

# FRANK YANG

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## EDUCATION

### Northwestern University

Bachelor of Science in Computer Science and Mathematics

Master of Science in Computer Science

Evanston, IL

Sep 2020 – Jun 2024

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

Research Assistant Intern

Stanford, CA

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 with 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

Research Assistant

Evanston, IL

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

Research Assistant

Evanston, IL

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  $\mu\text{m}$ -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

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**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

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**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”