Editorial

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Biographical notes: Ji Li is an Assistant Professor and the Deputy Head of CASE Automotive Group, and a manager of Birmingham CASE Automotive Research and Education Centre. He has awarded in PhD in Mechanical

Engineering in 2020 at the University of Birmingham. His research vision centralises on the critical role of artificial intelligence in shaping the future of automotive technology. He has authored over 30 peer-rereferred journal papers which the focus covers three key domains: multi-objective control, human-machine interaction, and cyber-physical systems, all oriented toward achieving net-zero and trustworthy engineering solutions.

Mingming Liu is an Assistant Professor in the School of Electronic Engineering at Dublin City University. He is also a Funded Investigator with the SFI Insight Centre for Data Analytics. He graduated with his BEng (1st Hons) in Electronic Engineering from the NUI Maynooth in 2011 and his PhD in Control Engineering from the Hamilton Institute at the same university in 2015. He is an IEEE senior member and has published over 50 papers to date including several top-tier IEEE journals. His research interests include control, optimisation, and machine learning with applications to electric vehicles and smart transportation.

Yang Xing received his PhD from the Cranfield University in July 2018. Before joining Cranfield University in 2021, he worked as a research associate with the Department of Computer Science at the University of Oxford from 2020 to 2021, and a research fellow with the Department of Mechanical and Aerospace Engineering, at Nanyang Technological University from 2019 to 2020.His research interest focusses on applied artificial intelligence, deep learning, computer vision, human-autonomy collaboration, and autonomous vehicles, where he has contributed two books and over 80 papers on high-quality peer-review journals and conferences.

Yanfei Li received his BEng in Power Machinery from the Jilin University, Changchun, China, in 2006 and PhD in Mechanical Engineering from the University of Birmingham, Birmingham, United Kingdom in 2012. He is currently a Research Scientist at the State Key Laboratory of Automotive Safety and Energy, Tsinghua University, Beijing, China. His research interests include two-phase flow, emissions and intelligent control for HEVs.

Quan Zhou received his PhD from the University of Birmingham in December 2019. He was appointed Professor of Automotive Engineering at the Tongji University in 2023. Before joining Tongji, he was a research fellow and an Assistant Professor with the School of Engineering at the University of Birmingham. His expertise area is automotive engineering with concerns about artificial intelligent methods for vehicle design and control. He is committee member of the SAE Hybrid and Electric Vehicle Committee and an associate editor of *IEEE Transactions on Transportation Electrification* and *IET Intelligent Transport System*. He contributed one book and over 100 research papers in high-quality journals and conferences.

Zero-emission road vehicles, propelled by innovations in electric and hybrid technologies, stand at the forefront of efforts to mitigate climate change by reducing transportation's carbon footprint.

Electric vehicles (EVs), encompassing battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and fuel cell electric vehicles (FCEVs), stand at the forefront of the automotive industry's shift towards sustainable transportation. These vehicles are pivotal in achieving the ambitious net zero emission target within the transport sector, addressing environmental concerns and reducing dependency on fossil fuels. Hybrid and plug-in hybrid vehicles, in particular, play a critical role in bridging the gap between conventional internal combustion engine vehicles and fully electric models. They serve as essential steppingstones by providing the necessary technical reserve and facilitating market expansion for renewable vehicles. To enhance the energy efficiency and dynamic performance of electrified powertrain systems, there is a pressing need for sophisticated modelling, control, and optimisation methods. These methods are crucial for developing advanced vehicle architecture and driving assistance technologies, ensuring that EVs meet the high standards of performance and reliability demanded by consumers. This special call seeks to gather tutorials and critical reviews on cutting-edge technologies that enable zero-emission road transportation. Contributions are invited across a broad spectrum, including fundamental research, practical applications, and comprehensive reviews. The goal is to broaden the knowledge base and foster collaboration among researchers and professionals from both academia and industry, further propelling the EV market towards sustainability and innovation.

This special issue includes five high-quality papers, which cover a wide range of on enabling technologies for zero-emission road vehicles: from the modelling and design for modern hybrid engines to the optimisation of energy management systems and energy consumption prediction systems of hybrid electric vehicles (HEVs). These enabling technologies to have proven to own valuable potential to improve the efficiency for saving fuel and reducing emissions.

For the modern engines, the injector nozzle is proven as one of the most important factors to influence the fuel economy and emissions. The paper by S.D. Rasika Perera provide a comprehensive comparison among the different injector sets. The different injector sets were brand new and from an engine of a vehicle that has done 40,000 km, 81,000 km, and 120,000 km. The investigation revealed that as the injector nozzle gets older, the spray cone angle gets reduced and the break-up length increases. Both the reduction of spray cone angle and increased break-up length can be attributed to poor atomisation quality. When the engine is running on old injectors, the fuel economy decreases and harmful emissions increase.

