

Wenchao Ding

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EDUCATION

- **Hong Kong University of Science and Technology** Hong Kong, China
Ph.D. in Electronic and Computer Engineering, HKUST *Sept. 2015 – August 2020*
Hong Kong PhD Fellowship (Top 3% among over 4000 applications) Supervisor: Prof. Shaojie Shen
HKUST Aerial Robotics Group Robotics Institute
- **Huazhong University of Science and Technology** Hubei, China
Bachelor in Electronics and Information Engineering, HUST *Sept. 2011 – June 2015*
GPA: 92.81/100; **Rank 1st** Supervisor: Prof. Wei Liu

EXPERIENCE

- **Autonomous Driving Solution (ADS), Huawei** *August 2020 - present*
TopMinds(天才少年)/Tech Lead/Research Scientist
 - **Product-level Comprehensive Prediction Solution (产品级全场景预测方案)**
I proposed a comprehensive learning-based prediction solution for highway and complex urban environments, which is massively integrated in our intelligent driving products. I also designed a scalable data pipeline (data mining, circling, and finetuning) for the constantly improving the net.
 - **Decision Making for The Toughest (最复杂场景决策方案)**
I led a pioneer team (about 10 team members) working on several key problems for urban autonomous driving: 1) how to combine prediction and planning; 2) how to design the planning module in a scalable way; 3) how to achieve human-like decision-making. Our methods are validated onboard in the toughest real-world scenarios (e.g., urban villages in Huangpu Shanghai).
- **Motion Planning, DJI Automotive** *June 2017-Nov 2017*
Research Intern *Oct 2019-Aug 2020*
 - **Motion Planning for Autonomous Vehicles (实车自动驾驶运动规划)**
I deployed my motion planning algorithm detailed in our RAL paper “Safe Trajectory Generation For Complex Urban Environments Using Spatio-temporal Semantic Corridor” on a real autonomous vehicle, and the method achieves safe and comfort driving experience in dense city traffic.
 - **Decision-making for Autonomous Vehicles (实车自动驾驶决策)**
I deployed my planning system in our TRO paper (which is a system integrating the former ICRA and RAL papers) on a real autonomous vehicle. The system achieves human-like social interaction, smooth lane changing and overtaking in dense traffic.

RESEARCH

- **Decision-making for Autonomous Vehicles**
 - **How to achieve efficient uncertainty-aware decision-making?**
Behavior and trajectory prediction can not be 100% accurate. Human drivers may have unpredictable behaviors. To systematically consider these uncertainties, we propose an efficient uncertainty-aware decision-making framework which can generate safe human-like behavior plans and is extensively tested in the real world. Before our work, most of the planning methods in the literature remain in simulation. (ICRA 2020, TRO 2021)
- **Prediction for Autonomous Vehicles**
 - **How to design product-level learning-based methods?**
For mass production, two problems are critical for prediction: 1) how to cover a large enough ODD in a unified way; 2) how to effectively bridge the gap between the upstream (i.e., perception noise) and between the downstream (i.e., planning purpose) modules. We proposed several learning-based methods which can generalize and have SOTA performance. (ICRA 2019 x2)

- **Coupled Decision-making & Prediction**

- **How to combine prediction and decision-making?**

Prediction and decision-making are typically separated. However, the decision of autonomous vehicles directly affects the behaviors of other agents. It is essential to systematically integrate prediction and decision-making so that human-like driving behaviors can be achieved. (TRO 2021)

- **How to design a scalable planning system?**

The planning module requires heavy engineering due to exhausting model tuning, scenario-dependent rules. There is few planner being capable of generalizing to a large design domain. Building a scalable planning system is challenging and I proposed several pioneering methods. (To be submitted)

- **Motion planning for Autonomous Vehicles**

- **How to achieve safety-guaranteed motion planning?**

I propose a safe and unified motion planning framework for modeling numerous semantic elements in complex urban environments based on spatiotemporal information. It can work in different complex environments without special tuning efforts and has a safety guarantee. (IEEE RAL)

- **Planning for Micro Aerial Vehicles**

- **Trajectory planning for monocular vision-based quadrotors**

Efficient trajectory replanning framework for onboard autonomous flight in unknown indoor and outdoor environments with only one camera and one IMU. (ICRA 2018, IROS 2018, TRO 2019)

- **Trajectory planning for dual-fisheye vision-based quadrotors**

Trajectory planning framework for a quadrotor with dual-fisheye cameras to achieve omnidirectional vision, navigation and exploration. (**Journal of Field Robotics**)

PUBLICATIONS

- **Journal papers**

1. [TRO] **Wenchao Ding***, Lu Zhang*, Jing Chen, Shaojie Shen, “EPSILON: An Efficient Planning System for Automated Vehicles in Highly Interactive Environments,” in *IEEE Transactions on Robotics (T-RO)*, 2021.
2. [TRO] **Wenchao Ding**, Wenliang Gao, Kaixuan Wang, and Shaojie Shen, “An Efficient B-spline-Based Kinodynamic Replanning Framework for Quadrotors,” in *IEEE Transactions on Robotics (T-RO)*, 2019. [\[Paper\]](#) [\[Video\]](#)
3. [RAL] **Wenchao Ding***, Lu Zhang*, Jing Chen, and Shaojie Shen, “Safe Trajectory Generation For Complex Urban Environments Using Spatio-temporal Semantic Corridor,” in *IEEE Robotics and Automation Letters (RA-L)*, 2019. [\[Paper\]](#) [\[Code\]](#) [\[Video\]](#) (* equal contribution)
4. [JFR] Wenliang Gao, Kaixuan Wang, **Wenchao Ding***(Corresponding author), Fei Gao, Tong Qin, and Shaojie Shen, “Autonomous Aerial Robot Using Dual-fisheye Cameras,” in *Journal of Field Robotics (JFR)*, 2019.
5. [TWC] An Liu, Vincent KN Lau, **Wenchao Ding**, Edmund Yeh, “Mixed-Timescale Online PHY Caching for Dual-Mode MIMO Cooperative Networks,” in *IEEE Transactions on Wireless Communications*, 2019.

