CURRICULUM VITAE

Pratik Kunapuli
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ORCiD
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Google Scholar
NSF Graduate Research Fellow

EDUCATION

University of Pennsylvania
Ph.D. in Computer and Information Science *May 2026 (Expected)*
Advisors: Vijay Kumar, Ph.D. and Dinesh Jayaraman, Ph.D.
Research Area: Reinforcement learning for control of agile aerial robots; mixed imitation learning and reinforcement learning from demonstrations; sim2real transfer of control policies

Georgia Institute of Technology
M.S. in Electrical and Computer Engineering *August 2020*
Thesis Option: "Online Adaptive User State Estimation in a Powered Hip Exoskeleton"
Relevant Coursework: Mathematical Foundations of Machine Learning, Statistical Methods in Machine Learning

B.S. in Computer Engineering, summa cum laude: Highest Honors *May 2019*
Minor in Robotics
Relevant Coursework: Control System Design, Introduction to Robotics and Automation, Feedback Control Systems, Machine Learning, Data Structures and Algorithms, Statistics and Applications

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RESEARCH EXPERIENCE

Graduate Student Researcher
General Robotics, Automation, Sensory and Perception (GRASP) Lab *August 2020 – Present*
University of Pennsylvania
Advisors: Vijay Kumar, Ph.D. and Dinesh Jayaraman, Ph.D.

- Reinforcement learning-based control for agile aerial robots
  - Using model-free deep reinforcement learning (PPO) to train aerial manipulator in reaching tasks
  - Leveraging differential flatness to reduce complexity of reaching tasks by modifying action modality into ego-centric control
- Reinforcement learning from demonstrations for aerial robots
  - Combining imitation learning and reinforcement learning for improved sample efficiency in training model-free controllers for quadrotor control
  - Differential flatness-based trajectories for expert guidance, goal conditioned reinforcement learning for control

Graduate Student Researcher
Exoskeleton and Prosthetic Intelligent Control Lab *August 2019 – August 2020*
Department of Mechanical Engineering
Georgia Institute of Technology
Advisor: Aaron J Young, PhD

- Developed state-of-the-art user state estimation techniques for wearable robotic applications using machine learning and sensor fusion
    - User-independent gait phase, walking speed, and incline estimation for hip exoskeletons
    - Online adaptation of user-independent machine learning models to optimize model performance in real-time
- Pioneering reinforcement learning paradigm for human augmentation in powered hip exoskeletons
    - First of its kind human-in-the-loop based optimization of metabolic cost in an autonomous hip exoskeleton using reinforcement learning
    - Online adaptive user state and environment estimation of gait phase, walking speed, and slope for better informed torque application

Undergraduate Research Student
Exoskeleton and Prosthetic Intelligent Control Lab *August 2017 – August 2019*
Department of Mechanical Engineering
Georgia Institute of Technology
Advisor: Aaron J Young, PhD

- Developed a robotic prosthesis for assisting patients with transfemoral amputations
    - Developed a 3-tier hierarchical controller featuring closed loop torque control, a finite-state machine, and user intent recognition
    - Implemented 6-axis load-cell, CAN bus protocol for motor commands, and SPI-based IMU communication
- Created sensor-fusion based gait phase estimation for a powered hip exoskeleton
    - Applied supervised learning techniques to develop a continuous phase estimation
    - Eliminated auxiliary, distal sensors
    - Allowed for more accurate biological torques to be applied, improving assistance to user
- Explored the human robot interaction when using powered prosthesis through biomechanical analysis

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PROFESSIONAL EXPERIENCE

Motion Control Intern
Research and Development *May 2016 – August 2016*
Lexmark International

- Performed data analysis to predict poorly performing motors with 95% accuracy

- Created and implemented testing protocol in engine firmware for motor systems
- Improved detection of manufacturing defects by 15%

Software Engineering Intern
Special Projects *April 2015 – August 2015*
Sea Box Incorporated

- Rapidly prototyped control system for wireless container-moving vehicle
- Developed final control system software for wireless operation of vehicle
- Implemented autonomous features, reducing driver training time by 15%
- Designed dashboard for live-streaming of diagnostic information

