Haresh Karnan

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Education

The University of Texas at Austin   *Austin , TX, USA*
PHD IN MECHANICAL ENGINEERING (ROBOTICS PORTFOLIO PROGRAM)   *August. 2018 - April. 2023*
- Graduate Courses : Reinforcement Learning, Autonomous Robots, Deep Learning, Machine Learning.
- Advised by Dr. Peter Stone, Learning Agents Research Group.
- Research Area : Deep Reinforcement Learning, Sim-to-Real, Computer Vision, Autonomous Driving, Social Navigation.

Texas A&M University   *College Station, TX, USA*
MS. IN AEROSPACE ENGINEERING, DYNAMICS AND CONTROL   *August. 2016 - July. 2018*
- Graduate Courses : Artificial Intelligence, Estimation Theory, Optimal Control, Pattern Recognition, Probabilistic Robotics.

National Institute of Technology, Tiruchirappalli   *Tiruchirappalli, TN, India*
B.TECH. IN INSTRUMENTATION AND CONTROL ENGINEERING   *June. 2012 - July. 2016*
- Undergraduate Courses : Computer Vision, Data Structures and Algorithms, Linear Control, Neural Networks, Sensors and Instrumentation.

Work Experience

Amazon DEX Robotics (Amazon Scout)   *Austin, TX, USA*
APPLIED SCIENTIST INTERN   *May. - Aug. 2019/20/21*
   [VISUAL REPRESENTATION LEARNING]
- Implemented a contrastive learning based visual representation learning algorithm for coarse robot localization using image retrieval.
- Successfully learned weather and lighting invariant visual representations for coarse robot localization, improving retrieval success by 32%.
- Deployed the learned visual feature extractor on an Amazon Scout robot, integrating it with the localization stack.
   [DEEP LEARNING FOR POSE ESTIMATION]
- Worked on deep learning based computer vision algorithms to improve localization accuracy of Amazon Scout package delivery robots.
- Implemented and benchmarked deep learning based keypoint extraction algorithms for robot localization in the real world.
- Achieved over 55% improvement in fine pose estimation accuracy by implementing visual 3D localization in unstructured environments.
   [DEEP GENERATIVE LEARNING FOR ROBOT LOCALIZATION]
- Applied generative adversarial training to extract semantic image features for monocular robot localization in sidewalks.
- Improved transfer from simulation to real-world by applying domain randomization techniques.
- Benchmarked our novel approach with existing visual localization pipelines and achieved 30% improvement in localization accuracy.
- Submitted as a patent to the US patent office.

Projects

ACTIVE MEMBER OF UT AUSTIN'S ROBOCUP@HOME TEAM - UTAUSTINVILLA   *Jan. 2019 - Present*
- Participated in RoboCup 2019 and 2021 representing UTAustinVilla and won third place at RoboCup 2021. **[Paper][Video]**
- Implemented "Take out the Trash" task to perform autonomous cleanup of an indoor environment by the HSR robot. **[Video]**
- Implemented a synthetic data generation pipeline to train object detection and segmentation networks on YCB objects.

MEMBER OF UT AUSTIN'S ROBOCUP STANDARD PLATFORM LEAGUE - ROBOSOCCER TEAM - UTAUSTINVILLA   *Sep. 2019 - Present*
- Worked on the Sim-to-Real problem of transferring a walk policy from simulation to a real-world NAO humanoid robot.
- Modelled real-world transitions as a stochastic MDP and used action transformation to modify the SimSpark simulator.
- Successfully transferred a bipedal robot walk policy from simulation to real-world to walk on a bumpy terrain. **[Video]**

Publications & Patent

SPRINGER, MACHINE LEARNING   *Areas : [Reinforcement Learning, Sim-to-Real, Robotics]*
- "Grounded Action Transformation for Sim-to-Real Reinforcement Learning", Josiah Hanna, Haresh Karnan, et al., Springer, Machine Learning, 2021. **[Paper]**

NEURAL INFORMATION PROCESSING SYSTEMS (NEURIPS)   *Areas : [RL, Imitation Learning, Sim-to-Real, Robotics]*
- "An Imitation from Observation Approach to Transfer Learning with Dynamics Mismatch", Haresh Karnan, et al., Neural Information Processing Systems, 2020. **[Paper]**

INTERNATIONAL CONFERENCE ON INTELLIGENT ROBOTS AND SYSTEMS (IROS)   *Areas : [RL, Sim-to-Real, Vision, Robotics]*
- "Socially Compliant Navigation Dataset (SCAND): A Large-Scale Dataset of Demonstrations for Social Navigation", Haresh Karnan, Peter Stone, et al., RA-L 2022. **[Paper]**
- "VI-IKD: High-Speed Accurate Off-Road Navigation using Learned Visual-Inertial Inverse Kinodynamics", Haresh Karnan, Peter Stone, et al., IROS 2022. **[Paper]**
- "Stochastic Grounded Action Transformation for Robot Learning in Simulation", Haresh Karnan, Peter Stone, et al., IROS 2020. **[Paper]**
- "Reinforced Grounded Action Transformation for Sim-to-Real Transfer", Haresh Karnan, Peter Stone, et al., IROS 2020. **[Paper]**
- "Visual Feedback Control of Tensegrity Robotic Systems", Haresh Karnan, Robert Skelton, et al., IROS 2017. **[Paper]**

INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION (ICRA)   *Areas : [ML, RL, Autonomous Driving, Computer Vision]*
- "VOILA: Visual Observation-only Imitation Learning for Autonomous navigation", Haresh Karnan, Peter Stone, et al. ICRA 2021. **[Paper] [Video]**
- "Adversarial Imitation Learning from Video using a State Observer", Haresh Karnan, Peter Stone, et al. ICRA 2021. **[Paper] [Video]**

PATENT (PENDING)
- Systems and methods for utilizing images to determine the position and orientation of a vehicle (work done as an intern at Amazon Scout).**[Link]**

Skills

- Languages : C++, Python, Matlab, Arduino Language
- Libraries : OpenCV, PyTorch, Pytorch-Lightning, ROS, scikit-learn
- Software : MuJoCo, Gazebo, Git, COLMAP