Opposed piston two-stroke (OP2S) diesel engines are emerging as a promising alternative to traditional four-stroke diesels, offering potential benefits in emissions reduction and enhanced efficiency. The success of these advantages heavily depends on the airpath configuration, which dictates OP2S engines' scavenging processes and internal mixture formation through the management of intake and exhaust pressures, with significant pumping efforts occurring outside the engine cylinder. The paper by Erik Vorwerk et al. employs 1D simulations and a baseline model verified through experiments to assess how airpath designs impact the steady-state performance of a dual-cylinder OP2S engine. Initially, a variety of airpath setups are explored, including traditional, electrified, and innovative compression and expansion mechanisms, alongside several scavenging controllers, culminating in four feasible designs. These configurations are evaluated over their operational spectrums, complemented by a sensitivity analysis on the efficiency of different airpath components. The findings indicate that the optimal configuration features an electrically boosted turbocharger equipped with a variable geometry turbine.

The paper by Chengqing Wen et al. introduces a novel data-driven methodology for predicting thermal efficiency (TE) in hybrid engines, leveraging an advanced multi-network architecture to enhance prediction precision. This architecture innovatively segments input data, mitigating data representation nonlinearity across each segment, thereby facilitating more effective sub-network training. Within this framework, the grey wolf optimisation (GWO) algorithm is employed to determine segmentation breakpoints, creating an optimised multi-network configuration. The multilayer perceptron (MLP), chosen for its straightforward design featuring two hidden layers, serves as the foundational network model. Experimental data validation reveals that incorporating GWO into the multi-network model boosts prediction accuracy from 82% to 89%. Furthermore, GWO achieves optimal solutions in merely 21 iterations, outperforming particle swarm optimisation's 26 iterations and the gravitational search algorithm's 31 iterations, highlighting GWO's superior efficacy in this application.

Current drones have an average operational battery life limited to approximately 30 minutes, presenting challenges for extended applications like continuous delivery services and security surveillance. With the transport sector accounting for 93% of carbon emissions, optimising UAV energy use is imperative for achieving future large-scale, net-zero air traffic goals. The paper by Ziyue Wang and Yang Xing introduces a model based on reinforcement learning (RL) to enhance drones' energy efficiency. The RL framework adaptively adjusts the drone's control mechanisms to improve energy savings, taking into account the mission's goals, environmental conditions, and overall system efficacy. Utilising RL, the model develops an optimally adjusted control system for drones, enabling them to choose the most energy-efficient pathways. The findings suggest that, compared to their untrained counterparts, drones trained with this RL model can achieve energy savings ranging from 50.1% to 91.6% by navigating the same routes, underlining the significant potential of RL in drone energy management.

Optimising energy management in HEVs is essential for boosting fuel efficiency and cutting emissions. Despite the complexity involved in their development and deployment, basic energy management algorithms like rule-based (RB) strategies and equivalent consumption minimisation strategy (ECMS) are commonly utilised in commercial vehicles. The paper by Daofei Li et al. introduces a bi-level hybrid model predictive control (bi-HMPC) algorithm designed to enhance the fuel economy of HEVs, using a P2 hybrid powertrain passenger vehicle as a case study. The algorithm operates on two levels: the first uses a linear time-varying model predictive control (LTV-MPC) to determine optimal engine and motor torque distribution, and the second adjusts gear ratios using hybrid MPC (HMPC). Initial simulations indicate that bi-HMPC surpasses ECMS in fuel savings, showing its viability for real-world use. To address the challenges in actual vehicle implementation, the LTV-MPC for torque distribution was tested in real vehicles via dynamometer trials. Initial tests revealed a high fuel consumption rate of 7.05 L/100 km and elevated emissions. However, after applying several expert-RB optimisations, such as refining engine start conditions, fuel consumption was reduced to 6.2 L/100 km. The real-vehicle experiments demonstrate that the LTV-MPC algorithm supports real-time HEV operation, significantly enhancing fuel efficiency and lowering emissions.

We truly appreciate the great effort from all authors who had submitted papers to this special issue and, more importantly, the timely reviews from guest associate editors and reviewers, especially at this unprecedented time of challenge. We are also very thankful to Dr. Xubin Song, the Editor-in-Chief, for initiating this special issue, providing the opportunity to organise it, and for his tremendous support during the whole process. We also would like to express our deep gratitude to the IJPT staff for their swift support that eventually made this happen. We hope this special issue will provide powertrain professionals with a glance at the research of the enabling technologies for zero-emission road vehicles and help attract more readers, particularly vehicle technology researchers, to the journal.