FRANK YANG

Evanston, IL | (937) 344-8845 | frankyang2024@u.northwestern.edu | http://frankyang.me

EDUCATION

Northwestern University   **Evanston, IL**
Bachelor of Science in Computer Science and *Mathematics*   *Sep 2020 – Jun 2024*
Master of Science in Computer Science   *Expected, Jun 2025*
- **B.S. GPA:** 3.98/4.00 | **M.S. GPA:** 4.00/4.00 | **Honors & Awards:** Bachelor's degree with *summa cum laude*
- **Relevant coursework:** Probability and Stochastic Processes, Foundations of Optimization, Autonomous Quadrotor Design and Control, Cyber-physical System Design, Advanced Topics in Computer Vision, Deep Learning, Linear Algebra

RESEARCH INTEREST

I have a broad interest in robotic learning and control. I'm fascinated by the challenge of building autonomous robots that navigate complex environments and perform long-horizon tasks efficiently and safely. I am currently researching on equipping robots with learning and real-time decision-making capabilities within safety-critical systems. This interest extends from humanoid robotics to more common applications like self-driving vehicles.

PUBLICATION (* Stands for equal contribution)

Case Study: Runtime Safety Verification of Neural Network Controlled System
- Authors: **F. Yang**, S. Zhan, Y. Wang, C. Huang, Q. Zhu
- Conference: Runtime Verification, 2024
- Link: https://arxiv.org/abs/2408.08592
- Summary: presents a runtime safety verification approach for neural-network-controlled systems, demonstrating a safe online controller switching strategy based on reachability analysis results from POLAR-express

Efficient Encoding of Graphics Primitives with Simplex-based Structures
- Authors: **F. Yang***, Y. Wen*
- Conference: Midwest Machine Learning Symposium, 2023
- Link: https://arxiv.org/abs/2311.15439
- Summary: proposes a simplex-based approach for encoding graphics primitives, offering a more efficient alternative to traditional grid-based structures, especially in higher-dimensional spaces

RESEARCH EXPERIENCE

Stanford Vision and Learning Lab   **Stanford, CA**
Research Assistant Intern   *Jun 2024 – Present*
- Advised by: Fei-Fei Li, Inaugural Sequoia Professor of Computer Science at Stanford University
- Collaborated development on building 3D simulation environment and benchmark for robots to perform everyday activities in indoor scenes, and developing novel learning-based algorithms to perform long-horizon mobile manipulation tasks
- Integrated in-simulation RRT* path planning and collision detection with Curobo, enabling more efficient, parallelizable reinforcement learning for pick, place, and navigation action primitives
- Unified position and orientation access and modification for in-simulation objects relative to the global, scene, and prim parent frame in NVIDIA Isaacsim

Design Automation of Intelligent Systems Lab   **Evanston, IL**
Research Assistant   *Oct 2023 – Present*
- Advised by: Qi Zhu, Associate Professor of Electrical and Computer Engineering at Northwestern University
  Chao Huang, Associate Professor of Electronics and Computer Science at University of Southampton
- Conducted research on efficient and precise formal reachability analysis for neural network-controlled systems (NNCS)
- Performed first runtime safety verification on NN-controlled Turtle Bot navigations in ROS2 Flatland and RViz with NNCS reachability analysis tools
- Developed safety-guaranteed switching strategy between NN and obstacle avoidance controls using Monte-Carlo localization and POLAR-express reachability analysis
- Benchmarked real-time navigation performance with 100 parameter settings in complex benchmark environments; submitted result to RV 2024

Computational 3D Imaging and Measurement Lab   **Evanston, IL**
Research Assistant   *May 2021 – June 2022*
- Advised by: Florian Willomitzer, Associate Professor of Optical Sciences at University of Arizona
- Created a 3D imaging framework that facilitates non-technical users to discover micro-painting degradation in Kokomo glass test tiles
- Streamlined and packaged a 3-step calibration sequence (intrinsic, radiometric, and geometric) for FLIR cameras, allowing μm-level precision prior to starting Phase Measuring Deflectometry
- Field-tested reconstruction on specular objects; decreased reprojection error and calibration time

TALK

POLAR-Express: Efficient and Precise Formal Reachability Analysis of Neural-Network Controlled Systems, *tool presentation at Embedded Systems Week (ESWEEK) 2024*
Case Study: Runtime Safety Verification of Neural Network Controlled System, *conference talk at RV2024*

TEACHING EXPERIENCE

CS340 Networking, Graduate TA   *Winter 2023*
CS310 Scalable Software Architectures, Graduate TA   *Fall 2023*
CS396 Web Development, Undergraduate TA   *Spring 2022*
Institute of Electrical and Electronics Engineers, Project Manager   *Spring 2023*

