Ruoyang 'Alex' Xu

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Education

Carnegie Mellon University **Pittsburgh, PA**
Master of Science in Robotics *August 2020 - August 2020 (expected)*
- Research Advisor to be determined.

Georgia Institute of Technology **Atlanta, GA**
Bachelor of Science in Computer Engineering, GPA 3.88/4.0 *August 2016 - May 2020*
- Minor in Robotics, and Computing and Intelligence
- Graduate Level Courses in Machine Learning, Robot Intelligent Planning, and Computer Architecture.

Skills

Concepts: Motion Planning, Navigation, Computer Vision, Machine Learning, Computer Architecture
Programming: Wrote a lot: Python, C++, MATLAB; Knows: C, Julia; Coursework: VHDL, Java
Frameworks: Linux/Unix, Git, ROS, PyTorch, Keras, CMake, Eigen.
Hardware: Raspberry Pi, ARM mbed, ATMega, Intel DE10 SoC FPGA

Publication

J. Smith, **R. Xu**, P. Vela., egoTEB: Ego-centric, Perception Space Navigation Using Timed-Elastic-Bands, International Conference on Robotics and Automation 2020, 2020.

Research Experience

Intelligent Vision and Automation Lab | Georgia Tech **Atlanta, GA**
Student Research Assistant | Vision-based navigation *August 2018 - July 2020*
- **Perception space navigation** to reduces planning time and computation complexity for mobile and computationally limited platforms.
- Develop **local planning** algorithm that **directly plans in RGB-D sensor inputs**, benchmarked and evaluated in simulated Gazebo environment with monte-carlo rollouts with randomly populated obstacles, start, and goals.
- Developed a framework for benchmarking planner timings including execution rate, time, and message delays to evaluate between stages of planning.
- Transformed existing optimal local planner *Timed Elastic Band* to use **perception space representation**.

Lab of Automatic and Control Engineering | Technical University of Munich **Munich, Germany**
Summer Research Intern | Optimization-based Motion Planning *May 2019 - August 2019*
- Highway driving scenarios using stochastic model predictive control for **uncertain agent interactions**.
- Developed a framework for recursively update belief of interaction in agents and represented as chance-constraint.
- Wrote MATLAB script for simulation environment and controller design, average planning rate of ~5Hz.
- Rewrote to **JuliaLang** with Convex.jl and JuMP.jl for performance enhancement analysis.

Georgia Tech Systems Research Lab | Georgia Tech **Atlanta, GA**
Senior Design | Visual Inertial Odometry *Jan 2020 - May 2020*
- Deployed monocular **visual inertial odometry** on lightweight aerial vehicles with limited sensor quality and highly nonlinear dynamics.
- Developed image denoising and partial rejection framework, and modified DSO to achieve stable performance.
- Assessed system robustness to handle significant drift-free rotation and noisy image on self-collected datsets.

Sensors and Intelligent Systems Lab | Georgia Tech **Atlanta, GA**
Student Research Assistant | Opportunity Research Scholar's Program *August 2018 - May 2020*
- Assessed frequency modulated continuous wave radar in biosignal acquisition and clutter removal in team of 3.
- Responsible for verifying the most correlated frequency range in reconstructed data.
- Currently improving the performance of a system identification method in team of 4. Utilizing kernel method to reduce the settling time in kernel recursive least square method.

Low Frequency Lab | Georgia Tech **Atlanta, GA**
Student Research Assistant | Opportunity Research Scholar's Program *December 2017 - May 2018*

- Miniaturized a very low frequency receiver for atmospheric in team of 3.
- Implemented the control of data transfer between embedded FPGA and on-chip Linux system on an SoC board.
- Achieved sampling rate of 12.5k by controlling soft processor to control DMA modules for data transfer scheme.

Industry Experience

AJMIDE FM **Shanghai, China**
Software Engineering Intern | Radio Program Department *May 2018 - August 2018*

- Wrote automated data-cleaning scripts to clean ~30GB of transcripts for abstractive long text summarization.
- Implemented keywork extraction algorithms and identified the optimal choice for each genre of transcripts.
- Implemented a deep learning classifier in **Keras** and **PyTorch** with pretrained word vectors to improve model size, and classification accuracy. Produced significantly faster convergence time.

Teaching and Volunteering

Georgia Institute of Technology **Atlanta, GA**
Undergraduate Teaching Assistant | Digital Design Laboratory *August 2017 - December 2018*

- Helped students understand digital design and VHDL programming on Terasic DE2 FPGA Dev board.
- Helped student understand and implement a simplified single cycle processor.
- Hold lab hours, 30 students per semester.

Georgia Institute of Technology **Atlanta, GA**
Electrical Training Lead | RoboJackets - Competitive Robotics at Georgia Tech *August 2017 - May 2018*

- Led the design and teaching of freshman training program to robotics club, received by ~80 students.
- Program covers basic electrical concept from resistance, PCB design to firmware and communication protocols.

Georgia Institute of Technology **Atlanta, GA**
Volunteer | Georgia FIRST *August 2016 - May 2017*

- Mentored FRC team #5332 Toaster Tech in season 2016-2017. Volunteered for local FTC competitions as referee.

Honors and Awards

Faculty Honors - Georgia Tech Spring 2018 - Fall 2019
Academic average of 4.0/4.0 in proceeding term with no withdraw grades, at least 12 credit hours.

1st Design Award, 3rd Overall - 28th Intelligent Ground Vehicle Challenge July 2019
Comprehensive evaluation of vehicle design strategy and capability in completing navigation course

2nd Research Award - Georgia Tech May 2018
ECE Opportunity Research Scholar Program

Projects

Intelligent Ground Vehicle Challenge **Atlanta, GA**
Electrical Team | RoboJackets - Competitive Robotics at Georgia Tech *August 2016 - August 2020*

- **Electrical hardware experience** in building an autonomous robot capable of navigating off-road obstacle course.
- Designed and constructed custom sensor and control platform using ARM mbed, implemented motion control algorithms and communication firmware between onboard computer.
- Led the design of a vehicle-wide diagnostic system of distributed network of sensors for runtime awareness.

Sticker Peeler End-Effector **Atlanta, GA**
BMW Hardware Hackathon "Hack-A-Thing" at Georgia Tech *Fall 2018*

- Construction of an end-effector for UR-5 manipulator to peel off universal type of stickers.
- 2nd place of the competition (~70 participants).

SmartWatcher **Atlanta, GA**
HackGT *Fall 2017*

- Facial recognition and classification utilizing pretrained machine learning model.
- Built voice-accessible interface for administrator use and data base for analytics.

Relevant Coursework

Introduction to Automation and Robotics: Fundamentals in robotics from representation through manipulator kinematics, and control; End-effector planning through jacobian.

Machine Learning: Introduction to ML that covers **randomized optimization, supervised, unsupervised, and reinforcement learning.** Open ended projects for each topic for comparative algorithmic performance analysis and characteristic evaluation.

Intro to Computer Vision: Foundation of **classical computer vision**, Harris feature detector, SIFT feature descriptor, bag of words classification; stereo pose estimation; deep learning for classification in computer vision.

Percpetion and Robotics: Mobile robots **navigation stack** from perception (label recognition and classification) to execution (probabilistic localization and planning)