Harshal D. Kaushik

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Education

Ph.D. in Industrial Engineering (Fall 2021) Spring 2017 – Present
Oklahoma State University
Advisor: Dr. Farzad Yousefian
Dissertation: On Distributed Optimization Problems with Variational Inequality Constraints: Algorithms, Complexity Analysis, and Applications.

M.Tech. in Applied Mechanics 2013 – 2015
Indian Institute of Technology (IIT), Madras, India.

B.E. in Mechanical Engineering 2008 – 2012
University of Pune, India.

Awards and Scholarships

- *Roy* and *Virginia Dorrough* Distinguished Graduate Fellowship. 2020 – 2021
- Member of the Institute of Operations Research and Management Science (INFORMS). 2018 – Present
- Member of an honor society for Industrial and Systems Engineering students: Alpha Pi Mu. 2018 – Present
- M.Tech. scholarship from the Ministry of Human Resource and Development, Government of India. 2013 – 2015

Research Interest

- Convex and large-scale optimization
- Multi-agent distributed optimization
- Variational inequalities and computational game theory
- First-order optimization schemes

Publications

[1] H. D. Kaushik and F. Yousefian, "A method with convergence rates for optimization problems with variational inequality constraints", first revision for **SIAM Journal on Optimization**, Jan. 2021. arXiv: 2007.15845v1 [math.OC].

[2] H. D. Kaushik and F. Yousefian, "An incremental gradient method for distributed optimization with variational inequality constraints", manuscript under preparation for **IEEE Transactions on Automatic Control**.

[3] H. D. Kaushik and F. Yousefian, "An incremental gradient method for large-scale distributed nonlinearly constrained optimization", accepted for **2021 American Control Confernce (ACC)**, Jan. 2021. arXiv: 2006.07956v3 [math.OC].

[4] P. Ramu and H. Kaushik, "A log-third order polynomial normal transformation approach for high-reliability estimation with scarce samples", **International Journal of Reliability and Safety**, vol. 14, no. 1, pp. 14–38, 2020. [Link].

[5] H. Kaushik and F. Yousefian, "A randomized block coordinate iterative regularized subgradient method for high-dimensional ill-posed convex optimization", in **2019 American Control Conference (ACC)**, Philadelphia, PA, USA, 2019, pp. 3420–3425. [Link].

[6] H. Kaushik, R. Mohan, and K. A. Prakash, "Utilization of wind shear for powering unmanned aerial vehicles in surveillance application: A numerical optimization study", in **5$^{\text{th}}$ International Conference on Advances in Energy Research, ICAER 2015**, Mumbai, India, Energy Procedia, vol. 90, 2016, pp. 349–359. [Link].

Research Experience

Graduate Research Assistant 2017 – Present
Oklahoma State University

- **Large-scale, ill-posed convex optimization**: Extended the first-order schemes by leveraging the iterative regularization and the randomized block selection techniques to address a large-scale (solution space of the order $10^8 - 10^{12}$) ill-posed optimization problem. Proved the almost sure convergence and obtained the convergence rate statements.
- **Efficiency of equilibria in multi-agent competitive games**: Built a unifying optimization framework with the Cartesian variational inequality constraints that can quantify efficiency in the multi-agent networks. Developed iterative regularized block-coordinate gradient schemes with the goal of obtaining the convergence rate statements.
- **Finite sum problems with variational inequality constraints**: Proposed incremental gradient methods to circumvent a computationally costly projection operator and to address the variational inequality constraints in a finite sum distributed optimization problems. Analyzed the proposed schemes to obtain the rate of convergence.

Operations Research Intern Summer 2019
Schneider National

- **Network pricing problem**: Reformulated the nonlinear mixed-integer programming problem into a bilevel optimization framework. Built a hybrid algorithm by blending docplex solver with the iterative gradient descent scheme. Effectively employed SQL and Python libraries: pandas, NumPy. Profoundly collaborated across different teams, gathered data in a short time, and elucidated the presumable gain.

Project Associate 2015 – 2016
Indian Institute of Technology (IIT) Madras

- **Failure probability estimation**: Calculated the reliability of a complex system utilizing the available scarce dataset. Tools used: importance sampling, surrogate modeling, and the approximation of the tails of cumulative distribution function in a probit space.
- **Trajectory optimization of a glider and the stablity analysis**: Incorporated the six degrees of freedom flight dynamics model in the problem formulation. Optimized for improving the surveillance and stability.

Conference Presentations

- "An incremental gradient method for large-scale distributed nonlinearly constrained optimization", **INFORMS Online 2020** (Nov. 13$^{\text{th}}$, 2020).
- "First-order methods for optimization over the solution set of variational inequality problems", **INFORMS Annual Meeting 2019**, Seattle, WA (Oct. 22$^{\text{nd}}$, 2019).

- "A randomized block coordinate iterative regularized subgradient method for high-dimensional ill-posed convex optimization", **2019 American Control Conference**, Philadelphia, PA (Jul. 11^{th}, 2019).
- "A first order method for high-dimensional ill-posed optimization problems", **INFORMS Annual Meeting 2018**, Phoenix, AZ (Nov. 5^{th}, 2018).
- "Utilization of wind shear for powering unmanned aerial vehicles in surveillance application: A numerical optimization study", **5th International Conference on Advances in Energy Research, ICAER 2015**, Mumbai, India (Dec. 16^{th}, 2015).

Teaching Experience

- TA for **Engineering and Economic Analysis** (IEM 3503): Spring 2019, 2020. Fall 2017, 2018.
- TA for **Production Planning and Control System** (IEM 4613): Fall 2018, 2019.
- TA for the graduate level course, **Introduction to Optimization** (IEM 5013): Fall 2019.

Coursework and Programming Skills

- **Doctoral coursework**: Distributed and Parallel Optimization (IEM 6990), Stochastic Processes (IEM 5133), Network Optimization (IEM 5063), Convex Optimization (IEM 6990), Integer and Combinatorial Optimization (IEM 6053), Nonlinear Optimization (IEM 6043), Optimization Under Uncertainty (IEM 6063).
- **Programming**: Python 3 (NumPy, SciPy, pandas), SQL.
- **Optimization solvers**: docplex, Gurobi, CVX.
- **Engineering analysis software**: CATIA v5, ANSYS Fluent, OpenFOAM.