

MISHAL ASSIF P K

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EDUCATION

PhD, Electrical Engineering, University of Illinois Urbana Champaign 08/2019 - 12/2024 (Expected)
MS, Mathematics, University of Illinois Urbana Champaign 08/2019 - 08/2024
B.Tech + M.Tech, Mechanical Engineering, Indian Institute of Technology Bombay 08/2014 - 08/2019

EXPERIENCE

Nokia Bell Labs **Murray Hill, NJ**
Math & Algorithms Intern, Advisors: Dr. Iraj Saniee, Dr. Carl Nuzman *Jun 2022 - May 2023*

- Applied machine learning techniques to improve communication systems
 - Designed neural compression architectures utilizing convolutional and transformer autoencoders to efficiently compress Channel State Information (CSI) matrices in massive MIMO wireless communication systems, achieving 50% less distortion in the compression process
 - Developed time-efficient encoders for sparse-learning based compression algorithms applied to CSI matrices, resulting in a 10x increase in encoding speed
- Conducted theoretical research on applied game theory
 - Determined fair reward allocation schemes for various crowd sourced systems, including decentralized wireless networks, using tools from cooperative game theory

Coordinated Sciences Laboratory, UIUC **Urbana, IL**
Graduate Research Assistant, Advisor: Prof. Yuliy Baryshnikov *Aug 2019 - Present*

- Developed novel data analysis methods using computational topology (see github: [Traj2Phase](#), [height-persist](#))
 - Developed algorithms for computing minimal unimodal decompositions, a topological method to tackle the mixture estimation problem in statistics
 - Developed algorithms to reconstruct the state space topology of dynamical systems from time series of low-dimensional observations, applying them to data-driven analysis of neuromechanical systems
 - Created machine learning models for 3D shape classification using the persistent homology transform
- Conducted theoretical research on topological data analysis
 - Formulated a geometric theory to characterize biparametric persistent homology (BPH)
 - Derived asymptotic laws for statistical properties of BPH descriptors extracted from Gaussian random fields

Corteva Agriscience **Champaign, IL**
Research Intern *Jun 2020 - Aug 2020*

- Created mathematical models and simulations to investigate genetic resistance to pest management in insects

PUBLICATIONS

1. **M. Assif P K**, Y. Baryshnikov *Minimal Unimodal Decomposition is NP-Hard on Graphs*, In preparation
2. **M. Assif P K**, Y. Baryshnikov *Biparametric persistence of smooth filtrations*, Submitted [\[arXiv preprint\]](#)
3. **M. Assif P K**, W. Kennedy, I. Saniee *Fair Allocation in Crowd-Sourced Systems*, Games, Vol.14(4), 2023 (Poster presented at ACM Conference on Economics and Computation, 2023) [\[doi\]](#) [\[arXiv preprint\]](#)
4. **M. Assif P K** *Singularities of Gaussian random maps into the plane*, Journal of Applied and Computational Topology, Vol.7, 2023 [\[doi\]](#) [\[arXiv preprint\]](#)
5. **M. Assif P K**, M. R. Sheriff, D. Chatterjee *Measure of quality of finite-dimensional linear systems: A frame theoretic view*, Systems and Control Letters, Vol.151, 2021 [\[doi\]](#) [\[arXiv preprint\]](#)
6. **M. Assif P K**, D. Chatterjee, R. Banavar *Scenario approach for minmax optimization in the nonconvex setting: Positive results and caveats*, SIAM Journal on Optimization, Vol.30(2), 2020 [\[doi\]](#) [\[arXiv preprint\]](#)
7. **M. Assif P K**, D. Chatterjee, R. Banavar *A simple proof of the discrete time geometric Pontryagin maximum principle*, Automatica, Vol.114, 2020 [\[doi\]](#) [\[arXiv preprint\]](#)
8. **M. Assif**, R. Banavar, A. M. Bloch, M. Camarinha, L. Colombo *Variational collision avoidance on Riemannian manifolds*, Proceedings of the IEEE Conference on Decision and Control, 2018 [\[doi\]](#) [\[arXiv preprint\]](#)

SKILLS & COURSEWORK

- **Software Skills:** Python, C++, Unix, Matlab, PyTorch, Tensorflow, Keras, scikit-learn, numpy, Git
- **Coursework:** Machine Learning, Generative AI, Optimization, Information theory, High dimensional geometric data analysis, Statistical learning theory, Probability and random processes, Stochastic calculus

PROJECTS

Autonomous Underwater Vehicle team (AUV-IITB)

Bombay, India

Software Developer

Sep 2014 - May 2016

- Worked in a 25-member robotics team developing the software stack for an underwater robot, and secured second place at the 2016 AUVSI Robosub competition
- Developed a motion controller, debug interface and simulator for the robot using C++ and Python