Pre-conference Workshops

Workshop I

Time: Sept. 19, 08:30-11:50 (Wed.)

Venue: 1st Floor Reporting Room, Bionics Building, Nanling Campus, Jilin University

Speaker：Rui Xiong, Beijing Institute of Technology

Title：High-accuracy modeling, state estimation and application of lithium-ion batteries

Abstract: Batteries and their management are a technical bottleneck for electric vehicles. Battery state estimation, which is involved in energy management, cycling life, usage cost and safety, has theoretical meanings and application values. However, the battery has strongly time-variable and nonlinear characteristics, which are further affected by random factors such as working conditions and environment in electric vehicles, resulting great challenges for the accurate state estimation and energy management in real-time. This speech, which will conduct a discussion on issues including mathematically modeling with high accuracy, joint estimation of SOC/SOH/SOP on multi-time scales and its coupling with the model structure and performance, and the on-line application of algorithms, has strong scientific significance and practical engineering values.

Rui Xiong received the M.Sc. degree in automotive engineering and the Ph.D. degree in mechanical engineering from Beijing Institute of Technology, Beijing, China, in 2010 and 2014, respectively. Since 2014, he has been an Associate Professor in the Department of Vehicle Engineering, Beijing Institute of Technology, Beijing, China. Since 2017, he has been an Adjunct Professor in the Faculty of Science, Engineering and Technology, Swinburne University of Technology, Melbourne, Vic., Australia. He has conducted extensive research and authored more than 100 peer-reviewed articles. He holds ten patents. His research interests mainly include electrical/hybrid vehicles, energy storage, and battery management system. Dr. Xiong received the first prize of Chinese Automobile Industry Science and Technology Progress Award in October 2015 and the second prize of National Defense Technology Invention Award in December 2016. He received the 2018 Best Vehicular Electronics Paper Award recognizing the best paper relating to Vehicular Electronics published in the IEEE Transactions on Vehicular Technology during the past 5 years, he also received Best Paper Awards from the Energies and several international conferences. He is serving as a member of the Automation Society Vehicle Control and Intelligence Committee, Associate Editors of IEEE Access and SAE International Journal of Alternative Powertrains, Editorial Board of the Applied Energy, Energies, Sustainability and Batteries, and Guest editor of the Journal of Cleaner Production. He was the conference chair of the 2017 International Symposium on Electric Vehicles held in Stockholm (ISEV2017), Sweden.

Speaker：Bin Duan, Shandong University

Title：A new generation system for battery intelligent test and evaluation

Abstract: The power battery is the heart of EV, performance of the battery test system is crucial to the accuracy and authenticity of the data obtained, which is the cornerstone of battery evaluation. Based on the analysis of related products and technologies at home and abroad, a new generation intelligent test and evaluation system is proposed and its related technical problems have been solved. The third party and experimental results prove that the system can realize intelligent

test and evaluation of power battery. The power battery is the heart of EV. Performance of the battery test system is crucial to the accuracy and authenticity of the data obtained, which is the cornerstone of battery evaluation. Based on the analysis of related products and technologies at home and abroad, a new generation intelligent test and evaluation system is proposed and its related technical problems have been solved. The third party and experimental results prove that the system can realize intelligent test and evaluation of power battery.

Bin Duan, Member of Technical Committee on Vehicle Control and Intelligence, IEEE Member, Associate Professor, Deputy Director of the Automatic Control Institute, and Young Future Scholar of Shandong University. Research interests include advanced control theory methods and power electronics technology in the field of EV power batteries, new energy and so on. Participated or hosted projects include the National Major Scientific Research Instrument Program, Key Program of China Auto Industry Innovation Development Joint Foundation, National Key R&D Program, National Natural Science Foundation, Key R&D Program of Shandong Province (Major Key Technology) and so on. He was awarded several Prizes for Science and Technology Progress (STP) and Education, such as the Second Prize of National STP (seventh), First Prize of Shandong STP (fourth), and the Second Prize of National Teaching Achievement (third), two First Prizes of Shandong Teaching Achievement (third, second), and Special Prize of CAA Higher Education and Teaching Achievement (second).

