E-VOLVE
EV for Life, Value, Efficiency

E-VOLVE Cluster Newsletter

May 2022

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 7th Newsletter comes together in a time when projects are close to ending and results are in place.

Another E-VOLVE publication

The E-VOLVE partners once again came together to present their advancements.

H2020 projects ACHILES, EVC1000, FITGEN, SYS2WHEEL, CEVOLVER and MULTI-MOBY worked on and delivered a scientific publication about e-mobility in the context of WCX SAE World Congress Experience.

Figure 1: The E-VOLVE Cluster members innovations

Abstract

E-mobility is a game changer for the automotive domain. It promises significant reduction in terms of complexity and in terms of local emissions. With falling prices and recent technological advances, the second generation of electric vehicles (EVs) that is now in production makes electromobility an affordable and viable option for more and more transport mission (people, freight).

Still, major challenges for large scale deployment remain. They include higher maturity with respect to performance (e.g., range, interaction with the grid), development efficiency (e.g., time-to-market), or production costs. Additionally, an important market transformation currently occurs with the co-development of automated driving functions, connectivity, mobility-as-a-service. New opportunities arise to customize road transportation systems toward application-driven, user-centric smart mobility solutions.

The target of this paper is to provide a consolidated view of several related European research programs having the common goal to develop innovative, brand-independent architectures, components and systems for next generation electrified vehicles optimised for the infrastructure under the umbrella of the E-VOLVE cluster. This regroups the projects ACHILES, SYS2WHEEL, EVC1000 introducing innovative in-wheel motors for different vehicle segments, CEVOLVER introducing optimized concepts for energy and thermal management, and Multi-Moby focusing on the development of safe, efficient and affordable urban electric vehicles.

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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: Almost there!

Six months before the end of the project (November 2022), the integration of Achiles innovations into the AUDI Q2 BEV demonstrator is nearly finalized. The virtual integration of all models into the vehicle simulation

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framework has been completed to enable model calibration and hardware-in-the-loop verification. The powertrain and chassis components have been successfully prototyped and tested and are being physically integrated into the vehicle. The torque vectoring and BMS integration into the novel Centralized Computer Platform (CCP) has been achieved, together with the required interfacing with other subsystems. The focus will now be on finalizing the full vehicle physical integration to enable track testing and performance evaluation of the complete Achiles AUDI Q2 BEV.

Check out our project video to get to know the project objectives: https://www.h2020-achiles.eu/wp-content/uploads/2022/03/achiles_h2020_-__advanced_architectures_chassis_traction_concept_for_future_electric_vehicles-1080p.mp4

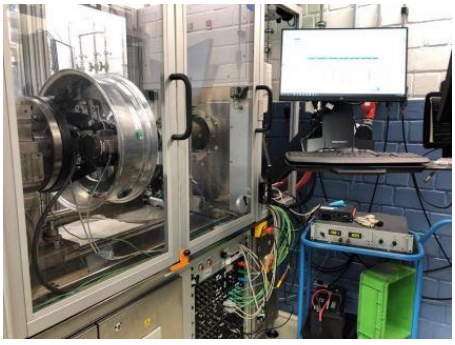

Figure 2: SMP tests

Learn more about ACHILES.

TELL: Ended but still alive!

The TELL project addressed 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 were 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.

By the end of the project in November 2021, 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 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.

Watch our latest video featuring the testing of the newly developed vehicle control features on the TELL demonstrator! https://horizon2020-tell.eu/videos/

Learn more about TELL

SYS2WHEEL

SYS2WHEEL will finalize its activities to build up and test the demonstrator vehicles in N1 and N2 category until end of September 2022.

Figure 3: Fiat Doblo (N1) with in-wheel motors in the front and close-to-wheel damping system ready to be evaluated

Regarding dissemination, SYS2WHEEL submitted one at the 10th Automotive Technologies Congress (OTEKON) in September 2021. Another conference paper for the SAE Conference in 2022 was successfully submitted at the end of year 2021 (Armengaud, E., Brandstätter, B., Bičeк, M., Buh, J. et al., "Towards Brand-Independent Architectures, Components and Systems for Next Generation Electrified Vehicles Optimised for the Infrastructure," SAE Technical Paper 2022-01-0918, 2022, doi:10.4271/2022-01-0918.).

