

# Yiduo Hao

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## EDUCATION

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### University of Cambridge

Cambridge, U.K.

Information and Computer Engineering (BA, MEng)

Sep 2020 – Jun 2024

- **Grade:** First Class Honors (**GPA 3.982**). 2yr **Rank 13** out of 319 students; 3yr **Rank 23** out of 277 students.
- **Relevant Courses:** Deep Learning and Structured Data, Probabilistic Machine Learning, Computer Vision, Internet of Everything, Computer Systems, Medical Imaging and 3D Computer Graphics, Statistical Signal Processing, Information Theory and Coding, Signals and Systems, Systems and Control
- **Awards:** Tripos Prize & Scholarship for three consecutive years

## PUBLICATIONS & PREPRINTS

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Conference Publications (\* indicates equal contribution)

- (**NeurIPS 2023**) Yifan Pu\*, Weicong Liang\*, **Yiduo Hao\***, Yuhui Yuan, Yukang Yang, Chao Zhang, Han Hu, Gao Huang. “Rank-DETR for High Quality Object Detection.” In NeurIPS 2023. [[pdf](#)] [[code](#)]

Preprints Under Review

- (**CVPR 2024, Under Review**) **Yiduo Hao**, Sohrab Madani, Junfeng Guan, Mohammed Alloulah, Saurabh Gupta, Haitham Hassanieh. “Bootstrapping Autonomous Radars with Self-Supervised Learning.” [[pdf](#)]
- (**IJCV, Under Review**) Yan Ma, Weicong Liang, Bohan Chen, **Yiduo Hao**, Bojian Hou, Xiangyu Yue, Chao Zhang, and Yuhui Yuan. “Revisiting DETR Pre-training for Object Detection.” arXiv:2308.01300, 2023. [[pdf](#)]

## RESEARCH EXPERIENCE

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### Bayesian Uncertainty Quantification in Transformers

Oct 2023 – Present

Advisor: **Prof. José Miguel Hernández-Lobato**

University of Cambridge

- Produced reliable estimates of uncertainty in transformer models by various optimization techniques, including GGN matrix and iterative prior refinement. Used Laplace approximation to make inference on the posterior of the last linear layer weights in transformers, especially in vision transformers and large language models.

### Multi-Modal Self-Supervised Learning on Radar Detection

Jun 2023 – Present

Advisor: **Prof. Haitham Al Hassanieh & Prof. Saurabh Gupta**

Swiss Federal Institute of Technology Lausanne, Summer@EPFL program (1.5% acceptance rate)

- Used self-supervised learning (SSL) and cross-modal learning to pretrain radar detection networks on unlabeled datasets, improving cascaded MIMO radar BEV rotated bounding box detection mean average precision by 5.8%.
- Proposed a novel radar heatmap augmentation method, and an SSL framework combining intra-modal and cross-modal learning between vision and radar. Paper submitted to *CVPR 2024* as the first author.

### 2D/3D Object Detection with Transformers & Visual Pre-training

Jul 2022 – Aug 2023

Advisor: **Dr. Yuhui Yuan & Dr. Han Hu**

Microsoft Research

- Contributed to the MMDetection repository and detection transformer (DETR) codebases; added hybrid matching method to DAB-DETR and DN-DETR, improving mean average precision (mAP) by more than 1%.
- Improved DETRs on object detection by self-training methods, surpassing SOTA detectors mAP by 1.4% on COCO dataset. Utilized LLMs and diffusion models to generate synthetic dataset. Paper submitted to *IJCV*.
- Proposed a novel ranking transformer architecture “Rank-DETR”, changing the matcher and loss functions to better align classification and localization tasks. Improved high-performing object detector mAP by 1.6% on COCO dataset. Paper accepted at *NeurIPS 2023* as the co-first author.
- Proposed a novel “rank and mask” method to help suppress negative proposals in self-attention blocks, improving SOTA 2D and 3D DETR-based object detector performance. Preparing the paper for *TPAMI*.

## SKILLS

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**Programming Languages:** Python (OpenCV, NumPy, Matplotlib, pandas, seaborn); MATLAB; Java; C++

**ML Frameworks:** PyTorch (MMDetection, Detectron2); JAX. **Skills:** Docker; Git.

**Language:** English (TOEFL 111/120; GRE Verbal 163/170, GRE Quantitative 170/170), Mandarin (Native)

## INTERNSHIP EXPERIENCE

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### Image Classification and Object Tracking for Autonomous Driving

Jul 2021 – Sep 2021

Advisor: Dr. Qian Zhang

Horizon Robotics

- Researched in constructing and training efficient backbone and detection models for autonomous driving perception. Applied various loss functions (e.g., 'biased loss'), and modified a CNN-based efficient classification model, resulting in improved top-1 and top-5 accuracies by 1-2%.
- Involved in the Journey-5 Full-Self-Driving project. Built an object tracking system that can track people and cars based on MMDetection object detection architecture, which can be used on autonomous vehicles. Rewrote the detection system, applied the IoU tracking algorithm, pHash and histogram reID algorithms, and optimized the overall efficiency of the architecture to process videos and frames.
- Co-developed 3D vision detection systems for birds-eye-view perception, increasing its accuracy and decreasing the inference time on both Journey-5 chips (from Horizon Robotics) and NVIDIA chips.

## PROJECT EXPERIENCE

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### FIRST Robotics Competition (Robotics)

Sep 2017 – Present

- As the team president, head of engineering and mentor, led a team of 60 students and engineers; organized and designed of the competition robot in mechanics, electronics, and software areas. Drew both mechanical and electrical CADs for robotics; designed the architecture for the robot circuits based on the NI-Roborio system.
- Programmed the robot in JAVA; co-programmed the PID control algorithm and drivetrain control for the robot. Also programmed the robot image processing algorithm.
- Founded the STEM summer camp in my team and organized the camp for five consecutive years. Promoted gender equality in the team and help new members to work on technical roles and thrive in their interested fields.

### Machine Learning Project (Reinforcement Learning)

Apr 2023 – Jun 2023

- Constructed a controller that balances an inverted pendulum 'cart-pole' system in a data-driven way.
- Analyzed the state space and governing differential equations and gathered training and test data from the simulator; fitted various non-linear regression models and assess their quality.
- Defined a function that maps from the system's state to control actions (the "policy"); optimized the policy to keep pendulum upright. Stress-tested control and learning systems in various ways.

### OpenAI Hackathon Challenge (Large Language Models)

Oct 2022 – Nov 2022

- Led a team of 4 students, built a recommendation system for eco-friendly food receipts based on queries of ingredients. Formalized a dataset for receipts; fine-tuned a GPT-3 language model; utilized DALL-E with OpenAI APIs; did data analysis using pandas and NumPy libraries.

### Integrated Design Project (Robotics)

Feb 2022 – Apr 2022

- Coded an Arduino-controlled robot in C++, with PID motor control, servo control, Wi-Fi MQTT messaging, and integration with computer vision systems. Skillfully utilized OpenCV to detect contours, cubes, mark orientations, etc. Constructed SVMs for color detection.

## AWARDS

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| College Tripos Prize & Scholarship 2023                 | Sep 2023 |
| College Tripos Prize & Scholarship 2022                 | Sep 2022 |
| College Tripos Prize & Scholarship 2021                 | Sep 2021 |
| Winner: FIRST Robotics Competition (Heartland Regional) | Mar 2019 |
| Runner-up: Robotics China Championship                  | Jul 2018 |
| Winner: FIRST Robotics Competition (Shanghai Regional)  | Mar 2018 |