Speaker：Xiaoxiang Na, Cambridge University

Title：An android application for road freight vehicle in service monitoring

Abstract: An Android app for in-service logging of the operation data of road freight vehicles was developed at the Centre of Sustainable Road Freight (SRF) at the University of Cambridge. It was thus named “SRF Logger”. The “SRF Logger” app generally serves two functions: 1) logging vehicle operation data in-service, and 2) transmitting data logged to a remote server in real-time. Key features of “SRF Logger” are described, and example data logged by “SRF Logger” are presented. Potential applications of “SRF Logger” to driving cycle measurement, engine fuel map reconstruction and vehicle parameter estimation are discussed.

Xiaoxiang Na received the B.S. and M.S. degrees in Automotive Engineering from the College of Automotive Engineering, Jilin University, China, in 2007 and 2009, respectively, and the Ph.D. degree in driver-vehicle dynamics from the Department of Engineering, University of Cambridge, U.K., in 2014. He started his career as a Research Assistant with the Centre for Sustainable Road Freight at the University of Cambridge, U.K. in 2014, where he is currently a Research Associate. He is currently the vice-secretary of the international Parallel Driving Alliance (iPDA), and a member of the Technical Committee on Parallel Intelligence at the Chinese Association of Automation. His research interest includes driver-vehicle dynamics, decision-making in intelligent vehicle systems and driver control of vehicle energy consumption. Recently he has been working on development of intelligent telematics for in-service monitoring of road freight operation.

Workshop Ⅱ

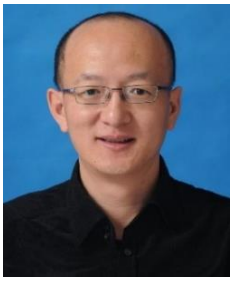
Time: Sept. 19, 08:30-11:50 (Wed.)

Venue: Conference Room 209, Bionics Building, Nanling Campus, Jilin University

Speaker：Shuyou Yu, Jilin University

Title：Stability and inherent robustness of discrete time nonlinear model predictive control

Abstract: The main idea behind model predictive control (MPC) is to solve an optimization problem online. On one hand, in reality, model/plant mismatches, exogenous disturbances, numerical errors and state measurement errors are present. On the other hand, model predictive control provides a feedback only at specific sampling instant and the system is open-loop controlled between adjacent sampling instants. Therefore, robust analysis and synthesis of MPC are of significantly theoretical and practical importance.



Shuyou Yu received the B.S. and M.S. degrees in Control Science & Engineering at Jilin University, PR China, in 1997 and 2005, respectively, and the Ph.D. degree in Engineering Cybernetics at the University of Stuttgart, Germany, in 2011. From 2010 to 2011, he was a research and teaching assistant at the Institute for Systems Theory and Automatic Control at the University of Stuttgart. In 2012, he joined the faculty of the Department of Control Science & Engineering at Jilin University, PR China, where he is currently a full professor. His main areas of interests are model predictive control, robust control, and applications in mechatronic systems.

Speaker：Fang Xu, Jilin University

Title：Real-time implementation of model predictive control and its applications

Abstract: Owing to the ability to handle multi-variable/multi-objective problems and deal with hard constraints explicitly, model predictive control (MPC) has become an attractive feedback strategy in a broad range of systems, and its application has been extended from process industry systems to fast dynamic systems. MPC requires repeated online solution of a receding horizon optimization problem at every sampling instant. The computation load remains the main challenge for the real-time practical application of MPC especially for fast systems. Moreover, fast systems require the MPC controller for high computational performance, miniaturization and high-level integration on a chip. This talk introduces some recent work on field programmable gate array (FPGA) implementation schemes and its applications in automotive control systems. Based on the FPGA-in-the-loop testbench, simulation and experimental results will be given to demonstrate the efficacy and real-time performance of the MPC-on-FPGA-chip strategy.

Fang Xu received the B.S. degree in automation and the Ph.D. degree in control theory and control engineering from Jilin University, Changchun, China, in 2009 and 2014, respectively. She is currently a Lecturer with the Department of Control Science and Engineering, Jilin University. Her current research interests include model predictive control, optimization methods, and field-programmable gate arrays.