Furthermore, there were 3 conference presentations at both A3PS conferences (Eco-Mobility) in November 2019 and November 2020 and at the #H2020RTR21 (https://youtu.be/7cARirhY1NU). At these conferences, intermediate project results were presented to a broad audience covering research, industry, EU representatives and governmental bodies. They were accompanied by linkedIn postings and individual postings by SYS2WHEEL partners.

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Figure 4: Electrical fully modular e-axle for N2-type vehicle ready to be integrated into the IVECO daily demonstrator

Learn more about SYS2WHEEL.

SELFIE: Towards the finalisation of the battery assembly

SELFIE project is in its 4th year of development and facing a crucial phase of demo vehicle integration in which the developed battery pack assembly and advanced thermal management system are being integrated into the Fiat Doblo demonstrator vehicle.

In details, the smart battery pack and advanced battery thermal system components which are cooling plates for active cooling and PCM packs for passive cooling has been delivered to IMECAR for the assembly. Figure 1 below shows the placement of the battery modules into the small compartment of the battery housing. The most common, economical, and light weight mechanic and electronic components and materials have been selected for the battery system assembly to be able to reach the modular and economic objectives of the project

Figure 5: Small box base part assembly

The cold storage device (CSD) including PCM buffer, refrigerant pump and control strategy will be finalised by end of June.

Learn more about research topics carried out in SELFIE during the last 3 years. You can find the complete list of scientific publications **here**.

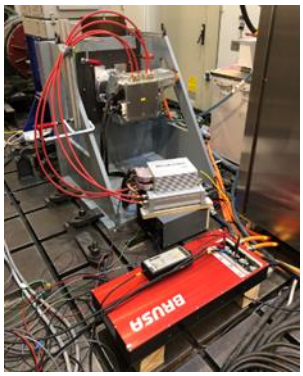
Learn more about SELFIE.

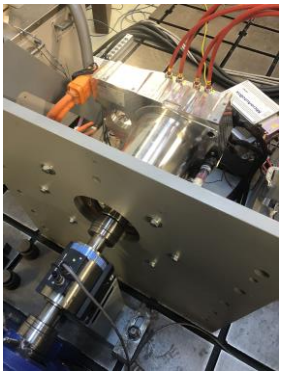
H2020 FITGEN project

In May 2022, FITGEN has less than five months to go until its scheduled end-date (Sept. 2022), and the project is preparing to deliver its consolidated final results. During the second half of 2021 and the first quarter of 2022 the e-axle went through an extensive test campaign at various levels of integration during which the control algorithm has been fine tuned for best stability, maximum efficiency, and fail-safe operation. In April/May 2022 the e-axle has been successfully tested across the following conditions at various operating temperatures:

- WLTP type approval duty cycle.
- US06 type approval duty cycle.
- Real-World #1 (city driving with starts and stops) and Real-World #2 (mixed driving, i.e. city - flat sub-urban - hill climbing suburban - highway) duty cycles.
- Constant speed from 80 to 130 km/h.
- Range tests #1 (WLTP series) and #2 (constant freeway speed at 110 km/h) until an energy consumption of 40 kWh.

In May the e-axle will be shipped to Turin for physical integration in the FIAT 500e platform, concluding the project with a fully functional vehicle demonstrator.





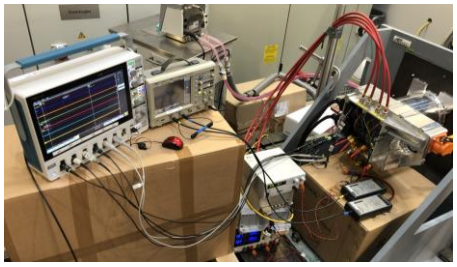


Figure 6, 7, 8: FITGEN testing phase (instrumented e-axle on the AIT test bench, courtesy of FITGEN consortium)

Learn more about FITGEN.

EVC1000 presented at the SAE WCX™ World Congress Experience

06 April 2022: Marius Heydrich and Valentin Ivanov (EVC1000) have presented a talk on the E-VOLVE cluster in a Special Session within the framework of the SAE WCX™ World Congress Experience in Detroit, USA. This event belongs to the most important discussion forums in the automotive community and attracts thousands of visitors every year.

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The talk "Towards brand-independent architectures, components and systems for next generation electrified vehicles optimised for the infrastructure", co-authored by AVL, Virtual Vehicle, Elaphe, University of Surrey, FEV, Vrije Universiteit Brussel, and Technische Universitat Ilmenau, has received very positive feedbacks from the audience and established several links between the cluster and international partners for further cooperation in the area of e-mobility.

