Niveditha Kalavakonda

BioRobotics Lab
Department of Electrical and Computer & Engineering
University of Washington, Seattle, WA, USA 98195

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https://nkalavak.github.io/
Google Scholar

Research Interests and Contributions

My research interests lie at the intersection of robot perception, control, and manipulation, with a primary focus on addressing challenges in unstructured, dynamic, and safety-critical environments to create lifesaving assistive healthcare technology. I have collaborated with healthcare providers in the states of Washington and California, and in Chennai, India to work on user-centric design of assistive tools. My work also strives to bring equitable access to robotics and graduate education for students from all backgrounds.

Education

University of Washington, Seattle Expected March 2025
PhD Candidate in Electrical and Computer Engineering
Certification: *Science, Technology and Society Studies*
Advisors: Prof. Blake Hannaford & Prof. Ryan Calo (UW Law)

University of Washington, Seattle June 2017
M.S. in Electrical and Computer Engineering
Thesis: Isosurface Visualization Using Augmented Reality for Improving Tumor Resection Outcomes
Committee: Prof. Blake Hannaford (Chair), Prof. Howard Chizeck

Amrita School of Engineering, Coimbatore - India May 2014
B.Tech in Electronics and Communication and Engineering

Relevant Work Experience

AI Center for Dynamics and Control, University of Washington *Aug. 2024 – Present*
Graduate Course Assistant
Manager: Dr. Alison Mehravari, Mentor: Michelle Hickner
Design course modules including lectures, assignments and discussion sections for AI/ML courses on topics including imitation learning, inverse reinforcement learning, and reinforcement learning.

PRO Unlimited at Apple Inc. *Oct. 2019 – March 2022*
Machine Learning Education - Course Facilitator
Manager: Dr. Ben Shapiro, Mentor: Jim Harmon
Lead office hours, discussions and grading for all Machine Learning courses within Apple as a part of the ML Education team. Worked on updates to course content, developed internal python packages and contributed to the open source project, Turi Create.

Amazon (Scout Robotics Team) *June 2020 – Sept. 2020*
Applied Scientist Intern Manager: Dr. Todd Hester, Mentor: Dr. Sheng Chen
Developed active learning pipeline to sample data efficiently for semantic segmentation and reduced annotation effort by 42% on average across neighborhoods. Integrated the redesigned sampling technique into the Scout production pipeline for data annotation.

Apple Inc. *June 2019 – Sept. 2019*
Machine Learning Intern
Manager: Dr. Krishna Sridhar, Mentor: Dr. Nick Jong
Led effort between Turi Create and internal Apple research teams to benchmark object detection networks. Implemented toolkit ports for Object Detection released in Turi Create 6.0

NVIDIA Research *June 2018 – Sept. 2018*
Research Intern
Manager: Dr. David Luebke, Mentor: Dr. Josef Spjut
Worked towards an alternative input mechanism on augmented reality headsets by understanding spatial and temporal dependencies in human-object interaction. Devised design parameters for synthetic object pose estimation dataset generated using Unreal Engine and a custom plugin

Indian Institute of Technology-Madras - Chennai, India *June 2014 – Aug. 2015*
Project Associate
Advisor: Asokan Thondiyath
Developed virtual reality-based simulator for teleoperation in surgical robots using Unity Game Engine. Integrated Phantom Haptic device with virtual environment for laparoscopic surgery and programmed an interface between the haptic device and a slave arm of custom surgical robot.

Publications

Preprints

* - equal contribution

4. **Collaborative Assistive Autonomy: A Pilot Study for Surgical Suction Support**
Niveditha Kalavakonda, Andrew Lewis, Blake Hannaford, Laligam Sekhar
IEEE Robotics and Automation Letters (In preparation).

3. **Exploring the Social Shaping of Teleoperated Surgical Robotics and its Effect on the Operating Room**
Niveditha Kalavakonda, Blake Hannaford, Ryan Calo
Science, Technology and Human Values Journal 2025 (in preparation) .

