAE, EVC1000 was also presented at the FISITA world congress, the forum where industry experts, engineers, and executives exchange ideas and discuss the trends that drive the automotive industry forward. EVC1000 was presented in a session co-moderated by Eric Armengaud from AVL and Valentin Ivanov from Automotive Engineering Group at TU Ilmenau, together with Sebastian Gramstat from AUDI AG, Christof Schernus from FEV Group, Aldo Sorniotti from University of Surrey, and Michele De Gennaro from AIT Austrian Institute of Technology GmbH. The topic of the discussion was the outcomes of research programs on innovative components for the next generation of electrified vehicles.

Although EVC1000 is now sailing towards the end of its activities, a new event has already been scheduled for the next spring. Our team is in fact preparing to participate in the next SAE World 2022 congress taking place in April 2022.

Figure 14: H2020 EVC1000 video

Learn more about EVC1000.

CEVOLVER: Investigating a new A-class vehicle in relation to fast-charging

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Despite the continuing corona challenges, CEVOLVER has been progressing towards the implementation phase of the features into the demonstrators. Our last CEVOLVER newsletter and the presentation given by Antonio Sciarretta during the EVOLVE round table at the AEIT conference in last November reflect latest news around the multi-level thermal and energy management strategies. In the last period the concept of the multi-level thermal and management strategy has been provided. The strategies are an integration of high-level planning features (Eco-routing, Range Estimation, Assured Charging) and lower-level control strategies (eco-driving, thermal management and smart fast charging) that work together to achieve energy gains or time gains for long distance travel. How these features integrate into a multi-level optimization have been registered in a functional architecture that comprises of the function blocks with interfaces.

The process of drafting the functional architecture led to the identification of the need for a supervisory feature. This feature is called the Trip Itinerary Planner. The features have been developed for a generic vehicle, which is parametrized based on an electric vehicle with generic characteristics according to descriptions of the demonstrator vehicle used and calibrated accordingly with in-house data. The features have been tested and demonstrated energy and-or time gains for the generic case in simulation. In follow-up, these features will be tailored to the demonstrator vehicles and will be tested for those vehicles specifically. **Read more...**

Figure 15: The CEVOLVER logo

Learn more about CEVOLVER.

E-VOLVE Round Table 2021

The E-VOLVE Cluster organized their 1st Round Table in November 2021, presenting all major technical project results, after welcoming special guests as keynote speakers.

The presentations and videos are available HERE.

Contact us evolvecluster.h2020@gmail.com

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