## Next-Generation Electric Vehicle Technology: Full Chassis-by-Wire Electric Vehicles

Lei Zhang Professor

E-mail: lei\_zhang@bit.edu.cn

National Engineering Center for Electric Vehicles Beijing Institute of Technology

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Conventional combustion vehicles have caused major concerns over environmental pollution and fossil oil depletion.



**Smog shrouds Most Northern Cities in winter.** 





Development of new energy vehicles (NEVs) has constituted a solid trend for automotive industry: Major countries and automotive companies have issued respective fossil fuel vehicles banning timetable.





	Conventional	Hybrid	Plug-in-hybrid	All-electric
Sources of Energy			<b>~~</b> + <b>*</b> ~	
Consumption				
Emissions		<u>و او او</u>		



Development of NEVs in China: By the end of 2021, more than 7.5 million
 NEVs have been on the road including 6.24 million battery electric vehicles,
 1.26 million plug-in hybrids.





#### TOP-10 EV MODELS - GLOBAL DELIVERIES 2021



















### Background

#### **X-by-Wire Chassis for Next Generation Electric Vehicles**



# Full X-by-Wire Electric Vehicle is a prerequisite for automated driving.



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### Significance

#### Each X-by-Wire subsystem can independently realize active safety control. But there are overlapping and conflicting functions.



**Steering-by-Wire** 



**Active Front Steering (AFS)** 

**Yaw Stability Control** 





In-Wheel-Motor-Drive



#### Significance



#### Chassis Coordinated Control for Full X-by-Wire is the key to ensuring vehicle dynamics stability, maneuverability and safety.



**Active Suspension System** 

**Active Roll Control (ARS)** 













#### **Achievements-**Motion planning and control



#### **Achievements-**Vehicle state and parameter estimation



#### **Achievements-**Active safety control



### **Selected Publications**

Google Scholar: https://scholar.google.com/citations?user=k1ujcBsAAAJ&hl=en

- [1] Ding X, Wang Z, and Zhang L\*, Event-Triggered Vehicle Sideslip Angle Estimation Based on Low-Cost Sensors[J]. IEEE Transactions on Industrial Informatics (JCR-Q1 Top), 2021.
- [2] Ding X, Wang Z, Zhang L\*, et al. Longitudinal Vehicle Speed Estimation for Four-Wheel-Independently-Actuated Electric Vehicles Based on Multi-Sensor Fusion[J]. IEEE Transactions on Vehicular Technology (JCR-Q2 Top), 2020, 69(11): 12797-12806.
- [3] Wang C, Wang Z, Zhang L\*, et al. A Vehicle Rollover Evaluation System Based on Enabling State and Parameter Estimation[J]. IEEE Transactions on Industrial Informatics(JCR-Q1 Top), 2020.
- [4] Liu J, Wang Z, **Zhang L\***, et al. Sideslip angle estimation of ground vehicles: a comparative study[J]. **IET Control Theory & Applications(JCR-Q2)**, 2020.
- [5] Wu J, Wang Z, Zhang L\*. Unbiased-estimation-based and computation-efficient adaptive MPC for four-wheelindependently-actuated electric vehicles[J]. Mechanism and Machine Theory (JCR-Q1 Top), 2020, 154: 104100.
- [6] **张雷**,余文,王震坡,等. 基于多方法切换的四轮轮毂电机驱动电动汽车容错控制策略[J]. 机械工程学报, 2020, 56(16): 227-239.
- [7] 王震坡, 丁晓林, **张雷\***. 四轮轮毂电机驱动电动汽车驱动防滑控制关键技术综述[J]. 机械工程学报, 2019, 55(12): 99-120.
- [8] Zhang L, Wang Y, Wang Z. Robust lateral motion control for in-wheel-motor-drive electric vehicles with network induced delays[J]. IEEE Transactions on Vehicular Technology (JCR-Q2 Top), 2019, 68(11): 10585-10593.
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#### **Research facilities**





























#### **Research facilities**

Sensoring







V-X test tools



















# Thank you