2. **Uncertainty-aware Surgical Instrument Segmentation**
Niveditha Kalavakonda, Blake Hannaford, Laligam Sekhar, Zeeshan Qazi.
Medical Image Analysis Journal 2024 (under review).

1. **2017 Robotic Instrument Segmentation Challenge**
Max Allan, Alex Shvets, Thomas Kurmann, Zichen Zhang, Rahul Duggal, Yun-Hsuan Su, Nicola Rieke, Iro Laina, **Niveditha Kalavakonda**, Sebastian Bodenstedt, Luis Herrera, Wenqi Li, Vladimir Iglovikov, Huoling Luo, Jian Yang, Danail Stoyanov, Lena Maier-Hein, Stefanie Speidel, Mahdi Azizian.
Pre-print:https://arxiv.org/abs/1902.06426

Conference Publications

6. **The Future of Skull Base Surgery: A View Through Tinted Glasses**
Laligam N. Sekhar, Gordana Juric-Sekhar, Zeeshan Qazi, Anoop Patel, Lynn B. McGrath Jr, James Pridgeon, **Niveditha Kalavakonda**, and Blake Hannaford.
World Neurosurgery (2020).

5. **Neurosurgical and Robotic Instrument Segmentation using Convolutional Neural Networks**
Niveditha Kalavakonda, Zeeshan Qazi, Laligam Sekhar, Blake Hannaford.
Workshop Proceedings in IEEE Conference on Computer Vision and Pattern Recognition (CVPR); 2019 June 16-20; Long Beach, California.

4. **Assistive Technology for Aiding Tumor Resection in Skull-Base Surgery**
Niveditha Kalavakonda, Laligam Sekhar, Blake Hannaford.
International Symposium on Medical Robotics 2019; 2019 April 03-05; Atlanta, Georgia.

3. **Learned Hand Gesture Classification through Synthetically Generated Training Samples**
Kyle Lindgren, **Niveditha Kalavakonda**, David Caballero, Kevin Huang, Blake Hannaford.
2018 IEEE/RSJ International Conference on Intelligent Robots and Systems; 2018 Oct 01-05; Madrid, Spain.

2. **Design and Development of Robot for Borewell Rescue**
John Jose Pattery*, **Niveditha Kalavakonda***, Jitu Verghese Kurian, Lekha Mohan, Jippu Jacob.
Proceedings of the 14th IFToMM World Congress; 2015 Oct 25-30; Taipei, Taiwan.

1. **Development of Virtual Reality Based Robotic Surgical Trainer for Patient-specific Deformable Anatomy**
Niveditha Kalavakonda, Sourav Chandra, Asokan Thondiyath.
Proceedings of the 2nd International Conference of Robotics Society of India: Advances in Robotics; 2015 July 2-4; Goa, India (ACM Publication).

Peer-Reviewed Non-Archival Publications

11. **Fallacy of Human Judgement: Estimating effects of over-reliance on AI for Data Annotation**
Niveditha Kalavakonda, Madeleine Grunde-McLaughlin, Wisdom O. Ikezogwo, Mehmet Saygin Seyfioglu.
International Conference on Robotics and Automation. London, UK. May 29-June 02, 2023.

10. **Metrics to Estimate Uncertainty and Communication of Competence Within Human-Robot Teams for Surgery**
Niveditha Kalavakonda, Blake Hannaford.
International Conference on Robotics and Automation. London, UK. May 29-June 02, 2023.

9. **Online Segmentation and Tracking of Surgical Instruments for Computer-Aided Surgery**
Niveditha Kalavakonda, Zeeshan Qazi, Laligam Sekhar, Blake Hannaford.
International Conference on Robotics and Automation. London, UK. May 29-June 02, 2023.

8. **Concurrent Segmentation and Tracking of Surgical Instruments**
Niveditha Kalavakonda, Zeeshan Qazi, Laligam Sekhar, Blake Hannaford.
🏆 **2nd Place, ACM Student Research Competition**.
Grace Hopper Celebration 2020 (Virtual).

7. **Instance Segmentation and Tracking of Surgical Instruments for Computer Aided Surgery**
Niveditha Kalavakonda, Zeeshan Qazi, Laligam Sekhar, Blake Hannaford.
International Symposium on Medical Robotics 2020 at Atlanta, Georgia (Virtual).

