Cutting-Edge Technologies on Automotive and Mobility Applied in Beijing 2022 Winter Olympics

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Electric vehicles (EVs) and intelligent and connected vehicles (ICVs) are promising solutions for a more sustainable environment and safer transportation. For better performance, EVs and ICVs need to address issues in special conditions, such as extremely cold weather, complex routes, and mixed traffic scenarios, where hazards associated with batteries, propulsion systems, and other automotive technologies could pose risks to vehicles.

Extremely low temperatures can affect the thermal management and battery performance of electric and fuel cell vehicles, causing problems like start failure, reduced driving range, and ineffective heating. When dealing with complex traffic conditions, propulsion system could suffer from insufficient torque and interrupted traction. Meanwhile, the mixed traffic scenarios, harsh weather, and lighting conditions all challenge the safety of autonomous driving.

To address such problems, multiple solutions are proposed, including fast battery heating system, non-interruption propulsion system, high-efficiency thermal management system, crowdsourced HD maps for ICVs, low-cost positioning, and decision-making under uncertain environments.

The solutions mentioned above are applied to the vehicles for the Beijing 2022 Winter Olympics to deal with the low temperature and complicated roads on the event venue. These vehicles, while enabling zero emission, ensure high comfort and great dynamic performances. Fleets of autonomous vehicles minimize the need for human drivers and make transportation within the park safer and more efficient.

This feature topic collects four papers presenting the state-of-the-art vehicle technologies to be applied in the Beijing 2022 Winter Olympics. It aims to reflect the latest progress on EVs and ICVs and give readers a clear picture of the advances that are to come.

Paper Highlight

1. The paper “Heating Lithium-Ion Batteries at Low Temperatures for Onboard Applications: Recent Progress, Challenges and Prospects” systemically reviews the existing heating methods and quantitatively summarizes their heating performance and onboard application potential. It helps to address the problems of start failure and significantly reduced the driving range of electric vehicles under extremely low temperatures.
2. The paper “Collaborative Control of Novel Uninterrupted Propulsion System for All-Climate Electric Vehicles” proposes a DMCP system for all-climate operations. Meanwhile, a collaborative control strategy consisting of the collaborative gearshift and collaborative power distribution is also introduced for the system. The proposed system can meet the operating requirements of the Beijing 2022 Winter Olympics such as high speed and adaptability to mountainous roads under severely cold environments.
3. The paper “Magnetic Coupler Robust Optimization Design for Electric Vehicle Wireless Charger Based on Improved Simulated Annealing Algorithm” presents a new type of magnetic coupler with increased misalignment tolerance optimized by an improved simulated annealing algorithm. This technology helps to realize the high-power wireless charging for the L4 autonomous trucks and buses in the Beijing 2022 Winter Olympics.
4. The paper “Crowdsourced Road Semantics Mapping Based on Pixel-Wise Confidence Level” proposes a new method to create a highly detailed high-definition map using multi-vehicle sensor data based on pixel-wise confidence level, and it implements a crowdsourced point-

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based visual SLAM to align and combine multiple local maps derived by each vehicle, which plays an important role in ICVs.

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Guest Editors

Cheng Lin received a Ph.D. degree from the School of Mechanical Engineering, Beijing Institute of Technology, China, in 2002. He is currently a professor at the School of Mechanical Engineering, Beijing Institute of Technology. For a long time, he has carried out fruitful and internationally influential creative work in the powertrain system of electric vehicles. He has published more than 100 academic papers, filed over 80 granted patents, won many scientific research awards at the national, provincial, and ministerial levels, and led a number of national projects. The high-performance all-climate powertrain system solution proposed by him will be used in electric buses for the Beijing 2022 Winter Olympics.

Diange Yang received his Ph.D. in Automotive Engineering from Tsinghua University in 2001. He is now a professor at the School of Vehicle and Mobility at Tsinghua University. He currently serves as the director of the Tsinghua University Development & Planning Division. His research interests include autonomous driving, environment perception, and HD map. He has more than 180 technical publications and 100 patents.

He received the National Technology Invention Award and Science and Technology Progress Award in 2010, 2013, 2018, and the Special Prize for Progress in Science and Technology of China Automobile Industry in 2019. He is the executive member of the China Society of Automotive Engineers (CSAE) council and the board member of the Journal of Intelligent Connected Vehicles and Automotive Innovation. In addition, he once worked as the guest editor for Engineering, Transport Research Part C, et al.