PROFESSIONAL EXPERIENCE

Target   **Minneapolis, MN**
Software Engineering Intern   *Jun 2023 – Aug 2023*
- Developed a Golang application within a Vela pipeline to enforce security standards for internal applications deployment
- Integrated Postgres and Target API-based database with RestAPI for build lifecycle and versioning information retrieval
- Incorporated 90% coverage on unit and integration testing with sqlmock and httptest, achieved Target-specific SLOs

Amazon Web Services   **Seattle, WA**
Software Developer Engineer Intern   *Jun 2022 – Sep 2022*
- Implemented a Sagemaker webpage that provides benchmarked architecture evaluations for machine learning models
- Challenged and simplified frontend implementation of S3 resource selector; presented an end-to-end demo to 150+ Sagemaker engineers and received candidacy to beta-launch Sagemaker model cards on AWS Re:Invent

PROJECT

Quadrotor Design and Control   *Feb 2024 – Jun 2024*
- Developed a WiFi-enabled quadrotor using Raspberry Pi and IMU; implemented PID control, safety measures, and joystick interfacing in C that allows stable manual flight control; integrated Vive Lighthouse with IR sensors to enable autonomous flight control with precise 3D positioning

Convoice   *Sep 2023 – May 2024*
- Launched an AI calling startup to provide businesses with context-aware voicebots with human-like voices
- Configured a serverless file processing pipeline with AWS and Pinecone to extract knowledge base from file uploads
- Enabled smart question querying from client knowledge base and conversation context using Azure GPT-4 API; enabled voice interruptions using Google Cloud Voices and realistic text2speech generation with ElevenLabs

Reminiscia   *Dec 2022 – May 2023*
- Implemented a text-to-image search application using vision-language CLIP; competed in Northwestern Wildhacks
- Employed Vision and CoreML to allow low-memory calculations of cosine similarity between text and image embeddings
- Distilled 224MB model into an 85MB image encoder while improving the album indexing and inference speed by 1.6 times

Simplex-based Structure Encoding   *Dec 2022 – May 2023*
- Adapted NVIDIA's "Instant NGP with Hash Encoding" simplex-based encodings for data compression and rendering
- Established novel mapping functions for simplex-grids in high dimensions; accelerated GPU giga-pixel image fitting speed by 9.4% and improved NeRF interpolation and rendering speed by 41.2% as compared to baseline method

Skuy, Lead Tech Engineer   *Apr 2022 – Jun 2024*
- Managed a cross-platform campus community network app using React Native; led a 2-months database migration from Heroku to Firebase for service growth and stability; set up RestAPI checkpoints for data verification
- Managed pull requests for 8 tech engineers and configured CI/CD pipeline on Expo for application deployments

Transformer-based Lie Detection *Feb 2022 – Jan 2023*
- Conceptualized a ViT-based detection model that detects lies from micro-facial, audio, and textual features with PyTorch
- Trained a transformer encoder and a LSTM binary classifier from fine-tuning Inceptionv3 with 121 clips of trial testimonies
- Pinpointed 20 micro-gestures and AUs that contributes to lying; achieved an out-of-sample classification accuracy of 76%

MatchaNU, Founder *Jun 2021 – Feb 2022*
- Founded a native-IOS application to assist Northwestern undergraduates with course planning and building navigation
- Web-scraped course catalogs and integrated Google Geocoding API to generate building name from geocoordinates
- Integrated UIKit and LocationManager in SwiftUI to track location and calculate the optimal walking route to classrooms

LANGUAGES & SKILLS

Languages: Python, Go, TypeScript, C/C++, SwiftUI, HTML/CSS/JavaScript
Robotic Learning: CUDA, Torch, TensorFlow, OpenCV, ROS2, Gazebo, RViz, MATLAB
Web/Mobile Frameworks: React, React Native, Redux, Node JS, Flask, ESLint, Cypress
DevOps: RestAPI, AWS, Firebase, Heroku, Elastic Beanstalk, Git, Vela, Docker, MySQL, PostgreSQL

INTERESTS

Photography & Film: Majored in Radio Television Video and Film (Portfolio). Participated as gaffer in a 16-student film set "Clark" and 70-student feature film "NECRO 101". Second camera assistant in featured films "Voicemail to My Son" and "Venessa"; Proficient in topics of cinematography and color correction

Piano: 3 years of volunteer teacher in Academy of Music and Arts for Special Education (AMASE); Composed music sheets most comprehensible to students with visual impairment; Co-founder & Pianist for a 3-member school band "Allison Trio"