E-VOLVE
EV for Life, Value, Efficiency

E-VOLVE Cluster Newsletter

December 2020

2021: Demos, testing & prototyping!

The virtual E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster is realizing and monitoring synergies between seven projects from the GV-01 Horizon 2020 call to execute joint dissemination, exploitation and standardization activities.

The Project Members

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

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

Figure 1: SAE Congress April 13-15, 2021, Detroit

E-VOLVE NEWS

Dissemination of project results takes off!

As E-VOLVE Project members proceed with implementation, more and more opportunities to showcase are available. While COVID-19 harshly interrupted communication activities, a transformation of conferences into virtual form has allowed implementation of communication strategies to move on successfully.

H2020RTR Green Vehicle sessions, AEIT 2020, SAE WORLD CONGRESS 2021, are only a few of the events attended or planned by the Cluster members.

More news, publications, demonstrations and prototypes are soon to come, stay tuned.

PROJECT NEWS

ACHILES: Rapid design and optimisation using low-fidelity models and their control strategies

Within the ACHILES project, low-fidelity models and control strategies have been developed for a generic representation of the Chassis system.

They will be used in the simulation environment to optimize their design and the design of the overall architecture.

An electromechanical brake system model, a parametric model used to describe the overall stiffness of the electro-mechanical brake systems of different clamping classes, developed by Fraunhofer. The model is also scalable to support the design process and to compare and calibrate the model in the overall system context and possibly also with operational data. In addition, low-fidelity models for brake disc, ball screw, planetary gear, ball bearings and electric motor have been developed.

Power electronics subsystems models, developed by Elaphe and VUB, such as Multi-inverter for multi-motors, which comprises two DC/AC inverters that convert the DC voltage from the battery pack to the AC voltage for driving two permanent magnet synchronous motors, DC-DC converter for auxiliary components, used to convert the high DC-link voltage of 400V from

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battery pack to low DC voltage of 12 V and on-board charger for converting the input three-phase AC voltage of 400V from the grid to DC voltage of 210-400 V.

A novel and modular battery system model developed by VUB, based on cell specification and innovative characterization techniques for determining both the electrical and thermal models and the lifetime model.

A vehicle multi body model, developed by TECNALIA, including chassis, steering and suspension and wheels modelling.

A Torque path model, also from TECNALIA, covering from the acceleration pedal interpretation to the torque command for each in-wheel motor after the torque vectoring strategy and taking into account the vehicle dynamics and other constraints coming from e-drive, energy storage system and the MC switch.

Find out more!

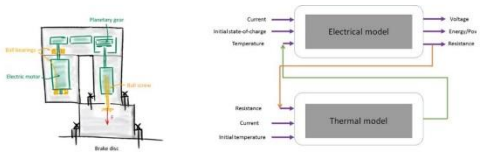

Figure 2: Achiles Break Disc & Schematic of the battery model

ACHILES: ACHILES at the H2020RTR conference

Dr. Thomas Geury, the technical manager of ACHILES has presented the concept and results of the project at the H2020 road transport research results conference on 1 December.
After the presentation a lively discussion took place between the >50 attendees and the representatives of the E-VOLVE cluster projects, SYS2WHEEL and FITGEN, chaired by Christof Schernus, the Coordinator of CEVOLVER.
On the same day, at an earlier session 3 other projects from the E-VOLVE cluster (EVC1000, CEVOLVER, TELL) were also presented and discussed, chaired by Luca Feola, INEA project officer.
If you have missed the conference, you can still look at the recording of the ACHILES presentation here and all other sessions here!
The E-VOLVE cluster is managed by ACHILES and consists of 7 H2020 projects. Find out more about it!

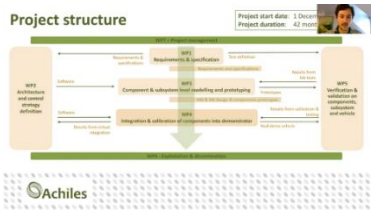

Figure 3: Dr. Thomas Geury presenting ACHILES at H2020RTR

CEVOLVER: Ford Demonstrator Vehicle

Ford's main task in the project is the development of a demonstrator vehicle system through a user-centric approach, selection and rightsizing of components and integration of novel connected control strategies and functionalities. For that purpose, commercial vehicle specific user scenarios and use cases were defined in a first step, considering EU typical boundary conditions as e.g. temperature ranges, velocity profiles, range requirements and charging infrastructure characteristics. Based on this framework, relevant strategies and thermal system components are analyzed and the most promising ones are selected for implementation in the demonstrator base vehicle, which is a Ford Transit Van with battery electric propulsion system.

