

# Anirudh Subramanyam

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CONTACT INFORMATION Argonne National Laboratory  
9700 S. Cass Ave., Lemont, IL 60439

*E-mail:* [asubramanyam\[at\]anl\[dot\]gov](mailto:asubramanyam@anl.gov)  
*Webpage:* [web.cels.anl.gov/~asubramanyam/](http://web.cels.anl.gov/~asubramanyam/)

RESEARCH INTERESTS Computational methods for large-scale nonlinear and discrete optimization under uncertainty, systems modeling, and applied probability, to address problems in critical infrastructure, energy, supply chain, transportation, and process systems.

EDUCATION CARNEGIE MELLON UNIVERSITY – Pittsburgh, PA, USA 2013 - 2018  
Ph.D. in Process Systems Engineering  
Advisor: Chrysanthos E. Gounaris  
Thesis: Robust optimization of vehicle routing problems under uncertainty  
Committee: Ignacio E. Grossmann, Lorenz T. Biegler, Willem-Jan van Hoesve, Jose M. Pinto  
Honorable Mention, INFORMS Best Dissertation Award in Transportation Science and Logistics

INDIAN INSTITUTE OF TECHNOLOGY (IIT), BOMBAY – Mumbai, India 2009 - 2013  
B.Tech. in Chemical Engineering  
Thesis: Stochastic modeling of biochemical reaction networks  
Undergraduate Research Award

RESEARCH EXPERIENCE ARGONNE NATIONAL LABORATORY – Lemont, IL, USA 2019 - present  
Postdoctoral Researcher in Mathematics and Computer Science  
Advisors: Mihai Anitescu and Kibaek Kim  
Responsibilities: Developing models, algorithms, theory, and software for optimizing U.S. Department of Energy applications including critical energy and transportation systems, and high-performance computing; supervising graduate students; leading funded projects; and grant writing.

HONORS & AWARDS 2nd place in INFORMS Best Dissertation Award in Transportation Science and Logistics 2019  
Finalist in Computing and Systems Technology (CAST) Directors' Student Presentation Award 2017  
FOCAPO/CPC Conference Travel Award 2017  
CMU John and Claire Bertucci Graduate Fellowship 2015  
CMU Dean's Fellowship 2013  
Best Student Paper Award at Institute of Chemical Technology, Mumbai 2012  
IIT Bombay Undergraduate Research Award 2011

FUNDING **Funded Proposals**  
• **A. Subramanyam** (PI). Advanced algorithms for optimizing critical infrastructure systems affected by high-impact rare events. *Laboratory Directed Research and Development Innovate Seed*, Argonne National Laboratory, 2020.  
Coverage: [Three MCS Division researchers received LDRD seed funding](#)

## PUBLICATIONS **Refereed Journal Articles**

1. **A. Subramanyam**, F. Mufalli, J.M. Lainez-Aguirre, J.M. Pinto, C.E. Gounaris.  
Robust multi-period vehicle routing under customer order uncertainty.  
*Operations Research*, Articles in Advance, 2020.  
DOI: [10.1287/opre.2020.2009](https://doi.org/10.1287/opre.2020.2009).
2. **A. Subramanyam**, C.E. Gounaris, W. Wiesemann.  
*K*-adaptability in two-stage mixed-integer robust optimization.  
*Mathematical Programming Computation*, 12, 193–224, 2020.  
DOI: [10.1007/s12532-019-00174-2](https://doi.org/10.1007/s12532-019-00174-2).
3. **A. Subramanyam**, P.P. Repoussis, C.E. Gounaris.  
Robust optimization of a broad class of heterogeneous vehicle routing problems under demand uncertainty.  
*INFORMS Journal on Computing*, 32(3), 661–681, 2020.  
DOI: [10.1287/ijoc.2019.0923](https://doi.org/10.1287/ijoc.2019.0923).

