Zhengwei Bai

Postgraduate Student · Junior Specialist · Machine Learning · Autonomous Driving

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Summary

My research interests lie in motion planning, control and driving strategy for Connected and Automated Vehicles (CAVs). My current focus is to explore time-efficient, eco-friendly driving strategies for CAVs under heterogeneous traffic environment utilizing deep reinforcement learning (RL), which is also the core of my master thesis topic.

Education

Beijing Jiaotong University — *Beijing, China*

M.S. in Transportation Information Engineering and Control — *Sep. 2017 - Jul. 2020*

- GPA: 3.70 / 4.00; Awarded the graduate students first-class scholarship for two consecutive years.

Beijing Jiaotong University — *Beijing, China*

B.E. in Electronic Information and Engineering — *Sep. 2013 - Jun. 2017*

- GPA: 3.61 / 4.00; Awarded the outstanding graduates in Beijing Jiaotong University.

Experience

Machine Learning Based Eco-driving Approach -- CE-CERT, University of California, Riverside. — *California, United States*

Visiting Scholar - Junior Specialist with Dr.Peng Hao — *June. 2019 - Present*

- Design and Develop a Unity-based reinforcement learning simulator: signalized intersection scenario with CAVs and human-driven vehicles.
- Design a time-efficient and eco-friendly driving approach for CAVs by utilizing vision perception and V2I communication.

Swarm-intelligent Vehicle Control Theory and Test Verification under i-VICS. — *Beijing, China*

Project Researcher with Prof.Wei Shangguan & Prof.Baigen Cai — *Sep. 2018 - PRESENT*

- Working on the cooperative vehicle control methods and driving-behavior planning strategy.
- Proposed a cooperative driving strategy to achieve better time-efficient driving performance for multi-vehicles.
- Working on the evaluation framework for the test verification of the system.

Machine Learning Based CAVs Control and Driving Strategy under Heterogeneous Traffic. — *Beijing, China*

Project Researcher with Prof.Wei Shangguan & Prof.Baigen Cai — *Oct. 2017 - PRESENT*

- Proposed a deep neural network called spatiotemporal LSTM to generalize the steering angle output by fitting in the raw image data.
- Proposed a deep Reinforcement Learning (deep RL) based high-level driving behavior decision-making algorithm.
- Developed a simulation environment based on the Unity3D Engine for the training and testing processes of the deep RL algorithm.

Intelligent Transportation Information Management System (ITIMS) -- Siemens Ltd. — *Zhuhai, China*

Software Engineer with Dr.Dakai Yang — *Jun. 2018 - Oct. 2018*

- Designed and Developed Five Software Modules of the ITIMS including bus, taxi, intersection, traffic signal, and flow detection modules.
- Developed several high-reliable multi-source data APIs which connect to the Traffic Police Department in Zhuhai.
- Management and maintenance overall service infrastructure utilizing remote controller, Oracle & Mysql database.

Sangtian Island Autopilot Test Site Construction Proposal (Winning bid) -- Siemens Ltd. — *Suzhou, China*

Proposal Author with Dr.Dakai Yang — *Jul. 2018 - Aug. 2018*

- Analyze the equipment layout requirements (such as video perception, V2X communication, geomagnetic sensors, etc.) of the test site.
- Designed the automatic driving test scenarios basing on the site characteristics (such as the car-flowing scenario, overtaking scenario, obstacles recognition, etc).
- Wrote the most part (over 80%) of the proposal (20134 words in total) and made an oral presentation to the local transportation department.

High-speed Railway Based BeiDou Fusion Positioning Performance Test — *Shenyang, China*

Software Engineer with Dr.Debiao Lu — *May. 2018 - Jun. 2018*

- Test the performance of the GPS/BeiDou/IMU fusion positioning under high-speed motion scenario using SPAN, UB380 recorder.
- Continuous testing on the Beijing-Zhangjiakou Railway (On the CR400 Train) for 7 days, 10 hours a day.

Field Strength Test System (FST) -- China Railway Urumqi Railway Administration Group Co.,Ltd — *Urumqi, China*

Software Engineer with Prof.Wei Shangguan — *Sep. 2016 - Jun. 2017*

- Design and developed a MFC framework based windows software (about 15,000 lines of C++ code) for the novel wireless FST system .
- Developed and tested the hardware system (collecting and packaging the sensor data such as ODO, GPS and TAX) of the FST system.
- Testing the whole FST system between Urumqi railway station and Akesu railway station (2018km in total).