6. **Robotic and Neurosurgical Instrument Segmentation for Development of Intelligent Surgical Assitant**
Niveditha Kalavakonda, Zeeshan Qazi, Laligam Sekhar, Blake Hannaford.
🏆 **1st Place, ACM Student Research Competition**.
Grace Hopper Celebration 2018, Houston, Texas. 26 – 28 September, 2018.

5. **Isosurface Visualization Using Augmented Reality for Improving Tumor Resection Outcomes**
Niveditha Kalavakonda, Zeeshan Qazi, Laligam Sekhar, Blake Hannaford.
🏆 **1st Place, Overall Graduate Student Poster**.
🏆 **1st Place, ACM Student Research Competition**.
CMD-IT/ACM Richard Tapia Conference 2018. Orlando, Florida. 19 – 22 September, 2018.

4. **Gesture-based Control of Display Devices for Surgical Procedures**
Niveditha Kalavakonda, Nava Aghdasi, Blake Hannaford.
International Conference on Cyber-Physical Systems, Chennai, India. 21 April, 2018.

3. **Isosurface Visualization Using Augmented Reality for Improving Tumor Resection Outcomes**
Niveditha Kalavakonda, Blake Hannaford, Laligam Sekhar.
International Computer Vision Summer School, Sicily, Italy. 11 September, 2017

2. **Surgical Assistant for Neurosurgical Procedures**
Niveditha Kalavakonda, Rakshith Shetty, Laligam Sekhar, Blake Hannaford.
Robotics and Automation for Humanitarian Applications Conference, Amrita University, Kollam, India. 18-20 December, 2016.

1. **Touch-free Navigation System for Assisting Surgeons**
Niveditha Kalavakonda*, Nava Aghdasi*, Blake Hannaford.
6th Joint Workshop on Computer/Robot Assisted Surgery, Pisa, Italy. 13 September, 2016.

Selected Awards and Honors

🏆 2nd Place, UW 3-Minute Thesis Competition *2024*
Selective graduate thesis competition held annually at the University of Washington

Yang Award for Outstanding Doctoral Student, UW-ECE *2024*
Awarded the Outstanding Thesis Award at UW-ECE, presented to 1 student

Husky 100 *2024*
Awarded to 100 students from all three University of Washington campuses (60,000+ students)

iREDEFINE Fellow *2024*
Selective, intensive NSF-funded workshop for graduate students from historically marginalized communities interested in ECE academic careers

EECS Rising Stars *2023*
Selective, intensive workshop for graduate students from historically marginalized communities interested in EECS academic careers

Outstanding Female Engineer Award *2023*
University of Washington - Women Engineers Rise (WE Rise)

Student Impact Award, UW-ECE *2022*
Awarded annually by UW-ECE to student with most impact through service

Irene Peden Fellowship *2022*
Awarded annually to 1 graduate student @ UW-ECE

Rushmer Fellowship *2022*
Awarded to support 1 graduate student @ UW-ECE

RSS Pioneers *2021*
Selected for workshop bringing together top early career researchers in Robotics

Outstanding Female Engineer Award *2018*
University of Washington - Society of Women Engineers

Google PhD Fellowship - Department Nominee *2018*
1 of 2 nominees from UW-ECE

Research Fellow *2017*
Laboratory for Analysis of Motion and Performance - UW, Seattle

Pacific Science Center Communication Fellow *2017*
Pacific Science Center - Seattle

Amazon Catalyst Fellow *2017*
Received $100,000 funding award for one year for research on Assistive Surgical Robot

Travel Grants

Conference on Computer Vision and Pattern Recognition Travel Grant *2024*
Awarded through Diversity, Equity and Inclusion Grant

International Conference on Robotics and Automation Travel Grants *2023*
Awarded through IEEE Student Travel Grant and UW Graduate School

International Conference on Machine Learning Travel Grant (Virtual) *2020*
Awarded by Apple through Women in Machine Learning