Speaker：Hongyan Guo, Jilin University

Title：An MPC application in path planning, following and driver automation collaboration of an intelligent vehicle

Abstract: With the rapid development of intelligent transportation systems and automobile technology, intelligent vehicles have aroused many researchers' attention due to various potential applications, such as reducing traffic congestion and traffic accidents, etc. Intelligent vehicles are comprehensive applications of multi-discipline knowledge and theories, in which path planning, path following and driver-automation collaboration are the three main components of the software configuration. With the rapid development of online optimization and hardware implementation, model predictive control (MPC) has attracted many focuses on discussing path planning, path following, and driver-automation collaboration issue of intelligent vehicles. In this speech, the development of the path planning, path following and driver-automation collaboration issues using MPC approach and present future concerns and perspectives for intelligent vehicles will be discussed.

Hongyan Guo received the MS in Control Theory and Control Engineering from the University of Science and Technology Liaoning in 2007, and received the Ph.D. degree in 2010 from Jilin University. She joined Jilin University, China, in 2011, where she became an Associate Professor in 2014. In the same year, she was selected as Jilin University funds for Excellent Young Scholars. In 2018, she received Jilin University funds for Distinguished Young Scholars. From 2016.11 to 2017.11, she was a Visiting Scholar with Cranfield University, Cranfield, U.K. Her current research interests include vehicle driving states and parameters estimation, vehicle active safety control, human-automation collaboration, and path planning and following of intelligent vehicles, and have been co-author of more than 50 scientific works, including journal and conference papers. She has applied for 21 items of the national invention patent and 12 items has been authorized. She was awarded first prize in natural science of Jilin Province in 2017 (5/10). In 2015, she received National Natural Science Foundation Youth Fund Project, and severed as a leader of 3 items National Natural Science Foundation subproject. In 2017, she became a committee member of Technical Committee on Vehicle Control and Intelligence, Chinese Association of Automation. In 2018, she joined Group of Women Scholar in Control and became a member. She also severed as a reviewer of many international journals, such as IEEE Trans on Vehicular Technology，IEEE/ASME Trans on Mechatronics, IEEE Trans on Industrial Electronics，IEEE/CAA Journal of Automatica Sinica, etc.

Workshop Ⅲ

Time: Sept. 19, 14:00-16:10 (Wed)

Venue: 1st Floor Reporting Room, Bionics Building, Nanling Campus, Jilin University

Speaker：Carlos Guardiola, Universitat de València

Title：Detection and modeling of knock distribution in SI engines

Abstract: Knock phenomenon may be studied and characterized in the time-frequency domain. From the analysis results, a new knock event definition may be derived, directly comparing the excitation of the cylinder resonance produced by the autoignition of the end gas to that associated with the flame propagation. The new definition permits a more consistent differentiation between knocking and not knocking cycles than the classical approach in the literature, thus allowing the improvement of the knock control strategies. On the other hand, a knock model combining a deterministic knock model

based on the in-cylinder temperature and an exogenous noise disturbing this temperature is presented. The autoignition of the end-gas is modelled by an Arrhenius-like function and the knock probability is estimated by propagating a virtual error probability distribution. Results show that the random nature of knock can be explained by uncertainties at the in-cylinder temperature estimation. The model only has one parameter for calibration and thus can be easily adapted online. In order to reduce the measurement uncertainties associated with the air mass flow sensor, the trapped mass is derived from the in-cylinder pressure resonance, which improves the knock probability estimation and reduces the number of sensors needed for the model.

Carlos Guardiola received the MS in Mechanical Engineering from the Universitat Politècnica de València (Spain) in 2000, and was honored with the First National Award by the Spanish Education Ministry. He received the PhD degree in 2005 at the same university, and he develops his research activity in the CMT-Motores Térmicos institute of the same university, where he serves now as Professor. He leads research on control and diagnosis of internal combustion engines, and has been co-author of more than 100 scientific works, including books, patents and journal and conference papers. He serves as Vice-Chair on Industry of the Technical Committee on Automotive Control of the International Federation of Automatic Control, and he is a member of the Editorial Board of the "Proc. of the Inst. of Mech. Eng., Part D: Journal of Automobile Engineering" and of "Springer Tracts in Mechanical Engineering". He is a recipient of the 2014 Ralph R Teetor Educational Award, by SAE International, and of the 2017 Betancourt y Molina Medal, by the Royal Engineering Academy of Spain.