4. **A. Subramanyam**, A. Wang, C.E. Gounaris.  
A scenario decomposition algorithm for strategic time window assignment vehicle routing problems.  
*Transportation Research Part B: Methodological*, 117, 296–317, 2018.  
DOI: [10.1016/j.trb.2018.09.008](https://doi.org/10.1016/j.trb.2018.09.008).
5. **A. Subramanyam**, C.E. Gounaris.  
A decomposition algorithm for the consistent traveling salesman problem with vehicle idling.  
*Transportation Science*, 52(2), 386–401, 2018.  
DOI: [10.1287/trsc.2017.0741](https://doi.org/10.1287/trsc.2017.0741).
6. **A. Subramanyam**, C.E. Gounaris.  
A branch-and-cut framework for the consistent traveling salesman problem.  
*European Journal of Operational Research*, 248(2), 384–395, 2016.  
DOI: [10.1016/j.ejor.2015.07.030](https://doi.org/10.1016/j.ejor.2015.07.030).

#### Refereed Conference Proceedings

7. **A. Subramanyam**, F. Mufalli, J.M. Lainez-Aguirre, J.M. Pinto, C.E. Gounaris.  
Robust multi-period vehicle routing under customer order uncertainty.  
*ODYSSEUS 2018, 7th International Workshop on Freight Transportation and Logistics*, Cagliari, Italy (pp. 154–157).
8. **A. Subramanyam**, C.E. Gounaris, P.P. Repoussis.  
Robust optimization of heterogeneous vehicle routing problems under demand uncertainty.  
*ODYSSEUS 2018, 7th International Workshop on Freight Transportation and Logistics*, Cagliari, Italy (pp. 150–153).
9. **A. Subramanyam**, C.E. Gounaris.  
Strategic Allocation of Time Windows in Vehicle Routing Problems under Uncertainty.  
*FOCAPO/CPC 2017, Foundations of Computer-Aided Process Operations*, Tucson, USA.
10. **A. Subramanyam**, C.E. Gounaris.  
Exact Methods for the Multi-Period Traveling Salesman Problem with Arrival Time Consistency.  
*ODYSSEUS 2015, 6th International Workshop on Freight Transportation and Logistics*, Ajaccio, France (pp. 227–230).
11. S. Bandyopadhyay, H. Mukundarajan, S. Mulay, M. Chaturvedi, M. Patel, S. Diwale, A. Shah, G.P. Subramanian, **A. Subramanyam**, K. Kaur, M. Dhanasree, A. Kumar, K.R. Eedara.  
System Engineering and Integration of Pratham, Indian Institute of Technology Bombay’s first Student Satellite.  
*International Astronautical Congress (IAC) 2010*, Prague, Czech Republic.

#### Under Review Articles (full text available)

12. **A. Subramanyam**, M. El Tonbari, K. Kim.  
Data-driven two-stage conic optimization with rare high-impact zero-one uncertainties.  
*Under review*.  
PREPRINT: [arXiv:2001.04934](https://arxiv.org/abs/2001.04934)
13. **A. Subramanyam**, J.M. Roth, M. Anitescu.  
Failure-probability-constrained AC optimal power flow.  
*Under review*.  
PREPRINT: [arXiv:2011.02453](https://arxiv.org/abs/2011.02453)
14. S. Tong, **A. Subramanyam**, V. Rao.  
Optimization under rare chance constraints.  
*Under review*.  
PREPRINT: [arXiv:2011.06052](https://arxiv.org/abs/2011.06052)
15. M. Schanen, D.A. Maldonado, F. Pacaud, M. Anitescu, K. Kim, Y. Kim, V. Rao, **A. Subramanyam**.  
Julia as a Portable High-Level Language for Numerical Solvers of Power Flow Equations on GPU Architectures.  
*Under review*.  
PREPRINT: [web.cels.anl.gov/~asubramanyam/files/parallel\\_computing.pdf](https://web.cels.anl.gov/~asubramanyam/files/parallel_computing.pdf)

## Public Software

1. **A. Subramanyam**, Y. Kim, M. Schanen.  
ProxAL.jl (written in Julia).  
Augmented Lagrangian-based distributed solver for multi-period nonconvex optimization.  
URL: [github.com/exanauts/ProxAL.jl](https://github.com/exanauts/ProxAL.jl)
2. **A. Subramanyam**.  
K-adaptability-solver (written in C++).  
Branch-and-bound solver for two-stage mixed-integer robust optimization problems.  
DOI: [10.5281/zenodo.3490004](https://doi.org/10.5281/zenodo.3490004)

