Geoffrey Clark

PhD Researcher - **Machine Learning for Robot Prediction and Control** - **Interactive Robotics Lab**

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Highlighted Skills

Languages: Python, C++, MATLAB, Embeded C
Frameworks: Tensorflow, Keras, Robot Operating System (ROS), Microchip Embeded Coder, CANopen, FreeRTOS
Tools: Visual Studio Code, MuJoCo, Tensorboard, LaTeX, Pybullet Simulator, git, Isaac Sim

Research: Statistical Machine Learning, Optimal Control, Behavioral Cloning, Deep Reinforcement Learning
Engineering: Mechatronics, Control Theory, Board Design, Sensor Implementation, Soldering, Machine Tools
Operating Systems: Linux Ubuntu, Windows

Experience

Research Associate
📅 Aug 2018 – Dec 2022

Interactive Robotics Lab - Arizona State University

- Built data pipeline to connect inertial, force, and vision data to Machine Learning models for fast (500Hz) inference.
- Create a monocular depth prediction deep neural network to classify terrain and detect objects such as stairs or curbs in order to incorporate environmental information into control for robotic prosthetics.
- Generate probabilistic models for control of powered prosthetics in human-robot symbiotic walking. ***Papers:*** ICRA '20.
- Produce safe controllers by ensuring constraint satisfaction of learned policies for wearable devices.***Papers:*** CoRL '22.
- Integrate optimal control methods with statistical machine learning to adapt control outputs from predictions made by probabilistic models to make wearable devices more robust, safer, and more ergonomic. ***Papers:*** Corl '20., T-RO '22.
- Create adaptable policies via reinforcement learning on legged robots with domain randomization for sim-to-sim transfer.
- Publish open source libraries and tutorials to aid in independent use and evaluation of my research. ***Repo:*** IntPrim **git**

Human-Robot Collaboration Internship
📅 May 2021 – Aug 2021

Honda Research Institute

- Formulate a perception library to collect and process camera, tactile, and human motion data for robotic experiments.
- Generate a neural network architecture to perform model predictive control (MPC) and facilitate safe and robust human-robot interactions. Culminated in the submission patent application for methods relating to our novel MPC.

Engineering Consultant
📅 May 2019 – Apr 2021

SpringActive inc.

- Develop, prototype, and test mechatronics for novel quasi-passive prosthetic ankle accommodates changes in stride.
- Lead interaction with university partners to design EMG sensor and conditioning board.

Bioforce

- Engineer hardware and software ecosystem to aid in processing blood samples for a novel cancer screening process.

Mechatronics Engineer
📅 Jan 2014 – May 2018

SpringActive inc.

- Designed controls and electronics for the Ruggedized Odyssey Ankle, which is the only prosthetic ankle to demonstrate fully powered walking and running while completely submerged in water, over uneven terrain, and in unconstrained environments. This technology was later sold to Össur. ***Video:*** here
- Influenced major electrical engineering and controls decisions on the development of powered prosthetics and exoskeletons. Directly drove state of the art controls and mechatronics research, which helped to secure multiple licensing agreements and over $8.5 million of government funding including SBIR phase I and II grants.
- Managed the design of multiple sensor packages including inertial, magnetic encoder, capacitive touch, temperature, force, and high fidelity current sensors from conception to implementation.
- Improved data collection process to allow for live streaming and plotting of data through a custom GUI, which reduced tuning time for individuals by 10X.

Electrical Engineering Internship
📅 Jan 2013 – Dec 2013

SpringActive Inc.

- Contributed with development of prosthesis design, control, tuning, and human subject testing.
- Engineered communications drivers in embedded system to improve data rate by 8x and computational efficiency by 10x.

Formal Education/Degrees

PhD Electrical Engineering (Dean's Fellow)
📅 Aug 2018 – Expected May 2022

Ira A. Fulton Schools of Engineering - Arizona State University

- Research Topic: Integration of machine learning with optimal control to transform the state of the art in robotic control.
- Focused coursework in: AI/machine learning, linear and nonlinear control systems, neural networks, and optimal filtering.
- Lead communications with perspective students by facilitating lab meetings and student interviews.

Electrical Engineering (Masters)
📅 Aug 2016 – Jul 2018

Ira A. Fulton Schools of Engineering - Arizona State University

- ***Dissertation:*** Learning Interaction Primitives for Biomech. Prediction.
- Worked on novel applications of machine learning toward robotic prosthetics, while developing research skills.
- Implemented a reinforcement learning algorithm on a bi-manual robot to throw basketballs into a hoop.

Engineering-Robotics (BSE)
📅 Aug 2009 – May 2013

Ira A. Fulton Schools of Engineering - Arizona State University

- Focus areas in Electrical and Robotics Engineering to learn the fundamentals of engineering, robotics, and control.

