Ninad Khargonkar

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# Education

2019 - 2024: **University of Texas at Dallas**, *Ph.D. in Computer Science* - [Intelligent Robotics and Vision Lab](https://labs.utdallas.edu/irvl/)

2017 - 2019: **University of Massachusetts, Amherst**, *M.S in Computer Science*

2013 - 2017: **Indian Institute of Technology (IIT) Kanpur**, *B.S. in Mathematics and Scientific Computing*

# Work Experience

## Research and Development Internship

Jun 2022 - Aug 2022: *Kitware Inc*

* Researched machine learning algorithms for approximating medial skeleton of point clouds & voxels
* Implemented UNet based segmentation models for skeletonizing 2D images and adapted them for 3D setting
* Demonstrated improved results via point-cloud skeletonization on data from hippocampi and leaflet regions

## Graduate Research Assistant

Aug 2019 - Present: *University of Texas at Dallas*

* Researcher in Intelligent Robotics & Vision Lab, working on robot grasping, 3D vision and learning from humans
* Concurrent research on interactive perception for unseen object segmentation in cluttered environments
* Prior work on submodular information measures for machine learning problems in data selection & active learning
* Involved in mentoring students, working as a teaching assistant and taking guest lectures in selected courses

## Mitacs Globalink Research Internship

May 2016 - Jul 2016: *University of Manitoba, Winnipeg*

* Studied the problem of graph sampling and extracting relevant statistics like clustering coefficient
* Implemented scale-down sampling with like Metropolis-Hastings and Jump random walks in R
* Statistical models like ERGM were used for producing model fits and simulating random networks
* Worked on second project for simulating team performance and biases in a football tournament structure

# Technical Skills

**Programming Languages:** Python, C/C++, R

**Frameworks/Libraries:** PyTorch, ROS, Unity, OpenGL, CUDA, OpenCV

**Development Tools:** Git/GitHub, Docker, VS Code, Vim, Tmux, LaTeX, Pandoc

# Research Projects

**Interactive Perception** | *Unseen Object Segmentation*

* Leveraging long term robot interaction with objects for real world unseen object segmentation
* Proposed self-supervised data collection method to improved real world segmentation performance
* Extended the method to utilize uncertainty in segmentation for minimizing number of interactions

**Object Manipulation** | *Robust Grasping & Skill Transfer*

* Learning a common representation across different robot gripper grasps for efficient skill transfer
* Proposed object contact-based metric learning constraints for effective learning in common space
* Demonstrated applications for human to robot grasp trasnfer via our encoding + retrieval pipeline

**Robot Benchmarking** | *Perception, Grasping & Motion Planning*

* Developed an intuitive method for replicable, real-world scenes of objects for robot benchmarking
* Implemented scene generation pipeline in simulation with focus on cluttered but graspable scenes
* Extened 10 existing methods across pose estimation, segmentation and grasping for real world experiments

**Submodular Information Measures** | *Robust Machine Learning*

* Proposed novel information theoretic measures for submodular set functionsin context for robust machine learning
* Theoretical properties backed up with applications on outlier aware subsets, summarization & clustering tasks
* Follow up works demonstrated computer vision applications in active learning for object detection

**Virtepex** | *Remote Strength Assessment*

* Design and development of a mixed reality system in Unity for Kinect-based force estimation of body movements
* Utilized Kinect to track body joints and an inverse dynamics solver to infer force/torque estimates for an user

# Publications

1. RISeg: Robot Interactive Object Segmentation via Body Frame-Invariant Features (*Under Review*)
2. SceneReplica: Benchmarking Real-World Robot Manipulation by Creating Replicable Scenes. (*Under Review, ArXiV:* [*2306.15620*](https://arxiv.org/abs/2306.15620))
3. CIS2VR: CNN-based Indoor Scan to VR Environment Authoring Framework, *In IEEE International Conference on AI & extended and Virtual Reality (AIxVR) 2024*.
4. Self-Supervised Unseen Object Instance Segmentation via Long-Term Robot Interaction. *In Robotics: Science and Systems (RSS), 2023*.
5. Skeletal Point Representations with Geometric Deep Learning. *In IEEE International Symposium on Biomedical Imaging (ISBI), 2023.*
6. NeuralGrasps: Learning Implicit Representations for Grasps of Multiple Robotic Hands. *In Conference on Robot Learning (CoRL), 2022.*
7. Virtepex: Virtual Remote Tele-Physical Examination System. *In ACM SIGCHI Conference on Designing Interactive Systems (DIS), 2022.*
8. Generalized submodular information measures: Theoretical properties, examples, optimization algorithms, and applications. *In IEEE Transactions on Information Theory Journal, 2021.*
9. Submodular combinatorial information measures with applications in machine learning. *In International Conference on Algorithmic Learning Theory (ALT), 2021.*

# Other Experience

**Professional Service:**

* Reviewer for CoRL, ICRA, IROS, IEEE VR, ACM MM, ICMR, ICHI, IJCAI (external reviewer)
* Organized the [Workshop for Neural Representation Learning for Robot Manipulation](https://neurl-rmw.github.io/) at CoRL 2023

**Teaching Assistant:** Machine Learning, Robotics, Computer Graphics, NLP, Statistics for Data Science

**Mentorship:** Peer mentor for new PhD students at UT-Dallas and member of Counselling Service at IIT Kanpur

# Course Projects

**Faster Inference for Chow-Liu Trees** | *Machine Learning*

* Developed approximation algorithms for faster inference in Chow-Liu tree probabilistic graphical model
* Tried out sub-quadratic variants for minimum weight spanning tree computation & compared with optimal setting

**Data Subset Selection** | *Optimization Algorithms*

* Framed subset selection from training data as an optimization problem with minimal impact on validation loss
* Utilized gradient approximation scheme to show utility on logistic regression and neural network models

# Academic Achievements

* Recipient of Inspire scholarship awarded by Indian Govt. for academic performance at IIT Kanpur.
* Awarded the Mitacs Globalink scholarship for fully funded summer research internship in Canada.
* Secured a percentile score of 97.7 in JEE (Advanced)-2013 and a percentile score of 99.8 in JEE (Main)-2013 national engineering entrance examinations.