Zhihao Ruan

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Education

University of Pennsylvania — Philadelphia, PA
- *Master of Science in Engineering in Robotics* — *May 2022*
  General Robotics, Automation, Sensing & Perception (GRASP) Laboratory
  - **Selected Coursework:** Introduction to Optimization, Advanced Topics in Machine Perception, Interactive Computer Graphics

University of Michigan — Ann Arbor, MI
- *Bachelor of Science in Computer Science Engineering,* ***GPA: 3.9/4.0*** — *Sept 2018 – May 2020*
  College of Engineering
  - **Selected Coursework:** Embedded Systems Design (grader), Machine Learning (grader), Computer Vision, Autonomous Robotics, GPU Programming & Architecture, Operating Systems

Shanghai Jiao Tong University — Shanghai, China
- *Bachelor of Science in Electrical and Computer Engineering,* ***GPA: 3.6/4.0*** — *Sept 2016 – Aug 2020*
  University of Michigan-Shanghai Jiao Tong University Joint Institute (UM-SJTU Joint Institute)
  - **Selected Coursework:** Electromagnetics, Signals and Systems, Analog Circuits, Semiconductor Devices

Research Experience

- **Interactive Sensing and Computing (ISC) Lab** — Ann Arbor, MI
  Research Assistant of Prof. Alanson Sample, Synthetic Health Sensor — *Jan 2019 – Dec 2019*
  - Built an embedded system in **C & MATLAB** with **STM32** microprocessor and Panasonic's GridEye® 8×8 IR sensor through **I²C & UART** that can collect, detect and visualize heat distribution in the room.
  - Constructed **a complete C API** for Panasonic's GridEye® 8×8 IR sensor for **STM32** microprocessor from scratch.
  - Implemented **Direct Digital Synthesis (DDS) in C** of a frequency-sweep ultrasonic sine wave from 39kHz to 41kHz with STM32 microprocessor and ultrasonic transducers.
  - Implemented two different ultrasound distance measurement algorithms in **Python** including **FMCW (Frequency-Modulated Continuous Wave) algorithm** and **phase-based ranging algorithm** with STM32 microprocessor.

Project Experience

- **Deep Neural Network Implementation for Machine Perception** — Philadelphia, PA
  CIS 680: Advanced Topics in Machine Perception — *Sept 2020 – Dec 2020*
  - Implemented **YOLO v1** for object detection in **PyTorch**, featuring anchor-based detection & **Non-Max Suppression (NMS)**.
  - Implemented **SOLO** for instance segmentation, using **ResNet50 FPN** as backbone and **MatrixNMS**.
  - Implemented **Regional Proposal Network (RPN)** and **FasterRCNN** object detection head using ResNet50 FPN as backbone, featuring **ROI Pooling**, reaching an **mAP of 0.581**.
  - Implemented multiple GAN architectures including **Variational Auto-Encoders (VAE)**, **DC-GAN**, **CycleGAN**, **BicycleGAN**. Achieved **Fréchet Inception Distance (FID)** score of 70.87 on CycleGAN and 76.82 on BicycleGAN.
- **Real-Time On-Device Flow Statistics Detection and Prediction** — Shanghai, China
  Undergraduate Major Design Experience, UM-SJTU Joint Institute — *June 2020 – Aug 2020*
  - Built a system in **Python** which detects human traffic flow, automatically analyzes & detects entrances on **Raspberry Pi 4B**, stores data on a server, visualizes analyzed data on a self-designed front-end website **in real time** ($\sim$ 15 FPS with Google Coral Edge TPU USB accelerator).
  - Achieved **20 FPS and 90% accuracy** object tracking & people counting with **self-designed Kalman filter tracker**, automatic entrance detection with density-based clustering algorithm — **DBSCAN** in Python.
- **MXNet Optimization with GPU** — Ann Arbor, MI
  EECS 498: GPU Programming & Architecture — *Nov 2019 – Dec 2019*
  - Implemented GPU parallelization of forward kernel of MXNet incubator 1.3.x with **tiled matrix multiplication** and **GPU shared memory**; boosted inference speed **from 30s to** $<$ **3s** on fashion-mnist dataset and Nvidia TITAN Xp graphics card.
- **DOAPP: Dynamic Object Avoidance and Path Planning** — Ann Arbor, MI
  Undergraduate Major Design Experience, University of Michigan — *Oct 2019 – Dec 2019*
  - Implemented a **GPU-accelerated motion planning algorithm** originally proposed by Chonhyon Park, et al. in **ROS C++ & CUDA** with Nvidia GPU parallel programming & optimization that could perform **real-time obstacle avoidance**.
  - Built a controller and trajectory follower in **ROS C++** for Dynamixel motors on robot arm from scratch and achieved **30 Hz signal transmission**.

Skills

Programming Languages: C/C++, Python, MATLAB, Verilog.
Development Tools: STM32CubeMX, OpenCV, PyTorch, Scikit-Learn, LCM (Lightweight Communications and Marshalling), ROS (Robotics Operating System), CUDA.