Editorial

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Biographical notes: Nan Xu received his PhD in vehicle engineering from Jilin University in 2012. He is currently an Associate Professor with the State Key Laboratory of Automotive Simulation and Control, Jilin University of China. In 2019, he was a Visiting Scholar with the Department of Mechanical and Mechatronics Engineering, University of Waterloo. His current research focuses on tyre dynamics and control, intelligent tyre, vehicle state estimation, and dynamics and stability control of electric vehicles and autonomous vehicles.

Hong Chen received her BS and MS in Process Control from Zhejiang University, Zhejiang, China, in 1983 and 1986, respectively, and her PhD in System Dynamics and Control Engineering from the University of Stuttgart, Stuttgart, Germany, in 1997. In 1986, she joined Jilin University of Technology, Changchun, China. From 1993 to 1997, she was a wissenschaftlicher Mitarbeiter at the Institut fuer Systemdynamik und Regelungstechnik, University of Stuttgart. Since 1999, she has been a Professor with Jilin University and hereafter a Tang Aoqing Professor. From 2015 to 2019, she served as the Director of the State Key Laboratory of Automotive Simulation and Control. Recently, she joins Tongji University as a

distinguished professor. Her current research interests include model predictive control, nonlinear control and applications in mechatronic systems focusing on automotive systems.

Aldo Sorniotti received his MSc in Mechanical Engineering and PhD in Applied Mechanics from the Politecnico di Torino, Turin, Italy, in 2001 and 2005, respectively. He is a Professor in advanced vehicle engineering with the University of Surrey, Guildford, UK, where he coordinates the Centre for Automotive Engineering. His research interests include vehicle dynamics control for electric vehicles with multiple powertrains and chassis actuators, novel stability control paradigms for connected and automated vehicles, and transmission systems for electric and hybrid electric vehicles.

Yanjun Huang is a Professor at the School of Automotive Studies of Tongji University. He received his PhD from the University of Waterloo in 2016. His research interest is mainly on the vehicle holistic control in terms of safety, energy-saving, and intelligence, including vehicle dynamics and control, HEV/EV optimisation and control, motion planning and control of connected and autonomous vehicles, and human-machine cooperative driving. He has published several books and over 80 papers in journals and conference. He is the recipient of IEEE Vehicular Technology Society 2019 Best Land Transportation Paper Award, the 2018 Best paper of Automotive Innovation, and top 10 most popular paper in *International Journal of Automotive Technology*. He is serving as Associate Editor and Editorial Board Member of *IET Intelligent Transport System*, *SAE International Journal of Commercial Vehicles* and *International Journal of Vehicle Autonomous Systems*, among many others.

1 Background and objectives of the special issue

In recent years, modern vehicles such as electrified vehicles and autonomous vehicles have already seen remarkable improvements. However, vehicle dynamics and control (VDC) as the basis of the vehicle engineering still requires more attention, especially in extreme driving conditions. The operational properties of the road vehicle are the result of the dynamic interaction of the various components of the vehicle structure, also including modern control elements. Vehicle dynamics are fundamental for vehicle handling, ride and safety. The study of classical vehicle dynamics in the past century focused on modelling, analysis, and optimisation of dynamic systems. With merits of efficiency, safety and comfort, the automated vehicle (also called unmanned ground vehicle (UGV)) is considered as the direction of future vehicle development. The recent advancements in sensing, communication, computation, and actuator technologies provide great potential for improvement of vehicle dynamics performance. However, great challenges also exist with increasing numbers of sensors and actuators, heavy networking, and growth of control systems: suspensions, ABS, ESC, braking distribution, active steering, tyre pressure, TCS, etc. It is complex to make the sub-systems collaborate towards the same goals, according to the vehicle situation. In addition, vehicle dynamics should be taken into consideration not only while controlling the vehicle state, but also at the motion planning and decision making phase.

Thus, these new features of vehicles require us to revisit the vehicle dynamics and control problems. What will happen when new modern vehicles meet traditional vehicle

dynamics and control theory? On one hand we have the questions of whether and how the modern technologies (e.g. autonomous driving, distributed driving and connected technology) can help the vehicle dynamics and control to significantly improve vehicle performance; on the other hand, there are questions of how vehicle dynamics and can contribute to the design of the aforementioned technologies to find more feasible solutions.

To address these trends in the automobile industry, the objective of this special issue is to solicit recent research and development mainly but not exclusively on vehicle dynamics and control in the context of electrified, autonomous vehicles, and intelligent transport system to enhance driving safety, energy efficiency, and environmental effects. The special issue is co-edited by experienced researchers of vehicle dynamics control domains based in China, the UK and Canada. The guest editors expect it to attract interest from multi-disciplinary sectors in the automotive fields, thus contributing to a more advanced VDC field.

2 Submissions overview

The Guest Editors have invited authors from different sectors and have collected manuscripts outlining several relevant and interesting application examples. These papers are envisioned to provide the reader with an overview of the current developments in vehicle dynamics and control and give insights into future research topics. In the work by Liang et al., a robust output-feedback guaranteed-cost control strategy for the path following control of autonomous vehicles is discussed, which considers the uncertainties of tyre cornering stiffness. Zhang et al. in their paper propose a four-wheel independent steering finite time control method based on the theory of heterogeneous multiagent, in order to improve the active safety and yaw stability of the distributed drive electric vehicle. The stability control for delta three-wheeled vehicles is discussed by Licea in his paper, where new tractable models are presented to detect and mitigate the risk of rollover and skidding, and a robust lateral and longitudinal stability control (LLSC) is proposed. The vehicle sideslip angle (VSA) estimation is vital to vehicle lateral safety control. Xia et al. highlight the advantages of a VSA estimation method based on fusing the vehicle dynamics and kinematics. A novel cooperative collision warning system based on trajectory prediction and conflict risk evaluation is proposed by Zhang et al. in their paper to reduce traffic accidents and fully guarantee driving safety at intersections. Considering the needs of automatic charging systems for electric vehicles, a priori map-based automated valet parking (AVP) system with accurate adjustment ability is proposed by Wang et al. Also, for the distributed drive electric vehicle, Li et al. propose an adaptive second-order sliding mode control (ASOSM) method based on a super-twist sideslip observer (SMO) to improve the lateral stability of the in-wheel-motor (IWM) electric vehicle. By considering the road gradient and bank angle information in off-road conditions, a local trajectory planning method and a double-layer tracking controller are designed by Li et al. Starting from comfort evaluation during curve movement, Liu et al. analyse the relationship between lateral acceleration and ride comfort, and propose a G vector control method based on fuzzy control, which is verified by simulation and experimental vehicle testing. Finally, to reveal the rollover mechanism of a vehicle with flexible frame and solid axle suspension on banked and graded uneven road, the special

issue also discusses the rollover index and control strategy for heavy-duty vehicle rollover in the work of Jin et al.

3 Conclusions and expectations

As mentioned in the previous section, this special issue aims to discuss the vehicle dynamics and control for electrified and autonomous vehicles from the multi-angle point of view. The Guest Editors believe that the special issue will be fascinating for researchers and industries with focus on VDC technologies.

Acknowledgements

The editors would like to thank all the reviewers and authors involved in production of this special issue.