Lu Wen

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EDUCATION

University of Michigan, Ann Arbor, MI, USA   *Expect: Apr. 2020*
Master, Mechanical Engineering   *GPA: 3.66/4.00 (first year)*
                                                                 3.94/4.00 (first term)

Tsinghua University, China
Bachelor, Department of Automotive Engineering, School of Mechanical Engineering   *Aug. 2014-July 2018*
Major in Automotive Engineering   *Major GPA:3.7/4.0*
                                                                 Overall GPA:3.5/4.0

AWARDS AND HONORS

- William Mirsky Memorial Fellowship (2 for ME Department), University of Michigan   *2019*
  (for outstanding research achievement and high academic achievement)
- Tsinghua's Friend- Gao Tian 1st prize Scholarship for Overall Excellence, Tsinghua   *2016*
- Outstanding Student of 2014, Tsinghua   *2014*
- 4th place in 10th Intelligent Car Competition, Tsinghua University   *2015*

PROJECT EXPERIENCE

■ **MACHINE LEARNING**

Parallel Constrained Policy Optimization (PCPO) for AV decision making at a cross road   *March 2018-Now*
Research Assistant: at Mcity, directed by Professor Huei Peng

- Developed a parallel constrained policy optimization, which employ synchronized parallel learners to explore different state spaces to increase the possibility of finding feasible states.
- Construct the simulation scenario where a fix number of vehicles try to drive through the cross road as fast as possible.
- Compared with the PPO algorithm baseline, this proposed parallel constrained policy optimization algorithm has faster convergence speed and converges to better results. The PCPO algorithm also relieves the large workload to adjust neural network parameters.

Reinforcement-learning-based Eco-driving   *May 2019- Now*
Intern: work with Concept Automotive Vehicle team, Ford, Dearborn MI

- Developed a reinforcement-learning (RL)-based method for the Eco-driving problem considering a sequence of traffic lights
- Implementing the trusted region policy optimization (TRPO) algorithm, defined the state and action space as continuous, and utilized the refined vehicle dynamic model and energy consumption model.
- Compared with the fuel consumption of human drivers' average behavior (lower baseline) and dynamic programming (upper benchmark), the proposed RL method's fuel consumption is 24% lower and 5% higher respectively.

■ **PLANNING & DECISION**

Perception, planning and decision at crossroads for Self-driving Vehicles   *Jan. 2017-Apr. 2017*
Cooperative project with Huawei Technologies Co. Ltd
Core group member. My contribution:

- Vehicle dynamics control: leveraged a PID controller, LQR method, and MPC method for vehicle control.
- Trajectory planning: implemented A-star algorithm and defined a Heuristic function reasonably to get optimal trajectory solutions.
- Simulation work: design simulation platform and environment.

■ **DYNAMICS & CONTROL**

Vehicle control and state estimation of autonomous driving   *Jun. 2017- Sept. 2017*
Visiting Scholar: work with Professor Tomizuka, MSC Lab, University of California, Berkeley, California CA

- Realize the trajectory tracking function on a Lincoln MKZ, refit by AutonomouStuff.
- State estimation: Extended Kalman Filter (EKF) is applied to obtain nonlinear estimation, based on DGPS and IMU.
- Vehicle control: optimal control and Model Predictive Control (MPC) are implemented to achieve desirable control performances.

Control for vehicle stabilization at the limits of handling based on Model Predictive Control   *May 2017-Jul. 2017*
Research Assistant: advised by Prof. Shengbo Li, Tsinghua University

- Built a dynamic model with two degree of freedom for vehicle, and a brush tire model for lateral force analysis.
- Defined state boundaries that exclude unstable vehicle dynamics. Leveraged a model predictive envelope controller to bound the vehicle motion within the stable region of the state space.
- Conducted Simulation work in SIMULINK.

PUBLICATION

- **L. Wen,** J. Duan, S. E. Li, S. Xu, H. Peng, "Parallel Constrained Policy Optimization-based Safe Reinforcement Learning for AV decision making.", *Nov. 2019*   (under review)
- Zh.Liu, **L.Wen**, Y.He, Y.Wei, "Three-dimensional free vibration of tires with the laminated composite Timoshenko beam theory." Proceedings of 46th International Congress and Exposition on Noise Control Engineering, Hong Kong, China, August 2017

SKILLS

- **Programming skills**: C/C++, Python.
- **Software:** MATLAB, AutoCAD, Abaqus, CARSIM.
- **Hardware:** MCU development.
- **System:** Mac, Windows, Linux, ROS.
- **Others:** machine learning: TensorFlow, Pytorch; experience with autonomous car operation and sensors.