Speaker：Yui Nishio, Honda Automotive R&D Center

Title：Model-based development and advanced control strategy of powertrains

Abstract: In this talk, the latest activity of Honda all over the world, model-based development of powertrains, and model-based powertrains control as a future control technique will be discussed. It is a challenge to sufficiently validate RDE (Real Driving Emission) performance under all conditions through road tests during vehicle development. A model-based development technology was established to simulate, verify and calibrate the emissions performance of a diesel vehicle. RDE permanence could be accurately predicted by coupling a vehicle driving simulation with an engine simulation that includes an ECU model, combustion model, and exhaust aftertreatment catalyst model. As a future control technique, the receding horizon optimal control is focused much attention in automotive control system applications due to the advantages in dealing with constrained optimization explicitly, multi-cost function, and the feedback structure etc. However, a key issue in conducting receding horizon optimization strategy is the constraint that the actual generated torque has to satisfy the demanded torque by the driver during the predictive period. This talk provides a receding horizon optimal control strategy with driver's demand prediction based on the traffic information in the sense of the learning of probability distribution of the demanded torque.

Yui Nishio received the M.E. degree in mechanical engineering from Waseda University, Japan, in 2009.He is currently an assistant chief engineer of Honda Automotive R&D center, and a Ph. D. student in Sophia university, Japan. He has more than eight years experiences in diesel engine field, where he has addressed model-based air path control, study of control and optimization strategy for diesel hybrid system, model-based calibration methodology and optimization, and advanced research of high efficient engines. His current jobs are development of advanced hybrid powertrain system, and construction of simulation environment for efficient calibration of hybrid system. His research topics in Sophia University are powertrain control with traffic information, model predicted control, and optimization.

Workshop Ⅳ

Time: Sept. 19, 14:00-16:10 (Wed)

Venue: Conference Room 209, Bionics Building, Nanling Campus, Jilin University

Speaker：Lars Eriksson, Linköping University

Title：Model-based development - the prosperous life, evolution, & impact of a diesel engine model

Abstract: Control systems have come to play an important role in the performance of modern vehicles with regards to meeting goals on low emissions and fuel consumption. In the development process, new technologies are introduced and the vehicle systems become more complex to enable optimization of the performance. Model based development is seen as a key methodology for handling the complexity and guiding the development and optimization of future complex hybrid electric vehicles. It can help reduce the time to market and thus increase the pace of innovation, but a cornerstone for a high innovation pace is the availability and reusability of models. In this presentation, we will follow the initiation and development of a diesel engine model that has been much used and evolved over the years to become used in a wide range of applications beyond the initial intentions. Starting as a model for a long haulage truck it has been refitted to a passenger car, reused in a diesel electric powertrain in an off-highway application, reused as building blocks for a large marine engine model. It is now the cornerstone in a benchmark model for development of planning strategies in future connected vehicles as well as in a model for studying hybrid vehicles and how the powertrain interacts with the after-treatment system. Much of the success of the model builds on the fact that it is component based, systematically developed and adapted to a real-world engine and that it was released as an open source model that can be downloaded freely and modified. As a key result, it will showcase the importance of control and how model based control can contribute to clean and efficient transports.

Lars Eriksson received the M.S. degree in Electrical Engineering 1995 and the Ph.D. in Vehicular Systems, 1999, both from Linköping University. His main research interests are modeling, simulation and control of vehicle propulsion system where he has a special interest in issues related to internal combustion engines and vehicle powertrains. The following list topics describe the research areas that Lars Eriksson has a high interest in: Ion sensing, Zero-dimensional in-cylinder pressure models, Calculation of chemical equilibrium, Modeling and control of turbocharged SI and DI engines, Turbocharger modeling, Optimal control of complex and hybrid powertrains.

Speaker：Masato Ehara, Toyota

Title：Control technology and development process for evolving powertrain

Abstract: Recently powertrain keeps increasing complexity from a sole simple internal combustion engine to a combination of ICE and electrified power units. Powertrain control has a large effect to performance and cost but required development cost keeps rising, hence, development efficiency improvement is a key issue. Efforts to reduce development cost, especially for calibration process at automotive industry will be presented.

Masato Ehara receives his master degree from Kyoto University, Japan, in 1999. He has been working for Toyota since 1999 and his main responsibility has been establishing efficient development process for internal combustion engine control system utilizing model based calibration. Now he is a project manager and works for further development efficiency improvement introducing model based control technology and machine learning.