

# Pravin Dangol

RESEARCH ASSISTANT · SILICONSYNAPSE LAB

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☎ (617)620-5992 | ✉ dangol.p@northeastern.edu | 💻 pravindngl | 🎓 Pravin Dangol

Research assistant working on control and motion planning of legged robots. Passionate about robotics, with a background in classical controls and robot dynamics. Currently interested in utilizing reinforcement learning as a higher level controller in a hierarchical scheme, and exploring reward machines to enforce desired behaviours patterns on robots.

## Education

### Northeastern University

M.S. ELECTRICAL ENGINEERING

Boston, MA

Dec 2021

### St. Cloud State University

B.S. IN MECHANICAL ENGINEERING

St. Cloud, MN

Dec. 2016

- Graduated Summa Cum Laude in the honors program.

## Work Experience

### The Mathworks Inc.

Natick, MA

SOFTWARE ENGINEER INTERN

May 2021–Sept 2021

- Involved in development of DDS/ROS middleware toolbox for the Simulink product line.
- Projects involve auto-generating and building C++ code from Simulink models for all supported vendors, which can be deployed by users.
- Created unit tests to check for failure and ensure generated code matched DDS standards.
- Assisted with creating an inference model to predict whether individual tests are likely to pass or fail given a change-list.

### SiliconSynapse Lab, Northeastern University

Boston, MA

RESEARCH ASSISTANT

Sept. 2018–Dec 2021

- Led projects that deal with the design and control of bio-inspired legged and aerial robots.
- Designed and assembled a lightweight quadrupedal robot. Implemented agile walking gaits through state estimation, motion planning and hierarchical control strategies; deployed on the hardware through a real-time OS.
- Implemented a robust closed-loop controller with optimized dynamic gaits for a thruster assisted bipedal robot. Designed running and walking gaits based on the Hybrid Zero Dynamics framework.
- Created data-driven models to classify gait patterns and estimate unknown aerodynamics forces acting on the wings of a flapping wing robot.

### Electrolux

St Cloud, MN

PRODUCT DEVELOPMENT ENGINEER

Jan. 2017 - Jul. 2017

- Managed and led projects aimed at increasing reliability, quality, and reducing the manufacturing costs of commercial kitchen appliances.
- Designed mass-produced components to extend the product life cycle of the existing appliance line.
- Gained hands-on experience with sheet metal fabrication, injection molding, extrusion, thermoforming, and tooling required for large volume production.

### TLC Electronics Inc.

St Paul, MN

AUTOMATION INTERN

May 2016 - Aug. 2016

- Automated assembly lines to improve build times for parts used in the electronics and medical device industry.
- Prototyped and designed test fixtures to increase efficiency in the assembly process and electrical testing.

### Hutchinson Technology Inc.

Hutchinson, MN

R&D ENGINEER CO-OP

Jan. 2015 - Aug. 2015

- Involved with design, process development, and research for shape-metal alloy based optical image stabilizers used in smart-phones.
- Worked on design for manufacturability of electro-mechanical assemblies, designed fixtures, tested and analyzed parts to optimize performance and power consumption.

## Projects

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### Online quadruped trajectory update through model free RL

SILICONSYNAPSE LAB

April 2020 - September 2020

- Utilized SOTA TD3 algorithm to control body posture, regulate walking speed and ground contact on a quadruped with limited observations.
- Timing based gaits with feet end position control, state and touchdown estimates were first used to create baseline dynamics gaits at a high bandwidth. The RL scheme was then used as a trajectory update law at a lower bandwidth to maximize training efficiency.
- This combined hierarchical structure resulted in more stable and robust gaits without needing to use complex model based controller or any costly online optimization methods.

### ML based ground dynamics estimation for bipeds

ADVANCED MACHINE LEARNING COURSE

November 2019 - December 2019

- The purpose of this project was to demonstrate techniques learned in an advanced machine learning course. A paper was recreated to estimate ground dynamics for bipeds traversing unknown terrains.
- The unknown dynamics of the ground reaction forces were modeled as Gaussian Process, the intractable posterior distribution was estimated through forward-backward pass variational inference method to account for inherent instability of dynamics systems.

### Image guided micro manipulation

PIEZO-ACTIVE SYSTEMS LAB

January 2018 - August 2018

- The project involved vision based feedback on a 3 axis (RRP) micro-manipulator to characterize carbon nanotubes and tissue samples.
- Utilized modern computer vision tools to navigate a manipulators' end effector around obstacles in order to grab the object of interest.

### Project development for undergraduate dynamics and control courses

MECHANICAL ENGINEERING DEPARTMENT, NEU

September 2017 - August 2018

- Designed coursework related projects to help student analyze, simulate and control physical electro-mechanical systems.
- Projects were focused on constrained single wheel active suspension system, multi cart gantry system, gyro-stable platform, and rotary/linear inverted pendulum.
- Established real-time communication with sensor and actuator to realize baseline control architecture for students to test their controllers.

## Skills

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**Technical Experience**   Robotics: Kinematics/Dynamics modeling, Motion Planning, DDS, ROS, AWS RoboMaker;  
Machine learning: Reinforcement learning; Deep learning, dynamics estimation;  
Controls Theory and State Estimation: linear, robust, adaptive, and non-linear methods;  
CAD: CATIA, SolidWorks, Ansys

**Programming**   C, C++, Python, MATLAB, OOP, Unit testing

**Toolboxes**   Trajectory optimization and control: CasADi, FROST, TOWR, DRAKE

Deep Learning: PyTorch, Tensorflow, CNN, Transformers, OpenCV, Model pruning

## Publications

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- P. Dangol, A. Lessieur, E. Sihite, and A. Ramezani, "A HZD-based Framework for the Real-time, Optimization-free Enforcement of Gait Feasibility Constraints," *Humanoids*, Munich, Germany, 2021
- A. Ramezani, P. Dangol, E. Sihite, A. Lessieur, and P. Kelly, "Generative Design of NU's Husky Carbon: A Morpho-Functional, Legged-Aerial Robot," *International Conference on Robotics and Automation (ICRA)*, Xi'an, China, 2021
- P. Dangol and A. Ramezani, "Performance and Robustness Satisfaction in a Thruster-assisted Legged Robot," *International Federation of Automatic Control (IFAC)*, Berlin, Germany, 2020
- P. Dangol, A. Ramezani and N. Jalili, "Performance satisfaction in Midget, a thruster-assisted bipedal robot," *American Control Conference (ACC)*, Denver, CO, 2020