Zhengwei Bai

POSTGRADUATE STUDENT · JUNIOR SPECIALIST · MACHINE LEARNING · AUTONOMOUS DRIVING

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Summary

My research interests are machine learning based control and decision-making methods for Connected and Automated Vehicles (CAVs). My current focus is to explore enhanced autonomous driving strategies for CAVs under signalized intersections by combining Learning-based and Rule-based algorithms, 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: 86.6/100.0. (TOP 5%).** 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: 89.3/100.0. (TOP 3%).** Awarded the outstanding graduates in Beijing Jiaotong University.

Experience

Machine Learning Based Eco-driving Approach -- University of California, Riverside. [C3], [J2]   *California, U. S.*

Visiting Scholar - Junior Specialist with Dr.Peng Hao, Dr.Guoyuan Wu and Prof.Matthew Barth.   *June. 2019 - Sep. 2019*

- Design and Develop a **reinforcement learning simulator** by using **Unity3D (C#)** and **Tensorflow (Python)**: a signalized intersection with mixed traffic and propose a time-efficient Eco-Driving Approach for CAVs.
- The experiments shown that the proposed Hybrid Reinforcement learning (HRL) method can save **1.2%-2.9% travel time** and reduce **12.25%-47.5% energy consumption** comparing with several baselines.

Swarm-intelligent Vehicle Control Theory and Test Verification under i-VICS. [J1]   *Beijing, China*

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

- Trying to propose a **cooperative driving strategy** to achieve better **time-efficient driving** performance for multi-vehicles.
- The purpose is to **reduce 10-20% travel time** in mixed urban traffic.

Machine Learning Based CAVs Control and Driving Strategy under Heterogeneous Traffic. [C1], [C2]   *Beijing, China*

Project Researcher with Prof.Wei Shangguan & Prof.Baigen Cai   *Oct. 2017 - Sep.2019*

- Proposed a deep neural network called **spatiotemporal LSTM** to generate the steering angle output by fitting in the raw image data.
- Proposed a deep Reinforcement Learning (deep RL) based **high-level driving control algorithm to achieve ego-efficient driving**.
- The experiments shown that the proposed method can improve 25.2-36.3% driving speed on dense highway.

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

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

- Developed Five **Web Service Modules (Java)** of the ITIMS including **bus, taxi, intersection, traffic signal, and flow detection**.
- Developed several **high-reliable multi-source API (C)** 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. [T1]   *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 communication-field strength along the railway between Urumqi railway station and Akesu railway station (**2018km in total**).

Publications & Ongoing Papers

[C3] <u>Zhengwei Bai</u>*, Peng Hao, Matthew Barth, "Hybrid Reinforcement Learning for Multi-Sensor Based Connected Eco-Driving at Signalized Intersections"
TRB2020

Accepted
Aug. 2019

[C2] <u>Zhengwei Bai</u>, Baigen Cai, Wei Shangguan* and Linguo Chai, "Deep Reinforcement Learning Based High-level Driving Behavior Decision-making Model in Heterogeneous Traffic", arXiv:1902.05772v2
CCC2019

1 citation on Google Scholar, 300+ Reads on ReaserchGate, Oral Presentation
Jan. 2019

[C1] <u>Zhengwei Bai</u>, Baigen Cai, Wei ShangGuan* and Linguo 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

150+ Reads on ReaserchGate, Oral Presentation
Oct. 2018

[J2] <u>Zhengwei Bai</u>, Peng Hao, Wei Shangguan*, Baigen Cai, Matthew Barth, "Eco-Driving Strategy for Connected and Automated Vehicles at Signalized Intersections: a Hybrid Reinforcement Learning Framework "
Ongoing

Preparing for IEEE T-ITS
Present

[J1] <u>Zhengwei Bai</u>, Wei Shangguan*, Bgaigen Cai, "Cooperative Driving Strategy for Connected and Autonomous Vehicles in Dense Traffic: A Deep Reinforcement Learning Approach."
Ongoing

Preparing for IEEE T-IV
Present

[T1] <u>Zhengwei Bai</u>, Baigen Cai*, "Design and Implementation of Novel Wireless Field Strength Test System."
Thesis

Outstanding Undergraduate Graduation Project Thesis
May. 2017

Presentation

[Oral] The 2018 Chinese Automatic Congress Session: Unmanned Control System
Xi'an, China

Introduced our working on deep learning based motion planning for autonomous vehicle.
Dec. 2018

[Oral] Suzhou Transportation Department: The Integrated Solution for Autopilot Test Site
Suzhou, China

Introduced the integrated solution for Sangtian Island Autopilot Test Site Construction Proposal.
Jul. 2018

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

2018	**Graduate students first-class scholarship**, Beijing Jiaotong University	*Beijing, China*
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*
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*

Misc

Conference reviewer, TRB2020, CCC 2019, CAC 2018	*Fall 2018 - PRESENT*
Deputy Director, the College Youth League Committee, BJTU	*Fall 2014 - Spring 2015*
Student Secretary, the School League general branch, BJTU	*Fall 2015 - Spring 2016*