The paper based on the talk will be published soon in Open Access on the website of EVC1000 and SAE International.

To follow the cluster's dissemination strategy, the Special Session "Electric Vehicle Drivetrain Dynamics" will be organised next year again in the SAE WCX™ 2023 event: <https://www.sae.org/attend/wcx/call-for-papers>. We are encouraging our community to prepare your submissions and promote your research results together with us.

Figure 9: EVC1000 at the SAE WCX™ World Congress Experience

Learn more about EVC1000.

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

Like other projects CEVOLVER struggled with the COVID-19 situation that affected the progress of the project in 2020-2021. It turned out that we were unable to implement parts of the project in the time frame as laid down in the EC Grant Agreement. To make sure we could fulfil all objectives we requested to extend the project which was granted by the European Commission. Instead of the 42 months duration of the project we now have a 48-month duration. Currently, validation measurements are ongoing on all demonstrator vehicles. More peer-reviewed papers will be published at the CO2 Reduction in Transportation Systems Conference in June and at the TRA2022 in November. With the amended duration, the project will be able to complete all obligations by the end of October 2022.

Figure 10: The CEVOLVER logo

Learn more about CEVOLVER.

Multi-Moby – Passive safety optimisation

In Multi-Moby, in the last few months special attention has been paid to passive safety. Small vehicles are hindered by the reduced space available to absorb the energy in the event of a crash. This disadvantage has two direct consequences: i) the design of the structure is more challenging; and ii) the requirements of the restraint system to protect the occupants are more demanding.

To ensure the safety of the occupants, the Multi-Moby methodology has consisted of an optimisation of the vehicle structure, carried out by I-FEVS and CIDAUT, with three main targets: a) to maintain the integrity of the cabin; b) to ensure that the battery compartment does not suffer relevant deformation; and c) to obtain Occupant Load Criterion (OLC) acceleration values lower than 45 g. After achieving these three targets for different frontal and lateral crash configurations, the following step has been to design a restraint system suitable for the acceleration pulses obtained in the different analysed crash scenarios.

The resultant vehicle structure is based on a tubular solution composed of SHSS (super high strength steels), optimised with advanced virtual modelling (Fig. 1(a)). Several iterations have been used to obtain the most suitable geometry of the structure, and to decide the quality of the high strength steel used in each of the tubular elements. In parallel, for the structure optimisation, stiffness and fatigue criteria have been considered. Subsequently, the structural design of the vehicle has been frozen, and the restraint system has been optimised according to the acceleration pulse (Fig. 1(b)). The design of the restraint system mainly covers the seat belt, airbags, seat, and steering wheel, and the parameters to be optimised are related to the relative position of each item, the capacity of the

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airbags, the number and size of the airbag valves, the airbag time to fire, the seat belt pretensioner characteristics (e.g., the pretensioner load), etc. Also in this case, an iterative optimisation process has been developed and executed to find a balanced solution among all the crash scenarios considered for the design.

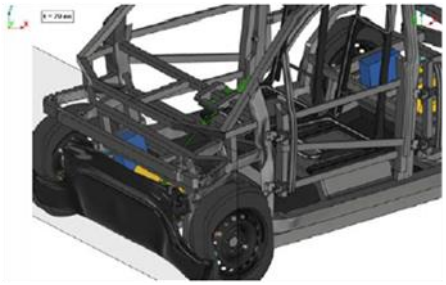

Figure 10: Simulation results of the Multi-Moby vehicle under the R137 crash, after structure optimization

Figure 11: analysis of the restraint system under the R137 crash

Once the virtual design was completed, four vehicle prototypes were manufactured by I-FEVS for crash tests that were performed at the CIDAUT facilities, two of them for frontal (Regulation 94 (R94) and R137), and one of them for lateral (R95) crash tests (Fig. 2). The fourth vehicle was used for fatigue tests. The crash tests have ensured that the three objectives a)-c) were met, i.e., no deformation of cabin and battery compartments occurs, and the maximum OLC in the most critical crash is 42.5 g. In addition, the protection of the occupants has fulfilled all the targets established by the standards. Further tests, such as the critical pole crash test, will be carried out soon.

Figure 12: Crash test aftermaths of three Multi-Moby prototype vehicles, from left to right: R137, R94, and R95

Learn more about MULTI-MOBY

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