

# Arnesh Sujanani

200 University Avenue West  
Waterloo, Ontario N2L 3G1  
✉ a3sujana@uwaterloo.ca

## Research Interests

Continuous Optimization, Semidefinite Programming, Nonconvex Optimization, Numerical Analysis, Scientific Computing.

## Research Positions

Sept. 2024– **Postdoctoral Fellow**, *University of Waterloo*, Department of Combinatorics and Optimization, Advisors: Stephen Vavasis, Henry Wolkowicz, Saeed Ghadimi, and Walaa Moursi.

## Education

2024 **Ph.D. Operations Research**, *Georgia Institute of Technology*, Advisor: Renato D.C. Monteiro, **GPA: 3.92/4.0**.

2023 **M.S. Mathematics**, *Georgia Institute of Technology*, **GPA: 4.0/4.0**.

2019 **B.S. Applied and Computational Mathematics**, *University of Southern California*, **GPA: 3.93/4.0**.

## Industry Research Experience

Summer 2023 **Graduate R&D Intern**, *Sandia National Laboratories*, Advisor: Christopher Eldred, Discrete exterior calculus for continuum mechanics and numerically solving PDEs.

## Papers

1. **A. Sujanani**, Renato D.C. Monteiro. Efficient parameter-free restarted accelerated gradient methods for convex and strongly convex optimization. *arXiv preprint arXiv:2410.04248* (2024). Submitted to Journal of Optimization Theory and Applications.
2. R.D.C. Monteiro, **A. Sujanani**, D. Cifuentes. A low-rank augmented Lagrangian method for large-scale semidefinite programming based on a hybrid convex-nonconvex approach. *arXiv preprint arXiv:2401.12490* (2024). Submitted to Mathematical Programming.
3. **A. Sujanani**, R.D.C. Monteiro. An adaptive superfast inexact proximal augmented Lagrangian method for smooth nonconvex composite optimization problems. *Journal of Scientific Computing* **97** (2), 34 (2023). <https://doi.org/10.1007/s10915-023-02350-y>

## Working Papers

4. S. Ghadimi, **A. Sujanani**, T. Weames, H. Wolkowicz (alphabetical order). Fast projection and optimization over nonsmooth sets.

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## Research Experience

1. Developed a new parameter-free restarted method, namely RPF-SFISTA, and a new parameter-free aggressive regularization method, namely A-REG, for solving strongly convex and convex composite optimization problems, respectively. RPF-SFISTA has the major advantage that it requires no knowledge of the Lipschitz constant or strong convexity parameter of the objective. We display through extensive experiments that RPF-SFISTA is roughly 3 to 15 times faster than other restarted accelerated gradient methods. The A-REG method solves strongly convex regularized subproblems according to a stationarity criterion by using the RPF-SFISTA method with a possibly aggressive choice of initial strong convexity estimate. This scheme is thus more aggressive than several other regularization methods which solve their subproblems by running a standard ACG method for a predetermined number of iterations
2. Developed an algorithm, namely HALLaR, based on low-rank factorization, the Frank-Wolfe method, accelerated nonconvex optimization, and an augmented Lagrangian (AL) approach for solving large-scale SDPs. Extensive computational results testing HALLaR on the semidefinite relaxations of phase retrieval, matrix completion, and the maximum stable set problem display that it can solve huge SDPs, where the size of the matrix variable and the number of constraints are on the order of millions, in under a few hours.
3. Developed an efficient and adaptive proximal augmented Lagrangian method, with theoretical guarantees, for solving linearly-constrained nonconvex composite optimization problems. We show in practice that our method can be more than 10 times faster than all the other state-of-the-art codes (particularly when high accuracy is required) on a wide range of problem classes including the quadratic vector problem, the quadratic SDP problem, sparse PCA, and the matrix completion problem.

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## Teaching Experience

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| Fall 2023   | Guest Lecturer (3 lectures) - ISyE 6669: Deterministic Optimization (Masters Level), Georgia Institute of Technology. Instructor: Professor Renato D.C. Monteiro.        |
| Spring 2023 | Graduate Teaching Assistant - ISyE 6661: Linear Optimization (PhD Level), Georgia Institute of Technology. Instructor: Professor Arkadi Nemirovski.                      |
| Fall 2022   | Guest Lecturer - ISyE 6669: Deterministic Optimization (Masters Level), Georgia Institute of Technology. Instructor: Professor Renato D.C. Monteiro.                     |
| Summer 2022 | Graduate Teaching Assistant - ISyE 6739: Statistical Methods (Masters Level), Georgia Institute of Technology. Instructor: Professor Dave Goldsman.                      |
| Fall 2021   | Graduate Teaching Assistant - ISyE 6669: Deterministic Optimization (Masters Level), Georgia Institute of Technology. Instructor: Professor Andy Sun.                    |
| Fall 2019   | Graduate Teaching Assistant - ISyE 2027: Probability with Applications (Undergraduate Level), Georgia Institute of Technology. Instructor: Professor Sigrun Andradottir. |
| Spring 2018 | Undergraduate Teaching Assistant - ITP 168: Introduction to MATLAB (Undergraduate Level), University of Southern California. Instructor: Professor Ashley Williams.      |

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## Talks and Poster Presentations

1. **A. Sujanani (poster).** HALLaR: A New Solver for Solving Huge SDPs. *26th Midwest Optimization Meeting & Workshop on Large Scale Optimization and Applications*, University of Waterloo, November 2024.

