Ali Younis

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Graduating PhD Student focused on computer vision for perception and world understanding tasks with extensive industry experience in computer vision, robotics, deployable machine learning, embedded devices and general software development.

Education

Ph.D. Computer Science (Machine Learning & Computer Vision) — University of California, Irvine
Focus: Learnedable particle systems for computer vision. | Advisor: Erik Sudderth — *Oct. 2020 – June 2025 (expected)*

M.S. Computer Science — University of California, Irvine
Focus: Machine Learning and Artificial Intelligence | GPA: 3.882 — *Sept. 2017 – June 2018*

B.S. Computer Science and Engineering — University of California, Irvine
Deans Honor List (All Quarters) | Magna Cum Laude | GPA: 3.851 — *Oct. 2013 – June 2017*

Experience

Graduate Student Researcher - University of California, Irvine — *Oct. 2020 – June 2025 (Expected)*

Focus: Computer vision for perception, AR/VR, autonomous driving, human mesh reconstruction, tracking, ext. Creating end-to-end learnable particle-based state estimation systems which utilize the latest neural architectures (CNN, RNN, Transformer, ViT, ext) within Bayesian frameworks for superior accuracy and inference speed on multi-modal time-series data.

Notable Works:

- **Differentiable Particle Belief Propagation** (Current work): Creating end-to-end learnable belief propagation systems for human mesh reconstruction from video. By combining learnable networks with a novel end-to-end differentiable particle based belief propagation algorithm, we can exploit the graphical model structure of the system to enable more accurate human skeleton and shape predictions that maintain multiple modes which faithfully capture uncertainty.
- **3D Gaussian Splatting (3DGS) Simultaneous Localization and Mapping (SLAM)** (Current work): Developing novel end-to-end learnable particle filter based SLAM systems using 3DGS as the mapping back-end. Enables precise real-time localization with maps tailored for accurate and efficient novel view synthesis.
- **Differentiable Particle Filters** [2]: Created first end-to-end differentiable particle filter algorithm with unbiased gradients for computer vision tasks on time-varying (time series) systems with multi-modal data. Learns complex system dynamics and observation models end-to-end within the algorithm and predicts state as a continuous distribution with multiple modes. Applied to various robotic localization tasks using diverse range of sensors (RGB, odomentry, radar bearings).
- **Differentiable Particle Smoothers** [1]: Created the first end-to-end differentiable particle smoother and applied it to localization in a city-scale environment using multi-modal time-series data (camera and other sensors). Complex system dynamics and observation models are learned end-to-end within the algorithm enabling superior performance (2x accuracy and inference speed) over methods specifically designed for this task.

Software Engineering Intern (Machine Learning) - Qualcomm Inc. — *June 2024 – Sept. 2024*

Computer Vision Algorithms Research Group. Developed a novel machine learning based depth-from-stereo method based on differentiable non-parametric loopy belief propagation, trained end-to-end with internal neural networks tailored for mobile deployment. Assisted in commercialization of past work. Implemented training and evaluation pipelines in PyTorch.

Software Engineering Intern (Machine Learning) - Qualcomm Inc. — *June. 2023 – Sept. 2023*

Computer Vision Algorithms Research Group. Developed a proprietary depth-from-stereo method which blend classical and neural computer vision techniques while leveraging existing custom on-chip hardware accelerators. Method significantly out-performed existing real-time stereo methods (1.5x accuracy improvement). Implemented training and evaluation pipelines in PyTorch.

Software Engineer / Machine Learning Engineer (Part time) - Modal AI — *June 2020 – June 2023*

Developed, trained and deployed (to embedded) real-time depth-from-stereo algorithms (classic and machine learning based) for applications in mapping and collision avoidance. Algorithm development for GPU using OpenCL. Implemented data collection, training, validation, model quantization and deployment pipelines. Integrated various Visual Inertial Odometry systems and created custom camera drivers. Android development. Built custom Linux images. Used C. C++, Python, Java and OpenCL

Software Engineer - Tyvak Nano-Satellite Systems, Inc. — *Aug. 2018 – June 2020*

Designed and implemented mission critical embedded software systems for satellites. Engineer responsible for core software libraries and several spacecraft subsystems (sensors, actuators, control). **Software lead** for all computer vision based camera payloads and for mission with first consumer GPU in space. Platform bring up/Linux OS customization. Continuous integration maintainer. Facilitated inter-team cooperation by holding conflict resolution/sync-up meetings for various high stakes missions. Used C, C++, Java and Python.

