# Parth K. Thaker

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parththaker.github.io


## Education

**Arizona State University** — Phoenix, US

M.S. & Ph.D. in Electrical Engineering — Aug. 2017 – Present

- **Topics** : Structured Bandit Learning, Non-convex Optimization.
- **Advisor** : Dr. Gautam Dasarathy
- **GPA** : 3.79/4

**Indian Institute of Technology, Madras** — Chennai, IN

B.Tech. & M.Tech. in Electrical Engineering; — Aug. 2011 – Aug. 2016

- **Thesis** : Factored Gradient Descent
- **Advisor** : Dr. Radha Krishna Ganti
- **GPA** : 8.19/10

## Research Experience

### Bandits with graph structure

- Proposed a novel algorithm **GRUB**(**GR**aph **U**C**B** 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 $\Omega$(nodes/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- *(unpublished)* Established necessary conditions required to be satisfied by any contending QCQPs to ensure the existence of a first-order gradient descent algorithm that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.

## 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.

### Preprint

- **Parth Thaker**, Gautam Dasarathy, and Angelia Nedić. "On the sample complexity and optimization landscape for quadratic feasibility problems." arXiv preprint 2002.01066.

### Thesis

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

## Skill Summary

Interested in sustainable and modular implementation of provable theoretical methods to real-world applications.

### Theory-based coursework

- Real Analysis, Functional Analysis, Applied Probability, Large-scale Optimization, Graph Theory.

### Implementation-based coursework :

- Statistical Machine learning, Process optimization, Computation methods in EE, Multivariate Data Analysis.

### Practical Skills :

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

## Work Experience

**Mitsubishi Electric Research Laboratories** — Boston, MA
Algorithms Intern — May 2022 - August 2022

**Netradyne** — Bangalore, IN
Systems Engineer — Aug 2016 - May 2017

**Securifi Systems** — Hyderabad, IN
Intern — May 2014 - Aug 2014

**Cisco Systems Pvt. Ltd** — Bangalore, IN
Intern — May 2013 - Aug 2013

**Teaching Assistant** — Chennai, IN
IIT Madras — Aug 2015 – May 2016

- EE5011: Computer Methods in Electrical Engineering
- EE6151: Advanced Topics in Networks

**WiOpt 2015** — Mumbai, IN
Conference Volunteer — May 2015

## Awards and Achievements

- Recipient of **Engineering Graduate Fellowship** for the year 2019-2020.
- As a part of social initiative **Sahaay**, worked closely with NGO Vidhyasagar, based in Chennai, India. Developed software to assist patients affected with Cerebral Palsy to have an independent life.