## TALKS

- = INVITED
- = CONTRIBUTOR

## Invited Lectures and Seminars

Rare events and their optimization

- Grid Science Winter School & Conference, Santa Fe, NM, USA *January 2021*

Data-driven two-stage conic optimization with zero-one uncertainties

- Argonne National Laboratory, Mathematics and Computer Science, Lemont, IL *March 2020*

Robust optimization of vehicle routing problems under uncertainty

- Los Alamos National Laboratory, Center for Nonlinear Studies, Los Alamos, NM *March 2018*
- Argonne National Laboratory, Mathematics and Computer Science, Lemont, IL *February 2018*
- Pennsylvania State University, Dynamics and Controls Seminar, State College, PA *January 2018*
- Exxon Mobil Process Technology Department, Annandale, NJ *December 2017*

## Conference Talks

Data-driven two-stage conic optimization with zero-one uncertainties

- SIAM-CSE 2021, Virtual *March 2021*
- AICHE 2020, Virtual. *November 2020*
- INFORMS 2019, Seattle, WA, USA *October 2019*
- ICCOPT 2019, Berlin, Germany *August 2019*
- EURO 2019, Dublin, Ireland *June 2019*

Cascading failure-aware AC optimal power flow

- INFORMS 2020, Virtual *November 2020*

Distributed solution of linearly-constrained block nonlinear programs

- INFORMS 2020, Virtual *November 2020*

Robust optimization with decision-dependent uncertainty sets

- INFORMS 2019, Seattle, WA, USA *October 2019*
- EURO 2019, Dublin, Ireland *June 2019*

$K$ -adaptability in two-stage mixed-integer robust optimization

- ISMP 2018, Bordeaux, France *July 2018*
- AICHE 2017, Minneapolis, MN, USA *October 2017*
- IFORS 2017, Quebec City, Canada *July 2017*
- INFORMS 2016, Nashville, TN, USA *November 2016*

Robust multi-period vehicle routing under customer order uncertainty

- AICHE 2018, Pittsburgh, PA, USA *October 2018*
- ODYSSEUS 2018, Cagliari, Italy *June 2018*

- IFORS 2017, Quebec City, Canada *July 2017*
- INFORMS 2016, Nashville, TN, USA *November 2016*
- INFORMS Transportation Science and Logistics Society Workshop, Atlanta, USA *June 2016*

Robust heterogeneous vehicle routing problems under demand uncertainty

- INFORMS 2018, Phoenix, AZ, USA *November 2018*
- ODYSSEUS 2018, Cagliari, Italy *June 2018*
- INFORMS Transportation Science and Logistics Society Conference, Chicago, IL, USA *July 2017*

Strategic time window allocation in vehicle routing problems

- AIChE 2018, Pittsburgh, PA, USA *October 2018*
- INFORMS 2017, Houston, TX, USA *October 2017*
- (Poster) FOCAPO/CPC 2017, Tucson, AZ, USA *January 2017*

Exact algorithms for consistent vehicle routing problems

- AIChE 2015, Salt Lake City, UT, USA *November 2015*
- INFORMS 2015, Philadelphia, PA, USA *November 2015*
- ISMP 2015, Pittsburgh, PA, USA *July 2015*

TEACHING  
EXPERIENCE

**Teaching Assistant, Department of Chemical Engineering, Carnegie Mellon University**

Responsibilities: Mentor student projects, grade homeworks and deliver lectures.

Lectures: (110 minutes each)

- Introduction to stochastic programming
- Column generation and Dantzig-Wolfe decomposition
- Branch-price-and-cut algorithms

Courses:

- Special Topics in Process Systems Engineering (Instructor: C.E. Gounaris) *PhD elective, 2017*
- Optimization Modeling and Algorithms (Instructor: C.E. Gounaris) *Senior core, 2015*
- Chemical Product Design (Instructor: C.E. Gounaris) *Senior core, 2015*
- Chemical Process Systems Design (Instructor: I.E. Grossmann) *Senior core, 2014*

**Teaching Assistant, Tepper School of Business, Carnegie Mellon University**

Responsibilities: Design homeworks and exams, and grade homeworks.