2. **A. Sujanani (talk)**, R.D.C. Monteiro. Efficiency of a restarted parameter-free FISTA method for strongly convex/convex optimization with provable complexity guarantees. *2024 INFORMS Annual Meeting*, Seattle, WA, October 2024.
3. R.D.C. Monteiro, **A. Sujanani (talk)**, D. Cifuentes. A low-rank augmented Lagrangian method for large-scale semidefinite programming based on a hybrid convex-nonconvex approach. *MOPTA Conference hosted by Lehigh University*, Bethlehem, Pennsylvania, August 2024.
4. R.D.C. Monteiro, **A. Sujanani (talk)**, D. Cifuentes. A low-rank augmented Lagrangian method for large-scale semidefinite programming based on a hybrid convex-nonconvex approach. *25th International Symposium on Mathematical Programming*, Montréal, Canada, July 2024.
5. R.D.C. Monteiro, **A. Sujanani (poster)**, D. Cifuentes. A low-rank augmented Lagrangian method for large-scale semidefinite programming based on a hybrid convex-nonconvex approach. *Princeton Workshop on Optimization, Learning, and Control*, Princeton University, June 2024.
6. R.D.C. Monteiro, **A. Sujanani (talk)**, D. Cifuentes. A low-rank augmented Lagrangian method for large-scale semidefinite programming based on a hybrid convex-nonconvex approach. *IOS Conference hosted by Rice University*, Houston, Texas, March 2024.
7. R.D.C. Monteiro, **A. Sujanani (talk)**, D. Cifuentes. A low-rank augmented Lagrangian method for large-scale semidefinite programming based on a hybrid convex-nonconvex approach. *ISyE Student Seminar*, Georgia Institute of Technology, February 2024.
8. **A. Sujanani (talk)**, R.D.C. Monteiro. An adaptive superfast inexact proximal augmented Lagrangian method for smooth nonconvex composite optimization problems. *UMDSS Seminar*, Umeå University, November 2023.
9. **A. Sujanani (talk)**, R.D.C. Monteiro. An adaptive superfast inexact proximal augmented Lagrangian method for smooth nonconvex composite optimization problems. *Massachusetts Institute of Technology (MIT)*, November 2023.
10. **A. Sujanani (talk)**, R.D.C. Monteiro. An adaptive superfast inexact proximal augmented Lagrangian method for smooth nonconvex composite optimization problems. *2023 INFORMS Annual Meeting*, Phoenix, AZ, October 2023.
11. **A. Sujanani (poster)**, R.D.C. Monteiro. An adaptive superfast inexact proximal augmented Lagrangian method for smooth nonconvex composite optimization problems. *Acceleration and Extrapolation Methods*, Institute for Computational and Experimental Research in Mathematics (ICERM), Brown University, July 2023.
12. **A. Sujanani (poster)**, R.D.C. Monteiro. An adaptive superfast inexact proximal augmented Lagrangian method for smooth nonconvex composite optimization problems. *Foundations of Computational Mathematics 2023*, Sorbonne Université, June 2023.
13. **A. Sujanani (talk)**, R.D.C. Monteiro. An adaptive superfast inexact proximal augmented Lagrangian method for smooth nonconvex composite optimization problems. *SIAM Conference on Optimization*, Seattle, WA, May 2023.
14. **A. Sujanani (talk)**, R.D.C. Monteiro. An adaptive superfast inexact proximal augmented Lagrangian method for smooth nonconvex composite optimization problems. *2022 INFORMS Annual Meeting*, Indianapolis, IN, October 2022.
15. **A. Sujanani (talk)**, R.D.C. Monteiro. An adaptive superfast inexact proximal augmented Lagrangian method for smooth nonconvex composite optimization problems. *ISyE Student Seminar*, Georgia Institute of Technology, October 2022.

## Awards and Scholarships

- 2019-2020 William S. Green Fellowship, Georgia Institute of Technology. A fellowship awarded to incoming first-year PhD students.
- 2017-2019 Rose Hills Scholarship, University of Southern California. A merit-based scholarship awarded to exceptional University of Southern California students majoring in science and engineering.