# Ragheb Rahmaniani, Ph.D.

## Curriculum Vitae — February 2022

## Personal Information


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| Visa Status: | Permanent Resident | Webpage: | www.RaghebRahmaniani.com |
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## Education

2017 – 2018 **Visiting Scholar at Georgia Institute of Technology.**
I developed a generic decomposition algorithm to solve large-scale mixed-integer problems. The outcome of this research was published at Operations Research. The results also improved performance of SDDiP solver by 15x while solving 10% more real-world power generation instances.

2013 – 2017 **Ph.D. in Applied Mathematics at University of Montreal.**
The coursework was focused on the theory and methodologies of *computer science* and *optimization*. My research was on developing novel high-performance algorithms to solve large-scale non-convex problems. The published articles have received over 510 citations. The outcomes were also packaged in an efficient optimization solver, BCompose.

2011 – 2013 **M.Sc. in Systems Engineering at University of Science and Technology.**
The coursework had a strong focus on System Engineering, Statistics and Probability with additional courses in computer science. In my research, I applied the statistical and ML techniques to propose new methodologies for monitoring and evaluating public R&D institutes.

2007 – 2011 **B.Sc. in Industrial Engineering at University of Science and Technology.**
The coursework had a strong focus on Algebra, Optimization, Project Management, Programming, with additional courses in industrial designs. I graduated rank 1 among 45 peers.

## Work Experience

2020–now
I lead the Machine Learning Science team (4 scientists and 6 engineers) at Amazon's Payment Services. I am responsible for the ML platform that supports a wide-range of Amazon's payment products such as successful payment prediction, credit worthiness, anomaly detection, dynamic routing, payment selection, bad debt forecasting. One of my projects on Outage Detection and Mitigation has been awarded the "white puzzle piece" by Amazon IPs and it has been filed for a patent with USPTO.

2018–2020
I was responsible for designing, implementing, validating, and delivery of ML solutions and optimization models through a third party cloud service. I was also responsible for monitoring and managing pilot projects and technical support with the clients. My duties also included writing reports and proposals to adopt more clients. One of the projects that I worked on was to optimally place ads in linear TV and streaming services which resulted in direct adoption and a double digit increase in revenue for a major TV network in USA.

2017–2018
I was responsible of re-designing, improving, testing, and extending an optimization package for the multi-stage stochastic integer problems (with application to power generation management). I was also responsible for using the solver on new problems and provide analytical insights. My work resulted in 15x reduction of the run-time and solved 10% more problem instances that were previously unsolved.

2013–2017 — CIRRELT

I was responsible of reviewing online resources to gather information, check facts, proofread, and edit research documents and grant proposals to ensure accuracy. I was also creating presentation slides and posters to present various research findings to partners and colleagues at grant-competitions and conferences.

2012–2013 — UNIVERSITY of KURDISTAN

I was responsible for holding problem solving sessions, giving and correcting assignments, taking quizzes and instructing the course for 2 sessions for *Industrial Plants Layout Planning* and *Engineering Economics*.

## Journal Publications

### Machine Learning

1. **Rahmaniani, R.**, Khalilpourazari, S., Doulabi, H., "Decomposition based learning algorithms for MILP problems". To be submitted to *Informs Journal on Computing*. 2022
2. **Rahmaniani, R.**, Zhao, K., Shkothar, S., Dey, S., "The customer confidence score: COZCO", *Amazon Machine Learning Conference*, 2021
3. **Rahmaniani, R.**, Shkothar, S., Deewan, K., Dey, S., "ODS: A fast and accurate anomaly detection service for FinTech", *Amazon Machine Learning Conference*, 2021

### Exact Solution Algorithms

1. **Rahmaniani, R.**, Ahmed, S., Crainic, T.G., Gendreau, M., and Rei, W., "The Benders Dual Decomposition method", *Operations Research*, 2020, Vol. 68.3, pp: 878-895.
2. **Rahmaniani, R.**, Crainic, T.G., Gendreau, M., and Rei, W., "Accelerating the Benders decomposition method: Application to stochastic network design problems", *SIAM Journal on Optimization*, 2018, Vol. 28(1), pp: 875–903.
3. **Rahmaniani, R.**, Crainic, T.G., Gendreau, M., and Rei, W., "The Benders decomposition algorithm: A literature review", *European Journal of Operational Research*, 2017, Vol. 259(3), pp: 801-817.