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PEER-REVIEWED PUBLICATIONS (J – Journal, C – Conference, A – Abstract)

- C4: **P. Kunapuli**, J. Welde, D. Jayaraman, V. Kumar, "Leveraging differential flatness for model-free reinforcement learning-based control of an aerial manipulator" – In Preparation
- C3: J. Welde*, N. Rao*, **P. Kunapuli***, D. Jayaraman, and V. Kumar**, "**Leveraging Symmetry to Accelerate Learning of Trajectory Tracking Controllers for Free-Flying Robotic Systems", International Conference on Robotics and Automation (ICRA) – Under Review
- C2: A. Bhattacharya, N. Rao, D. Parikh, **P. Kunapuli**, N. Matni, and V. Kumar, "Vision Transformers for End-to-End Vision-Based Quadrotor Obstacle Avoidance", International Conference on Robotics and Automation (ICRA) – Under Review
- J3: J. Maldonado-Contreras, K. Bhakta, J. Camargo, **P. Kunapuli**, A. Young, "User- and Speed-Independent Slope Estimation for Lower-Extremity Wearable Robots", *Annals of Biomedical Engineering*, November 2023 – In Press [PDF] [BMES]
- J2: **P. Kunapuli***, I. Kang*, A. Young, "Real-Time Neural Network-Based Gait Phase Estimation using a Robotic Hip Exoskeleton", *IEEE Transactions on Medical Robotics and Bionics*, February 2020 – In Press [PDF] [IEEE]
- C1: I. Kang, **P. Kunapuli**, H. Hsu, A. Young, "Electromyography (EMG) Signal Contributions in Slope and Speed Estimation Using Robotic Hip Exoskeletons", *IEEE International Conference on Rehabilitation Robotics (ICORR),* March 2019 – In Press [PDF] [IEEE]
- J1: K. Bhakta, J. Camargo, **P. Kunapuli**, L. Childers, A. Young, "Impedance control strategies for enhancing sloped and level walking capabilities for individuals with transfemoral amputation using a powered prosthesis", *Military Medicine*, November 2018 – In Press [Military Medicine]
- A1: **P. Kunapuli**, I. Kang, A. Young, "Real-Time Neural Network-Based Gait Phase Estimation using a Robotic Hip Exoskeleton", BMES Annual Meeting, Atlanta, GA, October 2018 [PDF]

PRESENTATIONS (T – Talk, P - Poster)

- P3: **P. Kunapuli**, I. Kang, A. Young, Neural Network Based Estimation of Gait Phase in a Powered Hip Exoskeleton, *Biomedical Engineering Society Conference*, Atlanta, GA, October 2018
- P2: **P. Kunapuli,** J. Li, A. Young, Robotic Human Augmentation using a Powered Prosthetic Device, *Institute of Robotics and Intelligent Machines Spring Symposium*, April 2018
- P1: **P. Kunapuli**, J. Li, A. Young, Robotic Human Augmentation using a Powered Prosthetic Device, *Vertically Integrated Projects Innovation Competition*, March 2018
    - 1st Prize, Robotics Track ($2000)

AWARDS AND HONORS

- National Science Foundation Graduate Research Fellowship Awardee (NSF GRF) 2019
- 1st Place Poster, Robotics Track, V.I.P. Innovation Competition ($2000) *2018*
- Warren Batts Innovation Scholarship ($4000) 2018
- President's Undergraduate Research Award (PURA) ($1700) Summer *2018, Fall 2018*
- Highest honors upon graduation of B.S. *2019*
- Faculty Honors *Fall 2017, Fall 2018*
- Dean's List *Fall 2015, Fall 2016, Spring 2018*
- Winner, Lexmark Summer Student Symposium *2016*

OUTREACH PROGRAMS

- National Robotics Week, Georgia Tech *2017 – Present*
- Institute of Robotics and Intelligent Machines Lab Showcase 2017 - *Present*
- Mentor, FRC 1648 G3 Robotics *2015 – Present*

PROFESSIONAL MEMBERSHIPS AND SERVICES

- Student Member, IEEE *2018 – 2019*
- Member, Eta Kappa Nu (ECE Honors Society) *2018 – 2019*