Courses:

- Applications of Operations Research (Instructor: F. Kılınç-Karzan) *MBA elective, 2016*
- Optimization Models for Operations (Instructor: F. Kılınç-Karzan) *MBA elective, 2015*

**Institute Tutor, Department of Mathematics, IIT Bombay**

Responsibilities: Teach weekly hour-long recitation sessions.

Courses:

- Differential Equations – I (Instructor: N. Nataraj) *Freshman core, 2012*
- Differential Equations – II (Instructor: N. Nataraj) *Sophomore core, 2013*
- Complex Analysis (Instructor: N. Nataraj) *Sophomore core, 2013*

ADVISORY  
ROLES &  
MENTORSHIP

**Student Co-supervision**

- Shanyin Tong. Argonne National Laboratory Givens Associate. *2020*  
Topic: Rare events and their optimization.
- Mohamed El Tonbari. Argonne National Laboratory Givens Associate. *2019*  
Topic: Data-driven algorithms for optimal power flow.
- Tushar Rathi. CMU Master's Thesis in Chemical Engineering *2018*  
Topic: Decomposition algorithms for consistent vehicle routing problems.

- Garry Taifan. CMU Master's Thesis in Chemical Engineering 2017  
Topic: Models for vehicle routing problems with consistency constraints.
- Misna Sameer. CMU Master's Thesis in Chemical Engineering 2016  
Topic: Benders schemes for driver-consistent vehicle routing problems.
- Nikhil Apte. CMU Master's Thesis in Chemical Engineering 2016  
Topic: Models and formulations for multi-compartment vehicle routing.

### Mentorship

- Institute Student Mentor, IIT Bombay. 2011-2013  
Mentored 20 undergraduate freshmen from diverse socio-economic backgrounds over two years.

### PROFESSIONAL SERVICE **Conference Participation and Organization**

- Co-organized *YinzOR-2017*, 1st Conference of the CMU INFORMS Student Chapter.
- Organized and chaired sessions at SIAM-CSE-2021 (forthcoming), INFORMS-2020 (forthcoming), INFORMS-2019, ICCOPT-2019, ISMP-2018, IFORS-2017, INFORMS-2016.

### Referee for Peer-reviewed Journals and Conferences

American Control Conference, Applied Mathematical Modeling, Computational Management Science, Computational Optimization and Applications, Computers and Industrial Engineering, Computers and Operations Research, European Journal on Operational Research, Expert Systems with Applications, INFORMS Journal on Computing, Management Science, Mathematical Programming, Naval Research Logistics, Networks, Operations Research Letters, Optimization Letters, Optimization Methods and Software, SIAM Journal on Optimization, Transportation Science.

- OTHER R&D EXPERIENCE
- Undergraduate Research Assistant, IIT Bombay, India* 2012 – 2013  
Developed probabilistic models of biochemical reaction networks.
  - Member of Structures Subsystem of Pratham (IIT Bombay's first student satellite)* 2010 – 2012  
Validated design of the satellite structure by performing simulations of launch loads.
  - Research Intern, ITC Limited, Guntur, India* 2012  
Applied statistical process control tools to increase yields in a spice production facility.
  - Undergraduate Research Assistant, IIT Bombay, India (Advisor: Rochish Thakkar)* 2011  
Developed first principles fluid flow equations for electrorotation of vesicles in electric fields.

SKILLS Proficient in C++, Julia, Git and Unix. Some comfort with C and Matlab.

PROFESSIONAL MEMBERSHIPS Institute for Operations Research and the Management Sciences (INFORMS)  
Society for Industrial and Applied Mathematics (SIAM)  
American Institute of Chemical Engineers (AIChE)  
Mathematical Optimization Society (MOS)

REFERENCES Available on request.