The resulting effects on the key performance indicators as e.g. energy consumption, range accuracy or travel time are assessed by means of real world driving and testing in a controlled environment. Finally, the selected technologies are also assessed economically by carrying out a Total Cost of Ownership analysis.

Figure 4: Ford Demonstrator Vehicle

News on the status of H2020 EVC1000

The EVC1000 project has been running for more than one year and a half now. After the completion of important components, among which the e-traction axle system leveraging on the latest Elaphe in-wheel motor technology and the electric wheel dual drive (eWD²) by I&M, the consortium focused on finalising the Brembo brake-by-wire, and the Tenneco suspension systems respectively. The former consists in the development of new rear callipers and disc, integrated in the in-wheel motors, plus a pedal feel emulator, and an electro-hydraulic actuator. The latter in the design of two advanced suspensions adapted to the

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demonstrator and able to meet the energy efficiency objectives.

With all the components being currently in the final stage, the next steps will be devoted to their integration in the AUDI and JAC vehicles. This activity will be carried out in work packages 5 and 6 led by TUIL and Elaphe respectively, with the participation of partners among which AVL, Tenneco, Fraunhofer, and the University of Surrey. To finish off, next to the performance assessments and prototype demonstration, control strategies will be also developed.

Figure 5: H2020 EVC1000 video

The EVC1000's objective to create two electric vehicles fitted with the latest component technology in terms of energy efficiency and drivability, which allow for long-distance daily trips of up to 1000km, is now coming to reality. For a comprehensive overview on the project, you can watch the **EVC1000 video**.

H2020 FITGEN project midterm results

The main scope of the FITGEN project is to develop and deliver a functionally integrated e-axle ready for implementation in 3rd generation electric vehicles by exploiting the potential of a portfolio of electric drivetrain technologies and components. Its objectives can be summarised as follows:

- integrating the electric/electronic architecture (incl. high voltage) and control systems for the 3rd-generation electrified vehicles powertrains;
- developing smart bus systems, electric motors, and power electronics enabling smaller form factors when integrated in batteries and motors;
- establishing modular and flexible charging functionalities optimised for infrastructure capabilities of variable power, up to super-fast charging;
- designing a novel integrated cooling concept, to maximise energy efficiency.

FITGEN has reached in June 2020 its midterm status, delivering many of the expected results, did not facilitate the work. These results show that:

- FITGEN motor power density is expected to exceed the initial target of 5.0 kW/kg by 4%, realising 5.2 kW/kg and 24.5 kW/l;
- FITGEN motor speed is expected to exceed the initial target of 18,000 rpm by 28%, realising 23,000 rpm of max. speed;
- FITGEN inverter power density is expected to exceed the initial target of 25 kW/l by 5%, realizing 26.3 kW/l.

Here the CAD model of the FITGEN e-axle (from left to right: inverter box, motor housing and transmission, with mechanical links to the drive shaft and to the vehicle chassis):

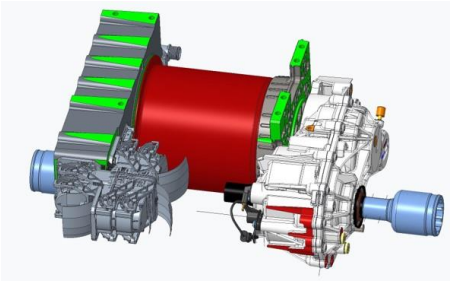

Figure 6: CAD model of the FITGEN e-axle

SELFIE: Second year results and outlook for 2021

During the 2nd year of the project (December 2019 – November 2020), SELFIE project focused on the final design and engineering of the battery housing which provides heat storage, excellent heating and cooling capability as well as a strong mechanical support for the battery cells. The battery housing consists of two compartments comprising together 18 battery modules (30 cells each, Fig.1). Furthermore, each compartment is equipped with a) cooling plates between the modules and in thermal contact with the aluminium foam/PCM plates to remove the heat from the battery pack; b) PCM heat buffer underneath the modules to absorb the heat generated during fast charge cycles in order to avoid an energy-consuming high power cooling system. The battery pack design was validated by simulation models in terms of functional performances, weight and volume reductions.

