Alphonsus Adu-Bredu

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Summary

I am interested in the integration of high-level planning with low-level control of dynamically complex robots (like bipedal humanoid robots) in a fashion that is taskable and reactive to unexpected changes in the robot's environment. My expertise include task and motion planning, reactive control, predictive control, numerical optimization and technical computing.

Education

Ph.D. University of Michigan — Ann Arbor, MI
Robotics — *2020 – 2023*
- Advisor: Professor Odest Chadwicke Jenkins
- Dissertation Title: Long-Horizon Planning Under Uncertainty and Geometric Constraints for Mobile Manipulation by Autonomous Humanoid Robots

Msc. University of Michigan — Ann Arbor, MI
Robotics — *2020 – 2022*
- Advisor: Professor Odest Chadwicke Jenkins

Bsc. Tufts University — Medford - MA
Mechanical Engineering and Computer Science — *2016 – 2020*
- Graduated with Honors
- Capstone Project: Modular Assistive Robot for paraplegics
- Advisor: Professor William Messner

Experience

Staff Software Engineer — September 2023 – Present
Boston Dynamics — *Waltham, MA*
- Working on humanoid controls on the Atlas Robot

Controls Software Intern — May 2023 – July 2023
Boston Dynamics — *Waltham, MA*
- Worked on humanoid controls on the Atlas Robot

Robotics Research Intern — June 2022 – September 2022
Ford Motor Company — *Ann Arbor, MI*
- Developed a whole-body control framework for last-mile package delivery with the Digit Bipedal Humanoid Robot

Graduate Research Assistant — August 2020 – Present
Laboratory for Progress - University of Michigan — *Ann Arbor, MI*
- Research on planning and reactive control techniques to enable robots to perform complex, long-horizon tasks in partially observed state spaces

Robotics Engineering Intern — May 2019 – August 2019
Near Earth Autonomy — *Pittsburgh, PA*
- Implemented algorithms for safe robot planning and navigation amongst dynamic obstacles in enclosed spaces

Undergraduate Research Assistant — February 2017 – May 2019
Assistive Robotics Group - Tufts University — *Medford, MA*
- Developed hardware and implemented feedback control algorithms on a kitchen-assistant robot for use by paraplegic individuals
- Developed a kitchen-assistant robotic software platform which generated task and motion plans to perform certain kitchen tasks.
- Coordinated 6 user sessions of the kitchen-assistant mobile-manipulator robot with human subjects

Undergraduate Research Assistant — January 2017 – May 2019
Urban Attitudes Lab - Tufts University — *Medford, MA*
- Developed multiple Twitter bots equipped with state-of-the-art language models to spread ideas about urban planning on Twitter and gauge people's reaction to them
- Trained Deep Learning models to predict attributes such as safety, affluence and liveliness from images of neighborhoods in Montreal and Toronto

PUBLICATIONS

Journal Articles
- **Alphonsus Adu-Bredu**, Zhen Zeng, Neha Pusalkar, and Odest Chadwicke Jenkins. Elephants don't pack groceries: Robot task planning for low entropy belief states. *IEEE Robotics and Automation Letters (RA-L)*, (Volume: 7, Issue: 1, Jan. 2022). Link to paper.
- Using Deep Learning to Examine the Relationship between Transportation Policy and Human Perception of the Built Environment. Justin Hollander, Gio Nikolaishvili, **Alphonsus Adu-Bredu**, Minyu Situ, Shabnam Bista. *Environment and Planning B: Urban Analytics and City Science Journal. September* 2020. Link to paper.

Conference Proceedings
- **Alphonsus Adu-Bredu***, Grant Gibson*, Jessy W Grizzle. Exploring Kinodynamic Fabrics for Reactive Whole-Body Control of Underactuated Humanoid Robots. In *2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). IEEE*, 2023. Link to paper.
- **Alphonsus Adu-Bredu**, Nikhil Devraj, Odest Chadwicke Jenkins. Optimal Constrained Task Planning as Mixed Integer Programming. In *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). IEEE*, 2022. Link to paper.
- **Alphonsus Adu-Bredu**, Nikhil Devraj, Pin-Han Lin, Zhen Zeng, and Odest Chadwicke Jenkins. Probabilistic inference in planning for partially observable long horizon problems. In *2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). IEEE*, 2021.(Won the Best Paper Award on Mobile Manipulation). Link to paper.
- Cartbot: A Direct-Manipulation Minimal Degrees-of-Freedom Mobile Assistive Robot to Maximize User Agency. Kentaro Barhydt, **Alphonsus Adu-Bredu**, Sarah Everhart-Skeels, Gary Bedell, Karen Panetta, William Messner. *IEEE International Conference on Human-Machine Systems (ICHMS), Rome, Italy, September* 2020. Link to paper.

Pre-prints
- GODSAC*: Graph Optimized DSAC* for Robot Relocalization. **Alphonsus Adu-Bredu**, Noah Del Coro, Tianyi Liu. 2021. *arXiv:2105.00546.* Link to paper.
- Contact simulation of a 2D Bipedal Robot kicking a ball. **Alphonsus Adu-Bredu**. 2021. *arXiv:2112.08426.* Link to paper.

AWARDS
- Best Paper Award on Mobile Manipulation, IROS 2021 - Winner.
- Qualcomm Innovation Fellowship 2022 - Winner.

SERVICE
- Reviewer for *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).* 2021 - 2023.
- Reviewer for *Autonomous Robots Journal.* 2021.
- Reviewer for *Towards Autonomous Robotic Systems (TAROS) Conference.* 2021
- Reviewer for *IEEE Robotics and Automation Letters (RAL)*, 2021 - 2022.

TEACHING ASSISTANTSHIPS
- Robotic Systems Lab, Fall 2021 - Graduate Level course
- Robotic Systems Lab, Winter 2022 - Graduate Level course
- Computational Linear Algebra, Fall 2022 - Undergraduate Level course

SELECTED OPEN-SOURCE LIBRARIES

KinodynamicFabrics.jl : Julia implementation of the Kinodynamic Fabrics whole-body control framework
Dynamatics.jl : Julia package for code-generating stand-alone Julia robot kinematics and dynamics functions
Fabrics.jl : Julia implementation of Geometric Fabrics
contact_sim.jl : Julia library for 2D physics simuation
MuJoCo.jl : A light-weight Julia wrapper for the MuJoCo Physics simulator
gtpmip.jl : Julia library for Grounded Task Planning as Mixed Integer Programming
godsacstar : C++ library for graph-optimized object pose estimation with RGB images

Technical Skills

Programming languages: Julia, Python, C++, C, Matlab
Software: Pinocchio, MuJoCo, PyBullet, ROS, JuMP.jl, MeshCat, OnShape, Arduino, Git, Linux