Publications & Ongoing Papers

Z. Bai, B. Cai, W. ShangGuan and L. Chai, "Deep Learning Based Motion Planning For Autonomous Vehicle Using Spatiotemporal LSTM Network," 2018 Chinese Automation Congress (CAC), Xi'an, China, 2018, pp. 1610-1614. ***CAC2018***

100+ Reads on ReaserchGate *Oct. 2018*

- proposed a deep learning based control modal (named as spatiotemporal LSTM network), which is able to generate a real-time steering angle planning based on raw image input.

Z. Bai, B. Cai, W. Shangguan and L. Chai, "Deep Reinforcement Learning Based High-level Driving Behavior Decision-making Model in Heterogeneous Traffic", arXiv:1902.05772v2 ***CCC2019***

1 citation on Google Scholar *Jan. 2019*

- Proposed a deep reinforcement learning-based method that can generate the high-level driving policy to make the CAV driving through a heterogeneous dense traffic flow at a higher speed with less lane change.

Z. Bai, P. Hao, M. Barth, W. Shangguan, B.Cai, "An Eco-driving Approach for Connected and Automated Vehicle under Signalized Intersection" ***Ongoing***

Preparing for Transportation Research Board *Present*

- Proposed a CAV control framework which combined conventional rule-based methods and reinforcement learning method. The ego-vehicle can go through a intersection faster and save more energy (compared with some baselines).

Z. Bai, W. Shangguan, B.Cai, "Cooperative Driving Strategy for Connected and Autonomous Vehicles in Dense Traffic: A Deep Reinforcement Learning Approach." ***Ongoing***

Preparing for a journal paper *Present*

- Proposed a cooperative high-level driving behavior decision-making methods so that the multi-CAVs can drive more time-efficiently.

Z.Bai, Design and Implementation of Novel Wireless Field Strength Test System ***Undergraduate Thesis***

Outstanding Undergraduate Graduation Project Thesis *May. 2017*

- Designed a novel wireless filed strength test system and implemented in China Railway Urumqi Railway Station.

Presentation

The 2018 Chinese Automatic Congress Session: Unmanned Control System *Xi'an, China*

Oral Presentation *Dec. 2018*

- Introduced our working on deep learning based motion planning for autonomous vehicle.

Suzhou Transportation Department: The Integrated Solution for Autopilot Test Site *Suzhou, China*

Oral Presentation *Jul. 2018*

- Introduced the integrated solution for Sangtian Island Autopilot Test Site Construction Proposal.

Skills

Programming	**Python**: Application of Machine Learning Algorithms
	C/C++: Application of the embedded systems & MFC software development
	C#: Application of the Unity-ML Based Simulation Environment Development
	Java: Application of a spring framework based Java EE project (Siemens: ITIMS)
	HTML/CSS/Javascript: Application of the Personal Website development
Embedded Systems	**STM32**: Application of the Novel CTCS (Chinese Train Control System) simulation system
	C51/MSP430: Application of the Beijing Electronic Design Competition
Machine Learning	**Tensorflow**: Application of most recent project (deep RL network).
	Keras: Application of deep learning network construction (Spatiotemporal LSTM Network).
Languages	**TOEFL** Reading 28, Listening 27, Speaking 23, Writing 23, Total 101
	GRE Verbal Reasoning 153, Quantitative Reasoning 167, Analytical Writing 3.5

Honors & Awards

Scholarships

2018	**Graduate students first-class scholarship,** Beijing Jiaotong University	*Beijing, China*
2015	**China National Scholarship ,** (top 1%), Ministry of Education of the People's Republic of China	*Beijing, China*
2015	**Excellent Student Cadre Sholarship ,** (top 3%), Beijing Jiaotong University	*Beijing, China*

Competitions

2018 **2nd Prize**, (top 10%), "BJTU Huiguang Cup" Graduate Academic Culture Festival Essay Competition *Beijing, China*
2016 **1st Prize**, (top 1%), "Nokia Cup" Innovation Competition Final *Beijing, China*
2016 **2nd Prize**, Beijing Electronic Design Competition Final *Beijing, China*

Misc

Conference reviewer, Chinese Control Conference 2019, Chinses Automation Congress 2018
Deputy Director, the College Youth League Committee, BJTU *Fall 2014 - Spring 2015*
Student Secretary, the School League general branch, BJTU *Fall 2015 - Spring 2016*
Volunteer, the 2014 APEC Youth Program *Nov. 2014*