- **Conference papers**

6. [CORL] Haoran Song, Di Luan, **Wenchao Ding**, Michael Yu Wang, Qifeng Chen, “Learning to Predict Vehicle Trajectories with Model-based Planning,” in *Conference on Robot Learning (CoRL)*, 2021.
7. [ECCV] Haoran Song, **Wenchao Ding**, Yuxuan Chen, Shaojie Shen, Michael Yu Wang, and Qifeng Chen, “PiP: Planning-informed Trajectory Prediction for Autonomous Driving,” in *European Conference on Computer Vision (ECCV)*, 2020.

8. [ICRA] Lu Zhang*, **Wenchao Ding***, Jing Chen, and Shaojie Shen, “Efficient Uncertainty-aware Decision-making for Autonomous Vehicles Using Guided Branching,” in *IEEE International Conference on Robotics and Automation (ICRA)*, 2020. (* **equal contribution**) [\[Paper\]](#) [\[Code\]](#) [\[Video\]](#)
9. [ICRA] **Wenchao Ding**, Jing Chen, and Shaojie Shen, “Predicting Vehicle Behaviors Over an Extended Horizon Using Behavior Interaction Network,” in *IEEE International Conference on Robotics and Automation (ICRA)*, Montreal, Canada, 2019. [\[Paper\]](#) [\[Video\]](#)
10. [ICRA] **Wenchao Ding**, and Shaojie Shen. “Online Vehicle Trajectory Prediction using Policy Anticipation Network and Optimization-based Context Reasoning.” In *IEEE International Conference on Robotics and Automation (ICRA)*, Montreal, Canada, 2019. [\[Paper\]](#) [\[Video\]](#)
11. [ICRA] **Wenchao Ding**, Wenliang Gao, Kaixuan Wang, and Shaojie Shen, “Trajectory Replanning for Quadrotors Using Kinodynamic Search and Elastic Optimization,” in *IEEE International Conference on Robotics and Automation (ICRA)*, Brisbane, Australia, 2018. [\[Paper\]](#) [\[Video\]](#)
12. [IROS] Kaixuan Wang, **Wenchao Ding**, and Shaojie Shen, “Quadtree-accelerated Real-time Monocular Dense Mapping,” in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Madrid, Spain, 2018. [\[Paper\]](#) [\[Video\]](#)
13. [GLOBECOM] An Liu, Vincent Lau, **Wenchao Ding**, Edmund Yeh, “Mixed Timescale Online PHY Caching and Content Delivery for Content-Centric Wireless Networks,” in *IEEE Global Communications Conference*, 2017.
14. [FPL] Jieru Zhao, Tingyuan Liang, Liang Feng, **Wenchao Ding**, Sharad Sinha, Wei Zhang, Shaojie Shen, “FP-Stereo: Hardware-Efficient Stereo Vision for Embedded Applications,” in *International Conference on Field-Programmable Logic and Applications*, 2020.

HONORS AND AWARDS

• Graduate - Hong Kong University of Science and Technology (HKUST)

Hong Kong PhD Fellowship	<i>Sept. 2015 - 2019</i>
Academic Award in School of Engineering, HKUST	<i>Sept. 2019</i>
Conference Travel Award: ICML 2018, Stockholm, Sweden	<i>July 2018</i>
Conference Travel Award: ICRA 2018, ICRA 2019	<i>2018, 2019</i>
Conference Travel Award: RSS 2017, Massachusetts, USA	<i>July 2017</i>

• Undergraduate - Huazhong University of Science and Technology (HUST)

ChangJiang Student (20 awardees in all 2015 graduates in Hubei province , China)	<i>June 2015</i>
BaoGang Outstanding Scholarship (25 awardees from Nationwide election, China)	<i>Nov. 2014</i>
Outstanding Winner in Mathematical Contest in Modeling (MCM, 13/6755, USA)	<i>2014</i>
Frank Giordano Award, MCM, USA	<i>2014</i>
Outstanding Undergraduate Student in HUST	<i>2015</i>
National Scholarship (Top 2%) & School Merit Student (Top 3%), China	<i>2014</i>
National Scholarship (Top 2%) & School Merit Student (Top 3%), China	<i>2013</i>
National Scholarship (Top 2%) & School Merit Student (Top 3%), China	<i>2012</i>
Excellent Student of Qiming School, HUST (Top 5%)	<i>2012</i>

TEACHING

Teaching Assistant: ELEC2600 Probability and Random Process, HKUST	<i>Spring 2016</i>
Teaching Assistant: ELEC4100 Digital Communications and Wireless Systems, HKUST	<i>Summer 2016</i>

SERVICE

Reviewer for TRO, RSS, AURO, RAL, ICRA, IROS, etc.