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*
- Developing Safe and Multi-Threaded Real-Time software for the hardware implementation of Whole-Body Controllers.
- Devised a **Task-Space QP Controller** in C++ that runs at approximately 2kHz for tracking different kinds of objectives like joint-space trajectories, Center of Mass trajectory, Swing-foot trajectory, attitude control of torso and swing-foot, and minimization of Centroidal Momentum.
- Generated dynamic walking primitives for humanoids, specifically for Digit robot using **TROPIC** for its **Direct Collocation** based trajectory optimization, which was modified to handle kinematic closed-loops and planar contact.
- Generated symbolic matrices for the Kinematics and Dynamics of the Digit humanoid robot using CasADi.

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 the 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

- K. S. Narkhede, A. M. Kulkarni, D. A. Thanki, and I. Poulakakis, *A Sequential MPC Approach to Reactive Planning for Bipedal Robots Using Safe Corridors in Highly Cluttered Environments.* IEEE-RAL, 2022

PROJECTS

Global Trajectory Tracking for a Humanoid Robot | *Hierarchical Control, Reactive Footstep Planning*
- Formulated an N-MPC problem for footstep generation utilizing the Linear Inverted Pendulum model as a close approximation of the Step-2-step dynamics of the actual robot.
- Formulated Whole-Body QP for tracking interpolated trajectories of Center of Mass and Swing-Foot.
- Implemented reactive footstep planning in the presence of Dynamic Obstacles using Control Barrier Functions.

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

Dynamic Walking and Turning for a 3D-Biped | *Hybrid-Zero Dynamics, Poincare Maps, Controlled Symmetries*
- 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 an 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.
- Generated **turning primitives** with the desired heading angle for a simple 3D biped with an under-actuated foot.

Trajectory Planning and Inverse Kinematics | *Jacobian Pseudo-Inverse Based Inverse Kinematics*
- 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 LBR iiwa 7 R800 robot arm model in the CoppeliaSim simulator.

TECHNICAL SKILLS

- **Languages**: C++/C, MATLAB, Python
- **Libraries/Frameworks**: MuJoCo, Eigen, CMake, Git, Drake, Docker, Pytorch, OpenCV, Testing