Personal Interests

🎹 Piano   📷 Film Photography   🏍 Motorcycle Restoration   🐾 Dogs   🔨 Woodworking

Publications

G. Clark, X. Liu, H. Ben Amor *A New Approach to Nonlinear Recursive Estimation: Learning Direct Stochastic Filters*
Under Review
📅 TBD

G. Clark, X. Liu, H. Ben Amor *Differentiable Ensemble Kalman Filters for Robot State Estimation*
Under Review
📅 TBD

K. Majd, **G. Clark**, T. Khandait, S. Zhou, S. Sankaranarayanan, G. Fainekos, H. Ben Amor   *Safe Robot Learning in Assistive Devices through Neural Network Repair*
Conference on Robot Learning (CoRL)
📅 Dec 2022

G. Clark, and H. Ben Amor.   *Learning Ergonomic Control in Human-Robot Symbiotic Walking*
Transactions on Robotics (T-RO)
📅 Oct 2022

G. Clark, J. Campbell, and H. Ben Amor.   *Learning Predictive Models for Ergonomic Control of Prosthetic Devices*
Conference on Robot Learning (CoRL)
📅 Nov 2020

G. Clark, J. Campbell, S.M.R. Sorkhabadi, W. Zhang, and H. Ben Amor.   *Predictive Modeling of Periodic Behavior for Human-Robot Symbiotic Walking*
International Conference on Robotics and Automation (ICRA)
📅 May 2020

G. Clark.   *Learning Interaction Primitives for Biomechanical Prediction*
Arizona State University, Dissertation Publishing
📅 Jul 2018

INVITED TALKS AND POSTERS

Certifiably-correct Control Policies for Safe Learning and Adaptation in Assistive Robotics
Trustworthy Robotics Workshop at NeurIIPS
📅 Nov 2022

Learning Ergonomic Control for Powered Prosthetic Devices
Dynamic Walking Conference
📅 Jun 2022

Environment-Aware Prediction for Symbiotic Walking
Online Machine Learning-Based Control of Lower Limb Exoskeletons at ICRA
📅 Jun 2022

Machine Learning for Adaptive Terrain Sensing and Control

Powered Leg Prosthesis Workshop at (IROS) 📅 Oct 2020

Learning to Walk with Prosthetics
International Symposium on Artificial Intelligence and Brain Science (AIBS) 📅 Sep 2020

Optimal Control for Robotic Prosthetics with Interaction Primitives
Dynamic Walking Conference 📅 Jun 2020

Predictive Biomechanics for Dynamic Walking
Dynamic Walking 📅 Jun 2019

The Human and Robotic Connection
Space to Thrive Public Panel 📅 Jun 2019

Better teaming through visual cues: how projecting imagery in a workspace can improve human-robot collaboration
International Conference on Robotics and Automation (ICRA) 📅 May 2019

Awards

Deans Fellowship
Awarded by Arizona State University: Ira. A Fulton School of Engineering, ECEE Dean's Office 📅 2018 - 2022

Arizona Graduate Scholar Award
Awarded by Arizona State University: Ira. A Fulton School of Engineering, Program Chair 📅 2016 - 2018

Sparkfun Autonomous Vehicle Challenge
Awarded by Sparkfun Electronics **(Video 2012)** **(Video 2013)** 📅 1st place - 2012, 2nd place - 2013

Deans List
Awarded by Arizona State University: Polytechnic School of Engineering, Deans Office 📅 2009 - 2013

National Underwater Robotics Competition: Collegiate division
Awarded by NURC in partnership with NASA and Honeywell 📅 1st place - 2010, 1st place - 2009, 2nd place - 2008

Mentorship & Competitions

Robotics Team Mentor 📅 2020 - Ongoing
Desert WAVE, Women in Autonomous Vehicle Engineering
- Teach courses on Deep Learning and lead the integration of object detection into the autonomous underwater robots with the Arizona State University women's robotics team.

Robot Design/Fabrication 📅 May 2014 - Jul 2014
Spare Parts Movie (Lionsgate Entertainment)
- Drafted and machined the Cornell remote underwater vehicle (ROV) including fabrication of: working sensor packs, controller, and water-proof housing, for the movie Spare Parts.

Robotics Team Coach 📅 2010 – 2013
Highland High School, Gilbert, AZ
- Mentored high school students competing in the FIRST robotics competition.

Track and Field Coach - Pole Vaulting 📅 2010 – 2013
Highland High School, Gilbert, AZ
- As the head pole vault coach for the track and field team, I designed daily workouts, trained students, ran competitions, and hoped to motivate confidence and self discipline for students.

Physics and Engineering Tutor 📅 2010 – 2013
Independent
- Tutor students in introductory physics and engineering coursework.

Engineers in the Classroom 📅 2011 – 2013
Grade School Science Instructor
- Give hands on instruction in science, math, and engineering lessons to students at underprivileged schools.