

# Akshay Paruchuri

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## Interests

Computer Graphics, Computer Vision, Augmented Reality, Virtual Reality, Telepresence, Human-Computer Interaction

## Education

### University of North Carolina at Chapel Hill

DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

Advisors: Soumyadip "Roni" Sengupta and Henry Fuchs

Expected Completion: Spring 2026

Chapel Hill, NC

Aug 2021 - Present

### North Carolina State University

BACHELOR OF SCIENCE IN ELECTRICAL AND COMPUTER ENGINEERING

- Specialization: Embedded Systems and Sensors

Raleigh, NC

Sept 2014 - Dec 2019

## Experience

### University of North Carolina at Chapel Hill

GRADUATE RESEARCH ASSISTANT (ADVISORS: SOUMYADIP "RONI" SENGUPTA AND HENRY FUCHS)

Chapel Hill, NC

Aug 2021 - Present

- Investigate improvements toward the robustness of photoplethysmography (PPG) estimation using cameras. I work with Soumyadip "Roni" Sengupta and collaborators (Daniel McDuff and Xin Liu) at Google Health on this project
- Work on experimental, bench-top setups for privacy-preserving, non-camera imaging of the human face and human body pose
- Work on projects at the intersection of computer vision, visualization, and human-computer interaction with Danielle Szafir, including the study of interfaces involved in emergency response scenarios
- Mentor undergraduate students toward distinct components of research projects - for example, accurate simulation of experimental setups in Unity or synthetic generation of high quality avatars with measurable PPG signals
- Developed code in Python and C++ as extensions to an existing project in order to work toward physically plausible 3D reconstruction of human bodies
- Conducted experiments involving 3D reconstruction targeted for telepresence applications that involve a clinician and a patient involved in physical therapy
- Directed and helped write an NSF Smart and Connected Health (SCH) proposal related to augmented reality systems for the management of Parkinson's disease symptoms
- Helped publish a paper involving drone manipulation using augmented reality. This paper will appear in the Human-Robot Interaction 2022 Conference as a Late-Breaking Report (LBR)

### Nike

EMBEDDED SYSTEMS ENGINEER (MANAGER: VIKRAM MALHOTRA)

Beaverton, OR

Jan 2020 - Jul 2021

- Developed hardware, algorithms, and software toward novel, wearable consumer devices for experiences involving physical fitness

### Nike

EMBEDDED SYSTEMS ENGINEERING INTERN (MANAGER: VIKRAM MALHOTRA)

Beaverton, OR

May 2019 - Aug 2019

- Prototyped a feature-rich, non-form factor PCB to characterize power consumption in unique contexts and developed software toward meaningful gesture recognition using adaptive shoes

### Active Robotic Sensing Lab (ARoS), NC State

UNDERGRADUATE RESEARCH ASSISTANT (ADVISOR: DR. EDGAR LOBATON)

Raleigh, NC

Jan 2019 - May 2019

- Re-designed hardware and conducted experiments toward an autonomous robot for foraminifera identification

### Integrated Bionic MicroSystems Laboratory (iBionics), NC State

UNDERGRADUATE RESEARCH ASSISTANT (ADVISOR: DR. ALPER BOZKURT)

Raleigh, NC

Aug 2018 - Jan 2019

- Investigated application of non-contact electrodes to perform electrocardiogram and bio-impedance measurements on canines involved in animal assisted therapies

## Publications

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Angelos Angelopoulos, Austin Hale, Husam Shaik, **Akshay Paruchuri**, Ken Liu, Randal Tuggle, and Daniel Szafir. (2022). Drone Brush: Mixed Reality Drone Path Planning. To Appear in *Late-Breaking Reports at the IEEE/ACM International Conference on Human-Robot Interaction (HRI 2022)*. Sapporo, Japan.

