Haicheng Charles Zhao

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Education

Princeton University, **CS & Physics**, *2017 – 2021*, GPA: 4.0
Jeffrey O. Kephart '80 Prize in Engineering Physics
Accenture Prize in Computer Science

Languages & Technologies

Languages: Python • C++ • C • JavaScript • Java
Stats/ML: TensorFlow • PyTorch • scikit-learn • Pandas
Other: Airflow • CUDA • Weights & Biases • ROS

Experience

Senior Software Engineer, *Nuro* *November 2023 — Present*

Lidar-free onboard localization and HD mapping

- Developed a lidar-free perception system in 7 weeks as part of a small "tiger team" formed by the CEO, and was solely responsible for all localization and mapping work including demos.
- Updated both classical and deep learned parts of our stack to function fully lidar-free, even though previously lidar was the *only* exteroceptive sensor used by localization. Switched to camera-radar multimodal ML models.
- The success of this project has directly impacted the company's north star.

Learned HD mapping

- Wrote initial opinion doc on how to approach learned HD mapping given the current state of industry and academic research, including a proposal for a flexible and robust transformer-based approach, which kickstarted further planning across the team.
- Came up with and implemented novel ideas for improving model performance from both the architecture side (e.g. factorized attention, polyline tokenization, prior consumption) and the data side (e.g. improving polyline resolution).
- Led cross-team discussions and planning about the interface between localization and online mapping, and the role of localization within this new paradigm.
- Collaborated with perception and infra teams to budget and reduce onboard latency (TensorRT, nsys), ultimately leading to a successful onboard deployment.
- Set up continuous integration and automatic cloud workflows to increase developer productivity.

Software Engineer, *Nuro* *August 2021 — October 2023*

Learned localization merged with perception foundation model

- Collaborated with perception team to merge the localization model into the new perception foundation model as a head. This reduced the localization model's onboard latency by 72%, significantly increased the flexibility and generality of the localization model's architecture, and paved the way for future collaborations with the perception team.
- Completely rewrote the existing TF1 model in Keras/TF2. Significantly improved readability and maintainability by updating to modern code structure best practices, creating much more detailed documentation, and adding continuous integration.
- Optimized data loading and training to make distributed cloud training 5x faster with no impact on model performance.

Global localization

- Designed, implemented, and deployed an onboard global localization process which allows the bot to localize in-place instead of requiring 50m of manual driving. Included fallbacks and onboard logging for monitoring purposes.
- Led cross-team work with safety driver operations and visualization teams to enable a safe onroad deployment.
- Completely refactored all scan matching code into separate libraries and classes to better follow SOLID principles. Found and fixed a subtle but key mathematical bug in our coordinate transforms, and significantly fleshed out related documentation.

Software Engineer Intern, *Nuro* *June 2020 — August 2020*

- Developed an evaluation framework for scan matching algorithms based on synthetic perturbations.
- Researched, implemented, and tested robust global localization algorithms.

Quantitative Research Analyst Intern, *Stevens Capital Management* *May 2019 — August 2019*

- Researched and developed volatility models and trade execution algorithms using machine learning, econometrics, and parallel computing.

Computer Science and Mathematics Division Intern, *Oak Ridge National Lab* *May 2018 — August 2018*

- Implemented compilers with ANTLR and C++ to compile the IBM OpenQASM, Rigetti Quil, and ProjectQ quantum languages to the Eclipse XACC intermediate representation.
- Developed a modular CLI in Python for the lab's new internal website similar to LinkedIn. The CLI scrapes web sources to pre-fill researcher information and allows an admin to perform CRUD operations with the Spring backend.

Publications

Exploring Real World Map Change Generalization of Prior-Informed HD Map Prediction Models *CVPR 2024 WAD*
H. Charles Zhao*, Samuel M Bateman*, Ning Xu*, Yael Ben Shalom, Vince Gong, Greg Long, Will Maddern

Passive Attention in Artificial Neural Networks Predicts Human Visual Selectivity *NeurIPs 2021 oral*
H. Charles Zhao*, Thomas Langlois*, Erin Grant, Ishita Dasgupta, Tom Griffiths, Nori Jacoby