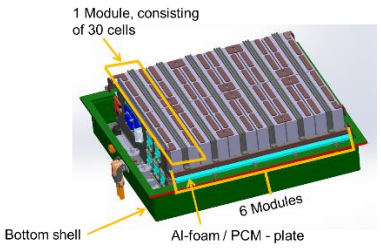

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Figure 7: Picture of the large compartment of the battery housing

Additionally, the design of the 1st group of components belonging to the Battery Thermal management (BTM) system was finalised. You can find more information in the Report "1st set of prototypes" (D3.2).

The plan for 2021 is quite ambitious and it will focus on a) prototyping of the different components and assembly of the battery system; b) optimisation of system thermal strategies and hardware test-bench development; c) complementary testing of the baseline vehicle & integration.

Although the COVID-19 pandemic is causing cancellations of physical events, SELFIE partners are disseminating the project results via website, social media channels and publications in scientific conferences and journals.

SYS2WHEEL enters 2nd part of implementation

The SYS2WHEEL project has entered now the second half of the project and three of the most important technologies have been developed: the efficient e-axle (Figure 8) has been designed and virtually verified.

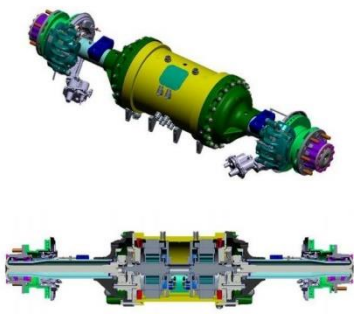

Figure 8: E-Axle for the IVECO 7t MCV demonstrator vehicle

Currently, the e-axle system is assembled and will be shipped to IVECO at the beginning of 2021. Then it will be installed in the rear axle of the IVECO 7t MCV demonstrator vehicle and tested. The second technology, which is also ready for the installation in the second demonstrator vehicle (Fiat Doblo) is the in-wheel motor system (Figure 9). It has been adapted for the requirements of the Fiat Doblo and will be installed in the front-axle. The third technology is the in-wheel suspension, which will be installed on the rear axle of the Fiat Doblo. Both the in-wheel motors and the in-wheel suspension save space due to their compact design focused on the wheel area. The additional space can be used for additional cargo space, which is an important factor for commercial vehicles. The second possibility would be to increase the size of battery, which would increase the driving range.

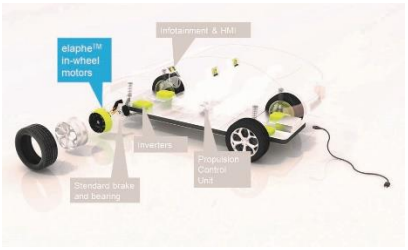

Figure 9: In-wheel system for the Fiat Doblo demonstrator vehicle

The next important steps in the project will be the installation of the mentioned technologies in the two demonstrator vehicles followed by a thorough vehicle testing. Further, dissemination and exploitation activities will be intensified.

TELL Project: optimisation and large-scale manufacturing of low and medium voltage electric powertrain solutions

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.

Since October 2020, Herbert Pairitsch, who has a long experience in the semiconductor industry, and is also a successful leader in funded projects, took over the coordination of the TELL project.

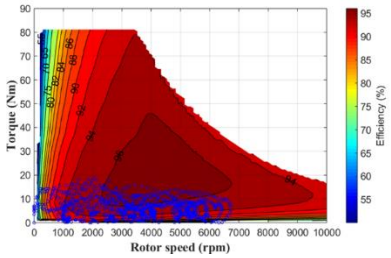

Figure 10: Example of efficiency map resulted from a motor optimization over WLTP Class 2 driving cycle. 4WD vehicle demonstrator case.

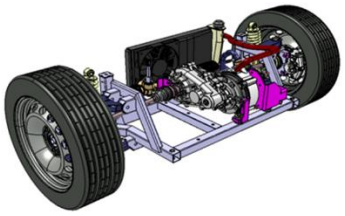

Figure 11: Finalised design of the 2WD vehicle demonstrator powertrain incorporated in the TELL demonstrator chassis

Some of the achievements, were presented in December at the RTR 2020 virtual conference organised by the European Commission,

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with extremely positive feedback from the audience and from the Commission itself.

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

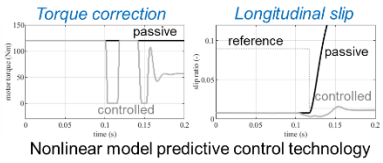

Figure 11: Simulation results for the newly developed NMPC traction controller, while driving an icy patch.

Figure 12: Great success for TELL at the RTR2020 conference in December

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