Dhruv Thanki

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EDUCATION

University of Delaware **Present**
Thesis Track, Master of Science in Robotics *Newark, Delaware*

LDRP Institute of Technology and Research **May 2019**
Bachelor of Engineering in Mechanical Engineering *Gandhinagar, Gujarat, India*

EXPERIENCE

Robotic Locomotion Lab, University of Delaware **Jan. 2020 – Present**
Graduate Student Researcher | Advised by: Dr.Ioannis Poulakakis *Newark, Delaware*

- Devised a **Prioritized Task-Space Controller** (PTSC-QP) for gait tracking and also for LIP based motion planning for a Humanoid robot in MuJoCo simulation. Used objectives like minimizing the Centroidal Angular Momentum and keeping the swing foot flat in addition to gait tracking objective to make the controller more robust.
- Formulated a QP based **Inverse Dynamics Controller** (ID-QP) for a humanoid robot in MuJoCo to track a desired set of Joint Space trajectories.
- Generated dynamic walking primitives for humanoids, specifically for Digit robot using **TROPIC** for it's **Direct Collocation** based trajectory optimization which was modified to handle kinematic closed-loops and planar contact.

AWL: DRDO Robotics And Unmanned Systems Exposition (DRUSE) **Jun. 2019 – Aug. 2019**
Team Member *Ahmedabad, Gujarat, India*

- Designed the flight module where the BLDC motors are mounted on links that are actuated using a gear train. These links open and move out of the robot as the upper hemisphere is raised using a rack and pinion mechanism.
- Qualified amongst top 30 out of 200 robotics teams in the Challenge in the West – India zone. [Patent Filed]

Space Application Center - Indian Space Research Organization (ISRO) **Jan. 2019 – Jun. 2019**
Robotics Intern | Advised by: Neeraj Mathur and Anurag Verma *Ahmedabad, Gujarat, India*

- Computed a closed form solution to the inverse kinematics for a 6-DOF Walk-and-Roll rover leg. (Department: MESA, Group: OPMG, Division: OMDD).

PUBLICATIONS

- Kunal Sanjay Narkhede, Abhijeet Mangesh Kulkarni, Dhruv Ashwinkumar Thanki, and Ioannis Poulakakis. *A Sequential MPC Approach to Reactive Planning for Bipedal Robots.* arXiv, 2022

PROJECTS

Path Planning for a Mobile Robot | *Predictive Control, Trust-Region Based Optimization* **May. 2021**

- Utilized MPC based path planning framework with obstacle avoidance using the kinematic model of a Turtle-Bot.
- Formulated Quadratic Program as **Trust Region based Sequential Convex Program**.

Object Classification and Semantic Segmentation | *Deep Learning, Computer Vision* **Nov. 2020**

- Designed a Convolutional Neural Network to carry out object classification using the CIFAR100 data-set.
- Implemented **resnet50** in Pytorch which was used to create feature maps for each object. Finally a segmented image identifying each object with a different color was displayed on top of the original image.

Turning Primitives for a Simple 3D-Biped | *Controlled Symmetries, Equivariance* **Aug. 2020**

- Generated **turning primitives** with a desired heading angle for simple 3D biped with an under-actuated foot.
- Presented intuitive insights into the presence of the controlled symmetries and an exhaustive literature review for different levels of model abstraction ranging from LIP to 3LP etc that are currently used by the community.

Trajectory Planning and Inverse Kinematics | *Jacobian Pseudo-Inverse Based Inverse Kinematics* **May. 2020**

- Implemented the **Jacobian Pseudo-Inverse** method for inverse kinematics to carry out trajectory planning while satisfying constraints for obstacle avoidance and joint torque limits.
- Verified the algorithm on a model of the LBR iiwa 7 R800 robot arm in CoppeliaSim simulator.

Feedback Control for Dynamic Bipedal Walking | *Hybrid Zero Dynamics, Poincare Maps Analysis* **Jan. 2020**

- Implemented the method of virtual constraints and optimized the trajectory for the actuated DOF to obtain a limit cycle corresponding to a stable walking gait for a planar 5-link bipedal robot with under-actuated stance foot.
- Simulated the robot with feedback linearization based tracking controller for the optimized trajectories. Carried out Poincare analysis to validate the stability of the Zero Dynamics.

TECHNICAL SKILLS

Languages: C++/C, MATLAB, Python
Libraries/Frameworks: MuJoCo, Eigen, CMake, Git, Drake, Docker, Jenkins, Pytorch, OpenCV, OpenGL, CREO