Conference on Computer Vision and Pattern Recognition Travel Grant *2019*
Awarded through Women in Computer Vision

International Symposium on Medical Robotics Travel Grant *2019*
Awarded through IEEE

Teaching and Mentorship

- **Teaching: University of Washington, Seattle**
  - Models of Robot Manipulation — Spring 2024

- **Teaching Assistant: University of Washington, Seattle**
  - EE447 Control Systems Analysis I — Fall 2016, Fall 2018, Fall 2019, Fall 2024
  - EE498/598 Engineering Entrepreneurial Capstone — Winter-Spring 2019, Winter 2020
  - EE271 Digital Circuits and Systems — Spring 2018
  - EE448-449 Controls Capstone — Winter-Spring 2016, Winter 2017
  - ENGR202 Introduction to Engineering — Summer 2016
- **Research Mentor: University of Washington** — Since 2017
  Generate projects of appropriate scope for Masters and undergraduate students; meet regularly to provide technical and logistical guidance for students; assist students in learning to properly propose research objectives, track their progress, and document their results.
  - Masters Researchers: Astitwa Lathe, Anirudh Velamore
  - Undergraduate Researchers: Cece Lovelace, Jonathan Shu, Yicheng Wang, Aman Dutta, Shaobin Wang, Savanna Yee, Yangyu Chen, Chenghao Chen, Yihao Li
  - High School Researcher: Eesha Jain
- **Undergraduate Research Mentor: R.M.K Engineering College, Chennai, India** — 2017-2019
  Mentored 9 undergraduate students in Computer Science with interests in Robotics and Virtual Reality by introducing relevant literature to projects of interest, tracking progress and collaborating on publications.
  - Sreeja Vaddi, S. Varsha, Arthi Jennifer, Lakshmipriya Selvaraj, P. Preethi, Chadipiralla Sai Varsha, Vinitha K.S., Rohithnathan Baskaran, Sailendra Guttikonda

Non-Thesis Research Projects at UW

Factorized Neural Layers for Semantic Segmentation Status: *Ongoing*
Research Partners: University of Washington/Microsoft Research/Stanford Medical Center Seattle, WA

- Analyzing performance effects of spectral initialization and Frobenius decay on networks containing factorized layers for 2D surgical robotics data
- Examining the viability of such initialization and regularization techniques for 3D medical imaging data

Cochlear Implant Tune Tool Status: *Completed*
Research Partners: University of Washington/Seattle Children's Hospital Seattle, WA

- Developed software tool for patients with cochlear implants to use in for mapping in telemedicine settings
- User studies underway with remote partner sites in collaboration with audiologists at Seattle Children's Hospital

Network characterization for robotic surgery Status: *Completed*
Research Partners: University of Washington/Seattle Children's Hospital/Ocean Beach Hospital Seattle, WA

- Worked with an interdisciplinary team across cardiology, economics, cybersecurity, sociology, law and surgical robotics to study effects of teleoperation on surgical teams
- Co-developed a teleoperation simulation study to analyze network effects on transmission of surgical robot data

Intraoperative Guidance Mechanisms in Surgical Robotics Status: *Completed*
Research Partners: University of Washington Medical Center Seattle, WA

- Designed a surgical simulator for intraoperative volume registration of CT scans using HoloLens
- Evaluated low-cost real-time tracking of two to four instruments simultaneously for Skull Base Surgery using lighthouse tracking system from Valve
- Implemented and performed a comparative analysis on automated audio transcription of surgeon utterances using three different speech APIs

A platform for evaluating the benefit of virtual travel for Alzheimer patients Status: *Completed*
Research Partners: University of Washington/Booz-Allen Hamilton Seattle, WA

- Developed three scenes modeling levels of difficulty for evaluating travel for patients with Alzheimer's in collaboration with Booz-Allen Hamilton
- Integrated a passive Brain-Computer Interface for patient evaluation using MUSE Electroencephalography (EEG) device
- Developed analysis of EEG response on Tableau for studying stimuli-response correlation

Biofeedback design for myoelectric prosthesis training Status: *Completed*
Research Partners: University of Washington/Veterans Affairs Seattle Seattle, WA