## Skills

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<b>Design</b>	PCB layout (Altium and EAGLE), Circuit modeling (SPICE), Physics simulation (COMSOL)
<b>Programming</b>	C, C++, Python (NumPy, PyTorch, and TensorFlow), MATLAB, C#
<b>Hardware</b>	MCUs, FPGAs, Soldering, Hardware debuggers (SEGGER J-Link, ST-LINK), Oscilloscope, Logic Analyzer, Spectrum Analyzer, 3D printing

## Funding

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### **SCH: An Augmented Reality Neurorehabilitation System for Monitoring and Management of Motor Symptoms of Parkinson's Disease (\$1,186,393)**

PROJECT NUMBER: 1R01HD111074-01

Fall 2022 - Present

PIs: HENRY FUCHS, GEDAS BERTASIUS, DANIEL SZAFIR, DANIELLE SZAFIR, MICHAEL LEWEK, AND NINA BROWNER

- As a part of my graduate research assistantship at UNC Chapel Hill in Fall 2021 and Spring 2022, I significantly participated in various aspects of putting together and submitting the proposal for this grant, including but not limited to collaboratively writing technical sections of the proposal, conducting experiments to supplement the proposal, and coordinating meetings and submissions key to the proposal

## Awards

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- ASSIST Center Undergraduate REU (Summer 2018, sponsored by RTNN)
- ASSIST Center Undergraduate Research Fellowship (Fall 2018)
- NC State ECE Department Undergraduate REU (Fall 2018)
- NC State Dean's List (4.0 GPA in Spring 2019 and Fall 2019)

## Presentations

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- FORABOT: An Autonomous and Accessible System for Sorting Foraminifera*  
Poster Presentation, NC State Undergraduate Research and Creativity Symposium (Spring 2019)
- Thermoelectric Properties of  $\text{CuBi}_x\text{Sb}_{1-x}\text{Te}_2$  Bulk Alloys*  
Technical Talk and Poster Presentation, National Nanotechnology Coordinated Infrastructure (NNCI) REU Convocation (Summer 2018)
- Thermoelectric Properties of  $\text{CuBi}_x\text{Sb}_{1-x}\text{Te}_2$  Bulk Alloys*  
Poster Presentation, NC State Undergraduate Research and Creativity Symposium (Summer 2018)
- Thermoelectric Properties of  $\text{CuBi}_x\text{Sb}_{1-x}\text{Te}_2$  Bulk Alloys*  
Poster Presentation, ASSIST Center Research Symposium (Summer 2018)

## Other Projects

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### **STOP: Offline Spatio-Temporal 6-DoF Object Pose Estimation Using Transformers**

COMP 790 - VISUAL RECOGNITION WITH TRANSFORMERS PROJECT

Spring 2022

IN COLLABORATION WITH: ANGELOS ANGELOPOULOS

- Fine-tuned DETR (end-to-end object detection method using transformers) model using synthetic datasets (typically under 10K examples) generated using Unity Perception toolkit. Achieved a mean Average Precision (mAP) of 0.884 using purely synthetic training data and validation data consisting of Cheez-It cracker boxes. Also achieved promising qualitative results on images of Cheez-It cracker boxes in the wild (e.g., from Google or Instagram) to inform future efforts using synthetic data in this project scope.
- Contributed to a object pose estimation pipeline by developing key components such as position calculation and image cropping and object segmentation for subsequent input into an orientation estimator
- Code: Available soon (expected Fall 2022 following code-base clean-up)

## Improved Compression Using Foveation and Reinforcement Learning

COMP 755 - MACHINE LEARNING PROJECT

Fall 2021

IN COLLABORATION WITH: CHUN-HUNG (RAUL) CHAO, CHI-JANE CHEN, AND OMAR SHABAN

- Utilized image foveation techniques based on multi-resolution pyramid structures that utilize reinforcement learning and metrics such as Kullback–Leibler (KL) divergence and structural similarity index (SSIM) to determine how well areas of images most salient to humans are retained in as high of a resolution as possible
- Developed image foveation algorithm, dataset creation, and dataset evaluation code using Python libraries such as NumPy and PyTorch, as well as dataset visualization tools such as FiftyOne
- Code: [https://github.com/comp755-improved-foveation-using-ml/optimized\\_foveation\\_using\\_rl](https://github.com/comp755-improved-foveation-using-ml/optimized_foveation_using_rl)

## Mentoring

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- Mingxuan Li (UNC CS BS, Spring 2022)
- Yulu Pan (UNC CS BS, Fall 2022)
- Howard Jiang (UNC CS MS, Fall 2022)

## Authorizations

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- U.S. Citizenship
- Amateur Radio License (Granted by FCC, Call-sign: KN4IOS)