Intern/Industry Experience

The Cooper Union Computer Center: System Administrator & Operator,   *Sept. 2017 - Present;*
Diagnose server and networking issues and Manage ee.cooper.edu servers, hardware, user accounts, infrastructure, web services, etc.

Momenta.ai : Lidar Research & Development Intern,   *May - Aug. 2018;*
I worked on an end-to-end Lidar perception system at both the Lidar team and HD map team. During my stay, I designed and implemented the real-time **object tracking** pipeline which is robust even with sparse point clouds based on the method of 3D probabilistic interpolation, and deployed the algorithm on the Level 4 self-driving solution of Momenta.ai. In the meantime, I devised efficient **Ground Detection** and **Lane Clustering & Segmentation** algorithms with 98% precision which was added as a feature in HD map module. As a side project, I managed to refactor the Object Segmentation module with 20% memory usage drop by utilizing specialized implementations and contributed to the **path planning** module with my implementations of RRT*, MP-RRT, and StRRT.

Totem Power Inc.: System Research & Development Intern,   *Jun. - Aug. 2017;*
I joined Totem Power as an independent research intern and had the chance to worked on a complete wireless charging system for vertical take-off and landing civilian drones all by myself. By the end of my internship, I presented a fully **autonomous wireless charging** pipeline which could perform charging for multiple drones in a queuing fashion under its coordination. The system was made possible with the help of a precise **pinpointing & landing** algorithm I came up to solve the wireless charging range difficulty, and the concise circuit adds minimal weight on the drone itself but ensures stable power transmission.

Didi Chuxing Technology Co.: Research Intern,   *Apr. - Jun. 2017;*
I worked on the intelligent order dispatching and dynamic pricing model of the Dispatch Team as a software development intern and research intern. My work initially involved building **RESTful API** for the dynamic pricing module and the order dispatch module and helping turn those modules into **microservices**. Later, I scored the chance to work on the probabilistic time series forecasting models. At DiDi, an accurate prediction for completed trips during special events, especially high variance segments like holidays, can lead to a more efficient driver allocation resulting in a decreased wait time for the riders. The model was aimed to replace the state-of-the-art forecasting method, namely a combination of univariate forecasting models and machine learning methods (e.g., random forest), which is hard to tune and add external features. My **LSTM autoencoder** implementation provided a powerful **feature extraction**, which was used for priming the Neural Network and the final end-to-end neural network architecture had performed well and shown its scalability on DiDi data.

Research Experience (full research descriptions could be found at https://zhekaijin.github.io/):

Cooper Mapper: Self-Driving Robot with MultiSensor Data Fusion,   *Sept. 2018 - Present;*
To make robots generally useful in the broader world, in applications like autonomous driving, urban search and rescue, AI-assisted precision agriculture, etc., they need to operate in large, three dimensional and potentially unstructured environments. Therefore, they need general algorithms for mapping, localizing, planning and exploring that work just about anywhere. In this work, we are working toward a general Simultaneous Localization and Mapping (SLAM) solution that fully leverages the advantages of Lidar and Camera sensor, has constant computation time (real-time) and linear in storage space, and utilizes efficient map representation which will be fully 3D and capable of representing arbitrary 3D geometry at a proper level of resolution. Our work is aiming to be an extension of **Active SLAM** with an efficient multisensor data fusion model to allow **accurate mapping, global loop closure** and **large-scale online SLAM** for challenging and complicated environment.

VR-TELE: Realization of 3D Telepresence with HTC Vive and Raspberry Pi,   *Sept. 2017 - Dec.2017;*
This project aims to build a realization of the abstract idea "3D Telepresence" by the aid of microcontroller (Raspberry Pi) and the Head Mounted Display (HTC Vive) and additional hardware. The idea is to make a wireless connected robot platform, mimicking the observer's perspective to capture its ambient environment and feeding it into observer's HMD, which therefore allows the observer to fully perceive device's surrounding as if he or she is in the device's position. A real scale environment of the robot is reconstructed to the user, with the user's motion reflected on the mobile device in real time. The applications of this work range from basic tasks like monitoring to highly expendable functions like bomb disposal. My work involves stages of web development, time-constrained **pose estimation**, efficient **3D metric map representations**, **stereo SLAM**, and data transmission & encryption.

The Cooper IoT: Generic Distributed IoT Platform for human traffic monitoring,   *Jun. 2017 - Sept. 2017;*
We propose utilizing Bluetooth/WiFi technology to estimate origin-destination (OD) demands and station wait times of users of any public transportation system. If the entrance and exit turnstiles at subway stations are equipped with Bluetooth/WiFi receivers, it is possible to capture OD information for some percentage of the riders with visible Bluetooth/WiFi devices. The riders who have electronic devices such as most cell phones, iPods, and computers carry unique information in their devices' Bluetooth/WiFi MAC address. This information can be used scrambled and used anonymously to detect the origin and destination of riders by matching data collected at entrances and exits from the system. I implemented real-time **WiFi-and-Bluetooth-address-based position tracking** and **human detection** algorithms to monitor human traffic flow and performed **time-series analysis** with a stochastic queuing model.