- Prototyped and tested three types of haptic devices to train new myoelectric arm users on gripping tasks while using prosthesis
- Integrated vibrotactile haptic device with raw Electromyography (EMG) data from Myo Gesture Control Armband
- Performed preliminary user study on able-bodied subjects for device comparison to integreate with HTC Vive platform

Touch-free Navigation system for assisting surgeon in operation theater Status: *Completed*
Research Partners: University of Washington Medical Center Seattle, WA

- Project developed for enabling interaction with CT and MRI scans intraoperatively (Language: C++, MATLAB)
- Worked on training Haar cascade classifier for gesture recognition and interfaced with display device
- Tested with other types of classifiers (SVM, HOG, Boosting) for static gesture classification

Haptics for texture recognition using prosthesis Status: *Completed*
Research Partners: University of Washington Seattle, WA

- Developed a texture identification algorithm for identifying standard object surface through vibrational feedback
- Implemented haptics module to use as interface for prosthesis users to realize texture by a peak detection algorithm

Talks

- **Surgical Scene Understanding Towards Human-Centered Collaboration in Robotic Surgery**
  - COMSC-341CV Computer Vision Guest Lecture, Mount Holyoke November 2024 (Virtual)
- **Role of Computer Vision in Revolutionizing Computer-Assisted Surgery**
  - UW Continuum Program for Taiwanese Nursing Students February 2024
  - Women in Data Science - Puget Sound 2022 April 2022(Virtual)

  - Grace Hopper Celebration — September 2020 (Virtual)
  - Google Developer Fest, Seattle — September 2019)
  - PyLadies, Seattle — June 2019
  - HopperX1 Conference, Seattle, WA — March 2019
- **Segmentation and Tracking of Endoscopic and Microscopic Surgical Instruments**
  @ Workshop on Data-Driven Methods for Robotic Minimally-Invasive Surgery,
  International Symposium on Medical Robotics (ISMR). — November 2021
- **Future of Healthcare - Surgeons and Robot Sidekicks**
  - Shorecrest High School Science Club, Seattle — February 2021(Virtual)
  - Pacific Science Center Seattle — November 2019
- **Google Developer Group - Seattle**
  - Machine Learning at Google I/O 2019 — May 2019
  - TensorFlow Dev Summit 2018 Extended — April 2018
- **Robotics in Neurosurgery** @ Seminar on Engineering Research for Transitioning Freshman,
  University of Washington, Seattle. — April 2018
- **Social Responsibility and Ethics in Artificial Intelligence and Extended Reality**
  - ACM Richard Tapia Celebration of Diversity in Computing, Orlando, Florida (BoF session) — September 2018
- **Surgical Robotics: A Developing Country's Perspective**
  - R.M.K Engineering College, Chennai, India — December 2016
  - R.M.K College of Engineering and Technology (CET), Chennai, India — December 2016
- **Importance of Robotics in Today's World** @ R.M.K Engineering College, Chennai, India — August 2014

Panels

- **Demystifying Graduate School**
  - Society of Women Engineers, University of Washington — January 2024
  - WE Rise Conference, University of Washington, Seattle — April 2023
  - 30th Women in Science and Engineering Conference, University of Washington — February 2021
- **Embedding Social Responsibility and Ethics into the Engineering Lifecycle**
  @ Grace Hopper Celebration — October 2019
- **Women in Computer Science** @ Girls Who Code, Discovery Corps, Seattle — January 2019
- **A new Tech Consciousness: Social Responsibility and Ethics** @ Grace Hopper Celebration — September 2018
- **Navigating the Balancing Act of Priorities and Time**
  - 27th Women in Science and Engineering Conference, University of Washington — March 2018

Tutorials/Workshops

- **Women in TensorFlow** @ Co-Lead Workshop Series. Women in Data Science at Google, Kirkland — Oct. - Dec 2019
- **Workshop on Computer Vision using Python** @ ACM Student Chapter, Kavaraipettai, Chennai — January 2019
- **Developing AR/VR Applications on Android** @ ChickTech Seattle — February 2018
- **Get Your VR Game On!**
  - Pratyusha Engineering College, Chennai, Tamil Nadu, India — December 2017
  - Women Who Code, Chennai, Tamil Nadu, India — December 2017
- **Introduction to AR/VR Development Using Unity3D**
  - Women Who Code Tech Spark, Seattle — September 2017
  - ACT-W Conference, Seattle — September 2017