### Meta-Heuristic Solution Algorithms

1. Ghaderi A. and **Rahmaniani, R.**, "Meta-heuristic solution approaches for robust single allocation p-hub median problem with stochastic demands and travel times", *The International Journal of Advanced Manufacturing Technology*. 2016, Vol. 82(9-12), pp: 1627-1647.
2. **Rahmaniani, R.** and Ghaderi A., "An algorithm with different exploration mechanisms: Experimental results to capacitated facility location/network design problem", *Expert Systems with Applications*. 2015, Vol. 42(7), pp: 3790-3800.
3. **Rahmaniani, R.**, Rahmaniani G., and Jabbarzadeh, A., "Variable neighborhood search based evolutionary algorithm and several approximations for balanced location–allocation design problem", *The International Journal of Advanced Manufacturing Technology*. 2014, Vol. 72(1-4), pp: 145-159.
4. Ghaderi, A., Jabal-ameli, M.S., Barzinpour, F., and **Rahmaniani, R.**, "An Efficient Hybrid Particle Swarm Optimization Algorithm for Solving the Uncapacitated Continuous Location-Allocation", *Networks and Spatial Economics*. 2012, Vol. 12(3), pp: 421-439.

### Mathematical Modeling

1. **Rahmaniani, R.** and Ghaderi, A., "A combined facility location and network design problem with multi-type of capacitated links", *Applied Mathematical Modeling*. 2013, Vol. 37(9), pp: 6400–6414.
2. **Rahmaniani, R.**, Saidi-Mehrabad, M., and Ashouri, H., "Robust Capacitated Facility Location Problem: Optimization Model and Solution Algorithms", *Journal of Uncertain Systems*. 2013, Vol. 7(1), pp: 22-35.

### Parallel Computing

1. **Rahmaniani, R.**, Crainic, T.G., Gendreau, M., and Rei, W., "An asynchronous Benders decomposition method". *Publication CIRRELT-2018-07*, Centre de recherche sur les transports, Université de Montréal, Montréal, QC, Canada.

    - Submitted to European Journal of Operational Research, October 2019.

### Nonlinear Optimization

1. **Rahmaniani, R.**, Sadjadi, S.J., Shafia, M.A., and Rahmaniyan, N., "The optimal pricing model in an uncertain and competitive environment: using possibilitic geometric programming approach". *African Journal of Business Management*. 2012, Vol 6 (46), pp: 11565-11574.

## Conference Presentations (Proceedings/Abstracts)

1. **Rahmaniani, R.**[1], Ahmed, S., Crainic, T.G., Rei, W., and Gendreau, M., "A decomposition method for mixed-integer problems", *INFORMS Optimization Society Conference*, Denver, USA, (March 2018).

2. **Rahmaniani, R.**[2], Crainic, T.G., Rei, W., and Gendreau, M., "Parallel Benders decomposition method for two-stage stochastic integer programs", *INFORMS Annual Meeting*, Houston, USA, (October 2017).

3. **Rahmaniani, R.**, Crainic, T.G., Rei, W., and Gendreau, M., "An efficient branch-and-Benders-cut method for two-stage stochastic network design problems", *Triennial Symposium on Transportation Analysis* (TRISTAN IX), Aruba, (June 2016), pp: 62-63.

4. **Rahmaniani, R.**[3], Crainic, T.G., Gendreau, M., and Rei, W., "Parallel L-shaped method to solve stochastic capacitated network design problem", *CORS/INFORMS International Conference*, Montréal-Canada, (June 2015).

5. **Rahmaniani, R.**, Saidi-Mehrabad, M., Rahmaniani, M. and Barzinpour, F., "Minimizing the transportation cost of delivery companies with uncertain demands and length edge", *The 8th International Industrial Engineering Conference, Tehran-Iran*, (February 2012), pp: 189-195.

6. Shafia, M. A., **Rahmaniani, R.**, Rezai, A., and Rahmaniani, M., "Robust optimization model for the capacitated facility location and transportation network design problem", *International Conference on Industrial Engineering and Operations Management*, Istanbul-Turkey, (July 2012), pp: 68-74.

7. **Rahmaniani, R.**, Ghaderi, A., Jabal-Ameli, M.S., and Bevrani, B., "Stochastic Maximum Covering Facility Location and Network Design", *The 4th International Conference of Iranian Operations Research Society*, Gilan-Iran, (March 2011), pp: 297-300.

## Invited Talks

1. The Benders decomposition method and stochastic network design problems, CIRRELT/GERAD/MORSC Joint Seminars, Montreal, Canada, February 2017.

## Articles in Progress

1. **Rahmaniani, R.**, Hewit, M., Rei, W., Wong, R., "On the generation of Pareto-optimal cuts".

    – To be submitted to *Operations Research*.

2. **Rahmaniani, R.**, "Lifted branching rule for MILPs".

    – To be submitted to European Journal of Operational Research.

3. **Rahmaniani, R.**, "BCompose: A general purpose decomposition-based solver for MILPs".

