

# Parth K. Thaker

1215 E.Vista Del Cerro Dr., Tempe, AZ

pkthaker@asu.edu  
parththaker.github.io

## Education

### Arizona State University

M.S. & Ph.D. in Electrical Engineering

Phoenix, US

Aug. 2017 – Present

### Indian Institute of Technology, Madras

B.Tech. & M.Tech. in Electrical Engineering;

Chennai, IN

Aug. 2011 – Aug. 2016

## Research Experience

### Enhancing DINO based Video search

- Analysed and identified the shortcoming of DINO DINO-based video search tool.
- Modified the training routine for the video search tool to enable improved fine-grained search capabilities
- Provided a quality-based assessment of the due to limited data and laid a road map for future directions for a more thorough evaluation and improvements to the already implemented enhancements.

### Bandit-based multi-agent resource monitoring

- Proposed an algorithm that combines thresholding MAB with grid-based search with fixed search patterns to achieve successful search termination with bounds on the economic costs and completion times.
- Proposed two metrics, *priority labeling time* and *economic cost*, to study the performance of the proposed algorithm. We demonstrate the minimax-optimality of the proposed algorithm based on these metrics.
- Integrated coordination requirements and the physical limitations of switching actions directly into the algorithm. We demonstrate the efficacy of our approach using numerical simulations.

### Bandits with graph structure

- Proposed a novel algorithm **GRUB**(**GR**aph **UCB** based Action Elimination) capable of capitalizing on structural graph information in Best-arm identification in stochastic bandits.
- Established rigorous theoretical complexity guarantees for GRUB showcasing the dependence of a graph-based speedup factor (scales as  $\Omega(\text{clusters})$ ).
- Modular python implementation of GRUB is available at this Git repository with accompanying evidence of performance boost compared to baseline algorithm.

### Solving for Quadratic feasibility

- Identified a subclass of Quadratically constrained quadratic programs (QCQPs), generally non-convex and NP-hard to solve, which can be tackled in a computationally efficient manner by first-order gradient descent methods.
- Theoretically established, under sufficiency conditions, that a non-convex loss function surrogate for the said QCQP satisfy *all local minima are in-fact global minima* and *all saddle points have strict negative curvature* property to guarantee success. Provided order-optimal sample complexity bounds in terms of the number of measurements for solving quadratic feasibility problems.
- (*unpublished*) Established necessary conditions required to be satisfied by any contending QCQPs to ensure the existence of a first-order gradient descent algorithm that can solve it.

### Differential programming using hyperspectral unmixing

- Hyperspectral unmixing is an important problem with applications like material identification and analysis. Incorporated a physics-based spectral variation model into a spectral unmixing pipeline to obtain superior performance.
- Part of a multi-departmental team to draw insights from optimization theory, physics and Deep learning methodology to propose a sequence of experiments to be performed for tackling the spectral unmixing problem.
- Provided conditions for initialization and theoretical convergence of alternate minimization approaches for spectral unmixing.

### Sensor Fusion

- Developed module to determine the deviation of the real-time orientation of mounted devices as well as detecting aggressive driving patterns (Hard acceleration, Hard braking, heavy swirling, etc.) using inertial sensor data.
- Worked on end-to-end implementation of the inertial modules including implementation of data acquisition algorithms from onboard inertial sensors, analysis of acquired data and notifying alerts on mobile and web applications.

### Factored gradient descent

- In most real-world applications, projection is generally a computationally intensive operation. Proposed a cost-efficient variant of projected gradient descent by splitting the gradient step and projection step into two timescale update algorithms. Performed experimental evaluation of trade-off for the proposed method.
- Extended factored gradient descent methods to tackle the problem of low rank estimation in fat and tall matrices using alternate minimization routines.

## Work Experience

### Inutitive Surgical | Intern

Sunnyvale | May 2023 - Aug 2023

- Enhanced the quality of suggestions of DINO-based Video Search tool by adding fine-grained learning capabilities during self-supervised training routines.

### Mitsubishi Electric Research Laboratories | Intern

Boston | May 2022 - Aug 2022

- Developed bandit algorithms for the task of resource monitoring with experimental validation.

### Netradyne | Systems Engineer

Bangalore | Aug 2016 - May 2017

- Worked on data pipelineing (acquisition, cleaning and analytics) for reckless driving alerts using inertial sensors.

### Securifi Systems | Intern

Hyderabad | May 2014 - Aug 2014

- Worked on server infrastructure automation and management using Puppet master slave architecture.
- Evaluated test metrics for comparing performance of Cassandra, MongoDB and MySQL on specific data formats.

### Cisco Systems Pvt. Ltd | Intern

Bangalore | May 2013 - Aug 2013

- Worked on python scripts for testing and overloading new proposed routers models using fake IP creation and bit-level manipulation of network signals.

## Publications

### Published

- **Parth Thaker**, Mohit Malu, Nikhil Rao, Gautam Dasarathy. “Maximizing and Satisficing in Multi-armed Bandits with Graph Information”, Neural Information Processing Systems (NeurIPS), 2022.
- John Janiczek, **Parth Thaker**, Gautam Dasarathy, Christopher Edwards, Philip Christensen, and Suren Jayasuriya. “Differentiable Programming for Hyperspectral Unmixing using a Physics-based Dispersion Model.” In 16th European Conference on Computer Vision (ECCV), 2020. Springer International Publishing.
- **Parth Thaker**, Gautam Dasarathy, and Angelia Nedić. “On the sample complexity and optimization landscape for quadratic feasibility problems.” In IEEE International Symposium on Information Theory (ISIT), 2020.
- **Parth Thaker**, Aditya Gopalan, and Rahul Vaze. “When to arrive in a congested system: Achieving equilibrium via learning algorithm.” In the 15th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt). IEEE, 2017.
- **Parth Thaker**, Stefano Di Cairano, Abraham P. Vinod. “Bandit-based multi-agent search under noisy observations.” 22nd IFAC World Congress, 2023.

### Preprint

- **Parth Thaker**, Gautam Dasarathy, and Angelia Nedić. “On the sample complexity and optimization landscape for quadratic feasibility problems.” arXiv preprint 2022.01066.

### Thesis

- **Parth Thaker**, Radha Krishna Ganti. Master’s Thesis, Indian Institute of Technology, 2016.

## Skill Summary

### Coursework

- Real Analysis, Functional Analysis, Applied Probability, Large-scale Optimization, Graph Theory.
- Statistical Machine learning, Process optimization, Computation methods in EE, Multivariate Data Analysis.

### Skills & Tools:

- Python, Bash scripting, MySQL, Cassandra, OpenCV.