M. Nomaan Qureshi

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Research interests

I want to work at the intersection of Robotics, Computer Vision and Reinforcement Learning to develop manipulation algorithms that can act in unstructured real-world environments.

Education

International Institute of Information Technology Hyderabad, India
Integrated BTech/MS in Computer Science August, 2018 – July, 2023
Advisor: Prof. K. Madhava Krishna.
GPA: 8.75/10

Academic Achievements

◊ Dean's Research List for excellence in research for the academic year 2020-21 and 2021-2022.
◊ Dean's Merit List for academic excellence for the academic year 2019-20 and 2018-19.
◊ Top Reviewer at NeurIPS, 2022

Publications

◊ **Deep Sequenced Linear Dynamical Systems for Manipulation Policy Learning**
M. Nomaan Qureshi, Ben Eisner, David Held
Generalizable Policy Learning Workshop, International Conference on Learning Representations (ICLR), 2022

◊ **RTVS: A Lightweight Differentiable MPC Framework For Real Time Visual Servoing**
M. Nomaan Qureshi*, Pushkal Katara*, Abhinav Gupta*,..., K. Madhava Krishna
International Conference on Intelligent Robots and Systems (IROS), 2021.

◊ **Learning Object Manipulation Skills from Video via Approximate Differentiable Physics**
Vladimir Petrik, **M. Nomaan Qureshi**, Josef Sivic, Makarand Tapaswi
International Conference on Intelligent Robots and Systems (IROS), 2022.

◊ **Flow Synthesis Based Visual Servoing Frameworks for Monocular Obstacle Avoidance Amidst High-Rises**
Harshit K. Sankhla*, **M. Nomaan Qureshi***, ... K. Madhava Krishna
International Conference on Automation Science and Engineering (CASE), 2022.

Research Experience

— Research Intern, Robotics Institute, Carnegie Mellon University, U.S.A.
Advisor: Prof. David Held April, 2021 – Present
• Developed differentiable trajectory representation to accelerate the learning by 150% on tasks from MetaWorld benchmark. Formulated a reparametrization of Linear Dynamic Systems, which makes it possible to integrate LDS into any end-to-end differentiable system. [GPL Workshop, ICLR '22.]
• Solved various engineering problems during the internship. Modified the Garage Reinforcement Learning Library to support multi-action policies, implemented control systems on the newly released Sapien simulator etc.

— Research Assistant, Robotics Research Center, IIIT Hyderabad.

Advisor: Prof. K. Madhava Krishna May, 2020 – Present

• Proposed a novel and lightweight visual servoing technique for fast navigation which is 10 times faster than existing state-of-the-art approaches. Utilized an effective sampling strategy for optimal control generation, resulting in a 74% decrease in the servoing time. [IROS '21]

• Formulated a framework that leverages the high-precision visual servoing frameworks for avoiding high-rise buildings. Our algorithm reduces the collision rate with buildings by 90% and is able safely navigate in an urban environment. [CASE '22]

— Research Assistant, CVIT, IIIT Hyderabad.

Advisor: Prof. Makarand Tapaswi September, 2021 – Present

• Worked on integrating Video Object Segmentation (VOS) with skill learning from videos. The improved segmentation masks obtained from VOS led to a 10% improvement in the execution of skills.

• Proposed a differentiable approach to solving a set of Ordinary Differential Equations (ODEs) that allows us to approximately model laws of physics such as gravity, friction, and hand-object or object-object interactions.[IROS '22]

Skills

Languages : Python, C, C++, Bash, Javascript
Frameworks : Pytorch, Git, Tensorflow, Garage, Mujoco
Platforms : Linux, Web, MacOS, Windows, ROS, Arduino, Raspberry

Selected Projects

Generating Birdview Occupancy Maps for KITTI Dataset

Used pre-trained DL models and camera transformations for generating occupancy maps. The system takes a stereo pair and generates a depth map (using PSMNet) and an instance-segmented scene (using MaskRCNN). A 3D model was generated using the depth and camera parameters. Projecting this 3D point cloud to the ground frame gives the occupancy grid.

Pose Graph Optimization (PGO) for 2D SLAM

Optimized the 2D trajectory of a robot from scratch using the Levenberg-Marquardt method for non-linear least squares. PGO is typically used in most of today's SLAM Backend.

Model Predictive Control for Path Planning

Implemented the MPC algorithm for an omnidirectional robot to navigate a two-dimensional space, avoiding known locations with various obstacles given the localization information.

Robotics/AI Sandbox

Collection of core algorithms in Robotics, AI and CV implemented from scratch. Some examples: Implementation of back-propagation algorithm, GrabCut implementation.

Implementation of Bash in C

Implemented a Linux Bash shell (command line interpreter) in C. Supports various bash commands along with piping, foreground, and background processing.