Skills

- **Languages(Fluent)**: Python, C++, Julia, C#, MATLAB, C, LaTeX, Wolfram
- **Languages(Familiar)**: CUDA, Node.js, CSS, HTML, Java, Assembly

- **Frameworks and Tools**: Robot Operating System (ROS), ROS2, Drake, Gazebo, RViz, CVX, Unity3D, Git, PyTorch, TensorFlow, TensorFlow Lite, OpenGL, Docker, Photoshop, Illustrator, Blender
- **Fabrication**: 3D printing, Laser cutting

Relevant Leadership and Professional Service

Reviewer for Machine Learning and Robotics Tracks in Conferences: ISMR (2023, 2024),MICCAI (2023, 2024), IROS (2019, 2021, 2022 & 2024), ECCV (2024), CSCW (2024), CVPR (2024 Workshop), ICRA (2020), ICLR (2021 Workshop), NeurIPS (2019 & 2020 Workshops), Women in Data Science - Puget Sound (2020-2022), Grace Hopper Celebration (2018-21), Hopperx1 Seattle (2017, 2019)

Workshop Organizer
Worked with researchers at different universities to organize workshops

- Founding Board Member, Women in Computer Vision; Focus on Mentorship & Events starting Nov. 2022
- General Chair, RSS Pioneers Workshop, Robotics: Science and Systems (RSS) 2022
- Women in Computer Vision (WiCV) Workshop at IEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) 2021 & 2022
- Women in Computer Vision (WiCV) Social at International Conference on Computer Vision (ICCV) 2021
- Machine Learning for the Developing World Workshop at Neural Information Processing Systems (NeurIPS) 2020 & 2021
- Breakout session on Disentagled Representations, Women in Machine Learning (WiML) Unworkshop at International Conference on Machine Learning (ICML) 2020
- Women in Data Science – Puget Sound (Speaker Selection Committee) for 2020-2023

Department Leadership roles - Electrical and Computer Engineering, UW
Helped foster a community within the department — Seattle, WA

- Curriculum Committee Representative, Graduate Applicant Support Program (2023-2024)
- Lead Organizer, Graduate Applicant Support Program (2021-2024)
- Lead Organizer, AMA with Current Graduate Students (2020-2024)
- Diversity, Equity and Inclusion Committee Facilitator (2020-2022)
- Founding Member, Student Advisory Council (2019-2020)
- Founding Chair, IEEE Women in Engineering (2017-2018)
- Officer, Graduate Student Association (2015-2017)
- Events Officer, IEEE at UW (2015-2018)

Volunteer Projects, Robotics and Women in Tech communities — 2016 - 2022
Organize/Present at community events — Seattle, WA

- Volunteer and Judge, FIRST Robotics, Washington State
- Member of Education team for Women in Data Science Seattle, responsible for organizing study groups, speed mentoring, workshop series, and book clubs
- Mentor for TensorFlow and Computer Vision events at Google Developer Group Seattle
- Committee member for Career Fair and Sponsorship committee at HopperX1 Seattle 2017 and 2019 and AI committee member for Grace Hopper Celebration 2019-2021
- Meet a Scientist (Surgical Robotics), Girls Night Out and Tinker Tank (Robotics) volunteer at Pacific Science Center-Seattle

Regional Student Representative - IEEE Robotics and Automation Society — 2017-2022
Coordinate efforts by different IEEE RAS chapters — IEEE Regions 1-7

- Represent needs of students in the Robotics and Automation at IEEE-RAS meetings and conferences
- Ensure relevant talks and workshops for students at conferences and events in North America
- Communicate information from leadership team to all IEEE-RAS chapters in regions 1-7

References

Blake Hannaford Ph.D Advisor
Professor, Electrical and Computer Engineering
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