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Research of unconventional drives and their components at the University Science Park of the University of Žilina

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Abstract

The article deals with the design of the Energy Usage Assist for the experimental electric vehicle Edison. The new testing facility of the University Science Park of the University of Žilina UVP MAHA is presented. The UVP MAHA facility allows testing vehicles with unconventional propulsion on the roller dynamometer MAHA MSR 1050. The main part of the article is about proposal of intelligent Energy Usage Assist. The Energy Usage Assist communicate with the driver by visual and acoustic method in order to optimize driving style to minimize energy consumption. There are presented first results of measurements which are necessary for the Energy Usage Assist designing.

Keywords: Energy, assist, electric vehicle, roller dynamometer

Introduction

Electrification of the automobile transportation will change character of the energy industry in the future. World's research is focused on the cost reducing of electricity production. Development of new materials is a very important task which helps reduce power consumption and improve the electrical and mechanical parameters of machinery and equipment.

There are no complex research institutes in the field of electromobility in Slovakia and in many EU countries. Support for organizations which develop systems and components for this research area is missing. University Science Park of the University of Zilina was opened in December 2015. The aim of the research facility is to create a functional system for the transfer of research and development into practice and improve the quality of life through technological innovation.

The aim of this research is energy flow optimization and minimizing losses through the construction of intelligent test and diagnostic system for unconventional drive vehicles and their components is

Testing facility UVP MAHA

Testing facility for measuring power flow of the electric and hybrid vehicles with roller dynamometer MAHA MSR 1050 enables comprehensive implementation of research activities in the field of unconventional vehicle powertrains.

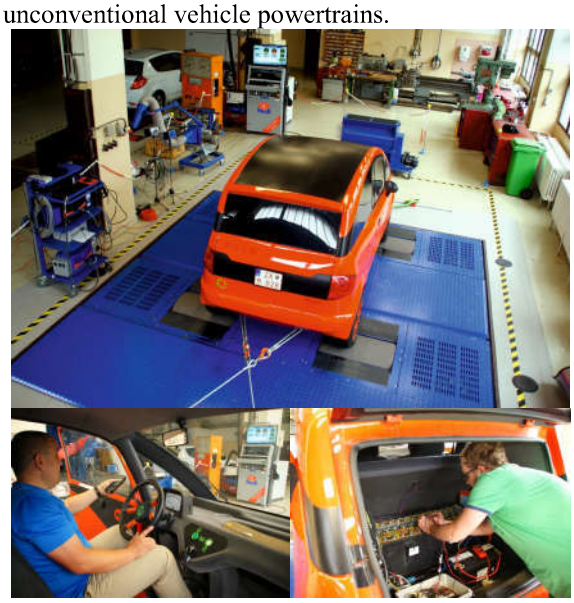

Figure 1 Testing facility UVP MAHA

It enables cooperation on development activities of organizations forming part of the platform of e-mobility, collaboration in the creation of legislative changes and it enables comprehensive testing of electric and unconventional vehicles:

- Testing of drive, electrical and mechanical properties of electric and hybrid vehicles,

- power flow measurement of electric and hybrid vehicles on the roller dynamometer MAHA MSR 1050 which is designated for measuring electric and hybrid vehicles,
- parameters influencing range and possibilities of energy recuperation testing with using its own experimental electric vehicle EDISON with programmable controller and battery management system for 25 lithium battery cells.

Research activity – Electric vehicle Energy Usage Assist

Range of electric vehicles has long been considered a major barrier in acceptance of electric mobility [1] due to electric vehicles having a significantly shorter range than conventional vehicles. Complex technology of Energy Usage Assist is used in modern electric vehicles to reduce energy consumption and simultaneously increasing range. The role of the intelligent Energy Usage Assist is audiovisual communication with the driver in order to optimize the driving style and minimize energy consumption.

Energy consumption monitoring in an electric vehicle

Energy consumption monitoring of an electric vehicle can be divided into three groups of indicators.

- engineering indicators - the most important negative indicator is weight which can be adjusted during the vehicle design,
- operational indicators - partly influenced by the driver. For example if an intelligent system helps to driver with the choice of optimal route in heavy city traffic. Further it is the impact of climatic conditions and the environment character [2], [3]
- driver impact – to the vehicle range and recommendations:
  - driving style (minimizing unnecessary braking and acceleration, which are the most critical in terms of consumption, smooth driving, suitable distance behind the vehicle, using recuperation and coasting),
  - preparing vehicle for drive (removing useless load-weight, tire pressure monitoring, care of the technical condition, itinerary of charging stations),
  - usage of electrical equipment in the vehicle (smart use of air conditioning, heating and other electrical devices) [4].

Basic tasks for Energy Usage Assist

One of the possibilities of how to influence the driving style is a system which gives driver the information on how to behave in order to reduce energy consumption. At the same time, it is necessary to define the basic conditions for effective optimization:

- driving style control with subsequent control of electric energy conversion into traction, control of all appliances in the vehicle, including the possibility of an independent shutdown of comfort functions,
- weather conditions monitoring,
- network control: battery state of charge - nearby charging station - using of a range-extender.

Energy Usage Assist proposal for Edison

The proposed Energy Usage Assist system will be applied into the experimental electric vehicle EDISON in several stages. The first two stages of development are:

- Phase 1 of energy assist development is focused on acceleration,
- Phase 2 is focused on deceleration with regard to using coasting and energy recuperation.

In the first phase the system will inform the driver if he is currently in the most efficient mode during acceleration – Highest Efficiency Mode.

If we assume that the driver needs to accelerate from an intersection in the city. System will use GPS position to evaluate the end speed during acceleration to 50 km/h. Based on powertrain efficiency map the system will inform driver by graphic indication on the dashboard which smooth acceleration mode he should choose (quick or slow). This will help the driver to achieve the optimal mode.

Fig.1 shows the efficiency map of experimental vehicle Edison depending on the vehicle speed and load. It is the overall efficiency, which takes into account the efficiency of the electric and mechanical losses.

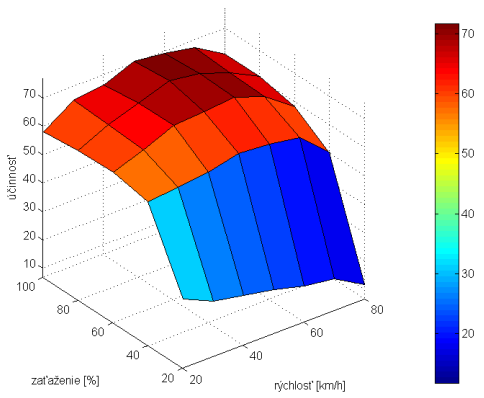

Figure 2 Edison overall efficiency map

The overall efficiency map was created on the basis of measurements on the test facility University Science Park of the University of Žilina, on the roller dynamometer MAHA MSR 1050.

Conclusion

The proposal of Energy Usage Assist for an electric vehicle driver is just one of the research projects of the test facility UVP MAHA. The tasks are focused on the area of energy flow control, security and communication systems, recharge energy and parameter testing of electric drives, energy flow measurements of electric and hybrid vehicles.

New knowledge gained from the field of unconventional propulsion vehicle usage and their components is presented by the facility to the international scientific community. This also includes the popularization of science in the field.

Acknowledgements

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