Software Engineering Intern - Qualcomm Inc. Corporate R&D *4 Summers from 2014 – 2017*

Designed collision avoidance system for drones using only on-board sensors (RGB/RGB-D/IMU) and processing; 3D mapping, state estimation and planning path to goal region (prototype for 2016 CES demo). Implemented customer facing UART driver. Created continuous integration testing tools. Developed new features for the drone flight stack; safety, GPS navigation, ground station communications and visualizations. Used C, C++, Java, Node.js, Python and Matlab.

Undergraduate Research Asst. - University of California, Irvine *Nov. 2013 – June 2017*

Researcher in the Programming Language Research Group under Professor Brian Demsky. Developed decentralized secure communications system for IoT devices where communication channel is hostile and intermittent [4]. Researched security of IoT devices [5]. Created a bare-metal ARMv7 test platform (real hardware and emulation) for research in robust software execution on unreliable hardware. Implemented lock-free concurrent data structures in C++11 using weak memory models. Wrote device drivers and Android applications. Used C, C++ and Java.

iOS Application Developer – Self Employed *2010 – 2013*

Designed and developed various iOS apps (games, app that syncs music playback between various devices using only audible cues) with over 100K downloads worldwide.

Skills

- **Languages** C, C++, Java, Python, Go, Bash, Matlab, LaTeX, Node.js, SQL, ARMv7 Assembly
- **Frameworks/Tools:** PyTorch, TensorFlow, 3D Gaussian Splats, Keras, TFlite, ONNX, CUDA, OpenCL, OpenCV, Make, CMake, Buildroot, Linux, Android, iOS, Google Cloud, MySQL, Postgres, SLURM, LSF
- **Neural Architectures:** Transformers, Attention, Vision-Transformers (ViT), Convolutional Neural Networks (CNN), Reccurrent Neueal Networks (RNN), Spatial Transformers, Segment Anything (SAM), YOLO, Mono/Stereo Depth Networks, ResNets, UNets, Diffusion Models.

Publications

[1] **A. Younis**, E. Sudderth. "Learning to be Smooth: An End-to-End Differentiable Particle Smoother". Neural Information Processing Systems (Neurips) 2024.

[2] **A. Younis**, E. Sudderth. "Differentiable and Stable Long-Range Tracking of Multiple Posterior Modes". Neural Information Processing Systems (Neurips) 2023.

[3] S. Agarwal, G. Hope, **A. Younis**, E. Sudderth. "A Decoder Suffices for Query-Adaptive Variational Inference". Uncertainty in Artificial Intelligence (UAI) 2023.

[4] R. Trimananda, **A. Younis**, T. KWA, B. Demsky, G. Xu. "Securing Smart Home Devices against Compromised Cloud Servers", Poster at HotEdge, June 2020

[5] R. Trimananda, **A. Younis**, B. Wang, B. Xu, B. Demsky, G. Xu. "Vigilia: Securing smart home edge computing", Symposium of Edge Computing (SEC) October 2018.

Select Side Projects

Automatic AI Short-Form Video Generator

Created python pipeline to generate short-form videos using AI tools. Used various APIs to integrate content sources (background images/videos and script material), to create scripts and voice overs using generative AI and to sync subtitles to audio.

Video Game Computer Player (Game: "1010!")

Create AI algorithm for playing "1010!" (a 2D variant of Tetris on iOS). AI player used custom highly optimized CUDA engine back-end to evaluate all possible moves. Full game (including UI) replicated on desktop.

Awards and Honors

- **Roberto Padovani Scholarship:** Awarded to select interns for outstanding performance over summer.
- **Qualcomm Qualstar Award (2 times):** Awarded for excellent team work while at Qualcomm.

Other Experience

- Reviewer at Neurips 2024.
- In charge of research labs compute cluster (administration, upgrading hardware, coordination).
- Teaching assistant for Various Machine Learning Courses: CS 178, CS 275P.