Mishal Assif P K

Resume

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EDUCATION

University of Illinois Urbana-Champaign   **Urbana-Champaign, USA**
Ph.D in Electrical Engineering, GPA: 3.97/4.00   *08/19 - 05/24 (Expected)*

Indian Institute of Technology Bombay   **Bombay, India**
B.Tech + M.Tech in Mechanical Engineering, GPA: 8.63/10.00   *07/14 - 08/19*

RESEARCH INTERESTS

I am broadly interested in the theory and applications of control, optimization and learning. I mostly use topological/geometric and stochastic tools in my research, mainly focusing on:

- Topological data analysis and Machine learning; Biparametric persistent homology, Stochastic differential topology, Applications to 3D vision.
- Control and Optimization; Geometric nonlinear control, Robust optimization.

PUBLICATIONS

Preprints and more details of all papers are available on arXiv and Google scholar.

1. **M. Assif P K** *Singularities of Gaussian random maps into the plane.* Submitted to Journal of Applied and Computational Topology.
2. **M. Assif P K**, Y. Baryshnikov *Biparametric persistence of smooth filtrations.* Submitted to Computational Geometry.
3. **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.
4. **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.
5. **M. Assif P K**, D. Chatterjee, R. Banavar *A simple proof of the discrete time geometric Pontryagin maximum principle.* Automatica, Vol.114, 2020.
6. **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.

EXPERIENCE

University of Illinois Urbana-Champaign, Dept. of ECE

Graduate Research Assistant, Advisor: Prof. Yuliy Baryshnikov   *Fall 2019 - Present*

- Developed a geometric approach to biparametric persistent homology (BPH) for extracting robust topological features from data. Working on applications of BPH to 3D shape classification and retrieval.
- Derived various formulae and asymptotic laws for the statistical properties of BPH descriptors extracted from Gaussian random fields on manifolds.

Corteva Agriscience

Research Intern   *Summer 2020*

- Created mathematical models and wrote python scripts that describe and simulate the onset of insect resistance to various pest management techniques in a variety of seeds.
- Studied the effectiveness of a combination of insect resistance management tactics and their economic and environmental impact using these models.

AUV-IITB, Autonomous Underwater Vehicle Team

Software developer *2015 - 2016*

- Worked as part of a ~20 member team in the development of an AUV and secured second place at the International AUVSI Robosub competition 2016.
- Maintained a modular software stack written in C++ and Python, using ROS for integration of various subsystems.
- Developed and tuned a PID controller for controlling the 5 degrees of freedom of the AUV.
- Created various ancillary tools such as simulators, runtime debug interfaces and drivers for sensors.

PROJECTS

 github.com/Mishalassif/height-persist *Fall 2021-Present*

3D Object classification using the Persistent homology transform (PHT)

- Created a pipeline that takes a CAD model and vectorizes it using the PHT.
- Trained a random forest classifier on the output of the vectorizing pipeline and obtained an accuracy of 80% on the ModelNet40 dataset containing 40 classes of CAD models.
- Working on a deep learning model that uses the PHT vectors to obtain a more accurate classifier. The sparse nature of the PHT vectors make this task challenging.

SOFTWARE SKILLS

Programming Python, C++, Matlab, Mathematica.

ML tools PyTorch, Tensorflow, Keras, scikit-learn.

Other tools LaTeX, Git, ROS.

PRESENTATIONS

- *Geometric Pontryagin Maximum Principle for discrete time optimal control,* 12th ICMAT Summer School on Geometry, Mechanics and Control, Spain, 2018.

RELEVANT COURSES

- **Probability**: Probability and random processes, Information theory, Stochastic processes.
- **ML**: Pattern recognition, Generative AI models, High dimensional geometric data analysis, Statistical learning theory.
- **Math**: Algebraic topology (I, II), Differentiable manifolds (I, II), Lie groups and Lie algebras.
- **Control theory**: Differential geometric control, Adaptive and Nonlinear control, Optimization.

TEACHING ASSISTANTSHIPS

- ECE 486 Control Systems, UIUC. *Fall 2020/Spring 2021*
- ME 310 Microprocessors and Automatic Control(Theory + Lab), IITB. *Fall 2018/Spring 2019*
- SC 624 Differential Geometric Methods in Control, IITB. *Spring 2018*

REFERENCES

- Yuliy Baryshnikov (ymb@illinois.edu), Professor, Electrical and Computer Engineering, UIUC.
- Debasish Chatterjee (dchatter@iitb.ac.in), Professor, Systems and Control Engineering, FIT Bombay.