[1] Session Chair
[2] Session Chair
[3] Session Chair

4. **Rahmaniani, R.**, and Ahmed, S., "The Benders dual decomposition method for problems with non-convex recourse".
   - To be submitted to *Mathematical Programming*.

## Reviewer for Journals and Conferences

Operations Research, Mathematics of Operations Research, SIAM Journal on Optimization, European Journal of Operational Research, Annals of Operations Research; Journal of the Operational Research Society; Applied Mathematical Modeling; Expert Systems with Applications; Soft Computing; Mathematical Problems in Engineering; African Journal of Business Management; 3rd International Conference on Industrial Engineering and Operations Management (IEOM, 2012).

## Honors and Awards

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| 2016 | International Internship Fellowship, FRQNT. |
| 2016 | Excellence Award (Bourses d'excellence), CIRRELT. |
| 2014 | Excellence Award (Bourses d'excellence), CIRRELT. |
| 2012–2013 | Graduate Students Fellowship, National R&D Institute, Iran. |
| 2012–2013 | M.Sc. Exceptional Researchers Award, University of Science and Technology. |
| 2011–2013 | Member of National Elites Foundation (Bonyad Melli Nokhbegan), Iran. |
| 2009–2011 | B.Sc. Exceptional Talents Award, University of Science and Technology. |
| 2007–2011 | Ranked $1^{th}$ in undergraduate studies for all semesters. |
| 2007 | Ranked in the top 1% among more than 400,000 competitors in National University Entrance Exam, Iran. |

## Selected Coursework

Mathematical Programming, Graph Theory, Convex Analysis, Machine Learning, Neural networks and Deep Learning, Integer Programming, Stochastic Optimization, Operations Research I and II, Decision Making with Multiple Criteria, Probability Theory, Statistical Methods, Advanced Engineering Economy, Logistics and Transportation Network Design, Numerical Analysis, Project Management, Principles of Simulation, Advanced Artificial Intelligence, Data Science.

## Software and Systems

### Programming Languages

C++17, C, Python, Java, Scala

### Cloud Computing

AWS (Solution Architect Associate)

### Optimization APIs

CPLEX, GUROBI, GAMS, BARON, CBC, CVXPY

### Machine Learning and Data

scikit-learn, PyTorch, Spark

### Parallelization Libraries

Message Passing Interface, Boost Threads, Protocol Buffers, Joblib

### Databases

PostgreSQL

### Web Design and UI

Ruby on Rails, JavaScript, HTML5, SCSS

### Data Visualization

Tableau

### Useful Libraries

DOCOPT, SPDLOG, OPENPYXL, TikZ, OSI

### Writing and Presentation Tools

LaTeX, Microsoft Office

### Development and Tooling

cmake, bazel, Bash scripting, cpplint, cpp-check, clang-tidy, clang-format, valgrind, gdb, asan, tsan

## Developed Software

**BCompose** Fully parallelized general-purpose decomposition-based solver for general MILPs written in C, C++, and Python. This package has over 100 tunable modules and it can used to solve a given problem with various exact solution algorithms.

- Binary files of this package are available on my github;
- Various use-examples of BCompose are available on my github repository;
- Sample performance comparisons with other state-of-the-art solvers are available on my webpage.

**SDDiP** I collaborated on developing this complex solver for multi-stage stochastic integer problems. My modifications in this package resulted in more than 3.5x speedups on standard testbeds. I also fixed some serious memory leaks (i.e., reducing memory requirement by 6.67x) and unsafe threadings.

**Others** In my previous role at Optimized Markets, I owned the development multiple software packages. Examples are:

- Audio streaming dynamic ad dispatcher;
- Dynamic scheduling engine for linear TV;
- Schedule manipulator (and viewer) engine.

In my role at Amazon, I own and collaborated in developing multiple systems. Examples are:

- Customer risk score
- Pi platform
- Outage detection and mitigation in payments
- Cash remittance reconciliation
- Payments Heartbeat for realtime feature extraction
- Backup payment method selection
- Dynamic transaction routing

## Participated Competitions

Google Hash Code, 2020
Montreal IPSW, 2016 Atelier de résolution de problèmes industriels de Montréal

## Language Skills

ENGLISH (fluent), FRENCH (advanced intermediate), KURDISH (native in both Sorani and Howrami), FARSI (native)

## Extracurricular activities

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| Music | Playing an instrument in a band is a great example of a teamwork where you need to pay attentions to a broad range of fine details. I play Santour professionally. Santour has a crystal sound which gives the joyful sensations of the ocean waves. I compose pieces for this instrument and teach it whenever I have the time. |
| Sports | I am passionate about group activities, e.g., volleyball, soccer, badminton, and hiking. I am also good at swimming and running. For me, going to gym is one of the best ways to conclude a productive day. |

## References

Available upon request.