Anirudha Ramesh

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EDUCATION

Carnegie Mellon University   Pittsburgh, Pennsylvania
*Masters in Robotics, **CGPA : 4.11/4.0***   *September 2021 - August 2023 (tentative)*
- *4.0+ GPA (Fall 2021, Spring 2022, Fall 2022)*

International Institute of Information Technology (IIIT-H)   Hyderabad, India
*Bachelor of Technology (Honors) in Computer Science, **CGPA : 9.32/10.0***   *Aug 2017 - May 2021*
- *Dean's List-1 : Top 5% of class (2018-19,2019-20, 2020-2021)*
- *Semester GPA 10/10 : (Fall 2019-20, Spring 2019-20, Spring 2020-2021)*
- *Dean's Research Award - In recognition of research contribution (2019-20)*

EXPERIENCE

Auton Lab / NREC   October 2021 – August 2023
Graduate Researcher - Advisors: Jeff Schneider,Christoph Mertz   *Pittsburgh, Pennsylvania*
- Created and deployed algorithms for multi-spectral vision in off-road, night time scenes with emphasis on minimal supervision and deploy-ability. Enabled 24/7 functioning of real robotic systems
- Develop novel algorithms to improve cross domain/modal adaptability for object detection, semantic segmentation, and other such perception tasks. Efforts for a top publication underway

Adobe   January 2021 – July 2021
Research Intern - Media and Data Science Research (MDSR) Lab   *Noida, India*
- Developed novel algorithms primarily on few-shot segmentation, representation learning, and automatic image compositing. **Published State-of-the-Art results in NeurIPS 2021 (Datasets and Benchmarks)**

Robotics Research Center   May 2019 – July 2021
Undergraduate Researcher - Advisor : Madhava Krishna   *Hyderabad, India*
- Designed state-of-the-art computer vision and monocular multibody SLAM systems in dynamic scenes relating to autonomous on-road navigation. **Authored papers accepted in IV-2020, IV-2021, VISAPP-2021**
- Mentored new lab inductees on computer vision, deep learning systems, and optimization.

PUBLICATIONS

What Ails One-Shot Image Segmentation: A Data Perspective
- Submitted and Published at NeurIPS 2021 Track Datasets and Benchmarks. Link to *Paper*

BirdSLAM: Monocular Multibody SLAM in Bird's-Eye View
- Submitted and Accepted at VISAPP-2021. Link to *Paper*.

Multi-Object Monocular SLAM For Dynamic Environments
- Submitted and Published at IEEE-Intelligent Vehicle (IV) Symposium 2020. Link to *Paper*, *Video*.

Probabilistic Collision Avoidance For Multiple Robots: A Closed Form PDF Approach
- Submitted and Published at IEEE-Intelligent Vehicle (IV) Symposium 2021. Link to *Paper*

PROJECTS

Multi-Spectral Cross Domain Perception System in Real Robots | *Pytorch, Tensorflow, ROS, Python, C++*
- Designed and deployed a first of a kind perception system capable of functioning 24/7, utilizing multi-spectral vision inputs across various modalities. Lead team for object detection and semantic segmentation, and collaborate with teams leading other components for general integration and system building.
- Transform perception systems equipped to work in structured, well-lit environments to unstructured environments with variable lighting by developing novel algorithms for domain adaptation and generalization so as to create more adaptable and robust robots and AI-systems. Utilize and extend state-of-the-art generative models, representation learning, and unsupervised/semi-supervised algorithms, and the creation of novel cross-{location,time,modality} datasets to aid in this effort.

Multi-Object Monocular SLAM for Dynamic Environments, and BirdSLAM | *Python, Matlab, C++, g2o*
- Created novel pipelines for Mutlibody SLAM in a dynamic road setting in relation to autonomous cars.

- Achieved State-Of-The-Art results in tracking the moving Ego vehicle and other vehicles in the scene, as well as formulated a novel mechanism to bring everything to a uniform global metric scale. Achieved 3x smaller absolute tracking error over the former leading method.

Few Shot Segmentation | *Python (Pytorch)*
- Discovered and solved biases in existing solutions, and in the structuring of prominent datasets for Few Shot Segmentation (FSS) Adobe MDSR team. Upon solving for these biases, we add to the performance of all tested underlying networks by $\sim 5\%$ mIoU. Published at NeurIPS 2021 along with a new dataset (TOSS) for nuanced evaluation of FSS.

Learning to Detect by Learning to Predict | *Python (Pytorch)*
- Human interactions with the environment are mainly powered by our prowess in prediction, and prediction often precedes detection. Using this intuition, we develop a system which improves detection by infusing the ability to predict within the system. Our novel pretraining consistently beats standard pretraining in average recall, particularly for small objects, by upto 2% on the COCO dataset, and shows promising results in improving current SoTA solutions. *Link*

Robotic Vision And Mobile Robotics Mini-Projects | *Python, Matlab*
- Implemented visual odometry on KITTI-Odometry, Dense Stereo Reconstruction from multiple images, Motion Estimation using PnP with non-linear reprojection error minimization, and the Extended Kalman Filter to combine motion and observation models to get better robot localization.

Computational Photography Mini-Projects : Implemented algorithms, and designed capture for the following
- Image Development Pipeline, HDR Capture and Merging, Gradient Domain Processing for image enhancement.
- Lightfield rendering, depth from focus, confocal stereo, capturing and refocusing your own unstructured lightfield, photometric stereo, and 3D Reconstruction using Structured Light
- Motion Magnification, Motion Mode Extraction, and virtualization of physical objects based on these modes, which allows deformation on application of forces. *Link*

XTREME TIC-TAC-TOE BOT | *Python*
- An expert Xtreme Tic-Tac-Toe Bot which uses Min-Max Iterative Deepening Search with Alpha-Beta Pruning, Hashing for speed, and a smart cut-off heuristic amongst other features.

Miscellaneous CV Projects
- **SLIDE MATCHING :** A tool to match projected frames during presentations with their corresponding digital counterparts using various vision techniques to get over 95% accuracy for given test sets.
- **3D AIRCRAFT SIMULATOR :** An OpenGL based 3D Aircraft Simulator.
- **6 DoF VR system :** Vision Based VR system built requiring low system processing requirements with mobile-unity integration.

Hackathons
- Detection of Mosquito Breeding Pools : Neural Network Based solution to accurately identify mosquito breeding spots using image input from drones.
- Question Generator : A solution to generate the best Fill-in-the-Blanks questions possible given an article, or textbook chapter. Extractive summarization, tf-idf, text-rank used amongst other techniques. Secured a podium finish ahead of 250+ participants.

Selected Coursework

Graduate Course: Machine Learning, Computer Vision, Visual Learning and Recognition, Computational Photography, Robustness and Adaptivity in Shifting Environments, Mathematics for Robotics, Robotics Business, Learning for 3-D vision.

Undergraduate Courses : Statistical Methods in AI, Optimization Methods, Artificial Intelligence, Graphics, Mobile Robotics, Data Structures and Algorithms, Operating Systems, Compilers, Database Systems, Probability, Discrete Math and Group Theory, Linear Algebra.

Teaching Assistant: Automata Theory. Helped design and teach Advanced Graphics, AR, and VR.

Technical Skills

Languages: Python, C/C++, Matlab, Golang, SQL
ML and Optimization: Pytorch, tensorflow, g2o, ceres, OpenCV
General Technical: Issue Identification, Algorithm Design, Pattern Recognition, System Planning, Feature Ownership, Cross-Team Collaboration