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Editorial

Electrified Powertrains for a Sustainable Mobility: Topologies, Design and Integrated Energy Management Strategies

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The Special Issue "Electrified Powertrains for a Sustainable Mobility: Topologies, Design and Integrated Energy Management Strategies" has been proposed with the main objective of contributing to the sustainable mobility agenda through enhanced scientific and multi-disciplinary topics, aimed at addressing concerns and real possibilities in the achievement of a greener mobility. It was therefore conceived to provide an interesting overview on new needs and investigation topics required for future developments.

In total, five articles, of which four research papers, and one review, have been submitted to the Special Issue covering a wide variety of topics within the proposed subject.

T. Donateo and A. Ficarella [1] have addressed the topic of urban air mobility with particular reference to air-taxi service. They propose a methodology for the design and energy analysis of conventional, hybrid-electric, and full-electric power systems for such application. The novelty of the paper with respect to the state of the art lies in the detailed modeling approach of the powertrains, the evaluation of CO2 emissions with a well-to-wing approach as a function of the electricity emission intensity factor and the comparison with road vehicles performing the same route in different driving conditions. The results demonstrate the advantages of an all-electric air-taxi with respect to a hybrid electric road taxi.

S. Lombardi et al [2] have tried to tackle the problem of reducing the energy consumption of the cooling circuit for the propulsion system of an all-electric road vehicle through two different approaches: optimization of the control strategy and improvement of the powertrain efficiency. In the first approach, a control strategy to reduce the auxiliary loads of the fan and the pump has been developed and compared with the conventional approach, where the pump and the fan are controlled with a thermostat, while in the second approach a single-motor powertrain has been replaced by smaller traction modules whose powers sum up to the total power of the original powertrain. The study has shown that increasing the powertrain efficiency leads up to a 54% reduction of energy consumption (but only if the cooling circuit is stressed enough and the fan is activated during the vehicle operation). While the optimization of the control strategy can lead up to a 27% energy consumption reduction if normally the cooling circuit is capable of lowering the coolant temperature without the intervention of the fan.

I. Komorska et al. [3] have proposed an algorithm which, by means of the segmentation and iterative synthesis procedures of Markov chains, returns an adaptive energy-efficient driving cycle for a road vehicle under a given route. Moreover, a Gaussian process regression is employed to monitor energy consumption during driving, so as to correct adaptively speed and acceleration in order to maintain the planned energy consumption. An autopilot driving cycle was verified in the study, and results showed that the energy consumption was reduced by approximately 15%, at the cost of increasing travel time by approximately 10%.

Q. Bi et al. [4] worked on a similar topic, but applied to cable shovels for robotic excavation. In particular, a two-phase multi-objective genetic algorithm was established for optimal digging trajectory planning for achieving effective and energy-saving operation.

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The results of the optimization under different digging conditions indicated that the digging time could be decreased from an average of 20 s to 10 s, and the energy consumption per payload could be reduced by 13.28%.

Finally, D. Beltrami et al. [5] have proposed a detailed overview on the state of the art and future trends in the electrification of compact off-highway vehicles, which can be an excellent application for boosting the electrification process, mainly because they are usually more suited for zero-emission tasks, while development costs can be more easily minimized. The paper has allowed for the highlighting of the key differences between on-highway and off-highway vehicles and provides a comprehensive summary of information on the multiple solutions investigated by researchers and currently implemented by manufacturers.

Even if the theme of sustainable mobility is very wide and still entails a lot of work, we believe that this Special Issue can give a small and yet important contribution to stimulate the debate between industry and academic researchers, thanks to the variegated topics of the received articles that cover important aspects related to the full spectrum of sustainable mobility, spanning from air mobility to off-road vehicles.

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