Kyle E. C. Booth

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Education

Ph.D., Industrial Engineering (Operations Research)

2015–2019	University of Toronto, Ontario, Canada
(Expected)	Department of Mechanical & Industrial Engineering
Supervisor:	Dr. J. Christopher Beck
Awards:	Distinguished Paper Award (CPAIOR2018), Distinguished Student Paper Award (CP2016)

B.A.Sc., Mechanical Engineering

2011	University of Toronto, Ontario, Canada
	Department of Mechanical & Industrial Engineering

Research

Operations research, artificial intelligence, constraint programming, optimization, vehicle routing, scheduling, hybrid algorithms.

Journal Publications

5. Roshanaei, V., **Booth, K.E.C.**, Aleman, D., Urbach, D., & Beck, J.C., "Branch-and-Check Approaches for Multi-Level Operating Room Planning and Scheduling", *International Journal of Production Economics*, accepted July 2019.

4. **Booth, K.E.C.**, Chan, T.C.Y., & Shalaby, Yusuf, "A Mathematical Optimization Framework for Expansion Draft Decision Making and Analysis", *Journal of Quantitative Analysis in Sports*, 15(1), 27-40, 2019.

3. Morin, M., Castro, M.P., **Booth, K.E.C.**, Tran, T.T., Liu, C., & Beck, J.C., "Intruder Alert! Optimization Models for Solving the Mobile Robot Graph-Clear Problem", *Constraints*, 23(3), 335-354, 2018. **Journal fast-track and winner of the Distinguished Paper Award at CPAIOR2018.**

2. **Booth, K.E.C.**, Mohamed, S.C., Rajaratnam, S., Nejat, G., & Beck, J.C., "Robots in Retirement Homes: Person Search and Task Planning for a Group of Residents by a Team of Assistive Robots", *IEEE Intelligent Systems*, 32(6), 14-21, 2017.

1. **Booth, K.E.C.**, Tran, T.T., Nejat, G., & Beck, J.C., "Mixed-Integer and Constraint Programming Techniques for Mobile Robot Task Planning", *IEEE Robotics and Automation Letters*, 1(1), 500-507, 2016.

Refereed Conference Publications

5. Senderovich, A., **Booth, K.E.C.**, & Beck, J.C., "Learning Scheduling Models from Event Data", *Proceedings of the Twenty-Ninth International Conference on Automated Planning and Scheduling (ICAPS2019)*, accepted Februrary 2019.

4. **Booth, K.E.C.**, & Beck, J.C., "A Constraint Programming Approach to Electric Vehicle Routing with Time Windows", *Proceedings of the Sixteenth International Conference on the Integration of Constraint Programming, Artificial Intelligence, and Operations Research (CPAIOR2019)*, 129-145, 2019.

3. **Booth, K.E.C.**, Do, M., Beck, J.C., Rieffel, E., Venturelli, D., & Frank, J., "Comparing and Integrating Constraint Programming and Temporal Planning for Quantum Circuit Compilation", *Proceedings of the Twenty-Eighth International Conference on Automated Planning and Scheduling (ICAPS2018)*, 366-374, 2018.

2. **Booth, K.E.C.**, Nejat, G., & Beck, J.C., "A Constraint Programming Approach to Multi-Robot Task Allocation and Scheduling in Retirement Homes", *Proceedings of the Twenty-Second International Conference on Principles and Practice of Constraint Programming, (CP2016)*, 539-555, 2016. **Winner of the Distinguished Student Paper Award at CP2016.**

1. **Booth, K.E.C.**, Tran, T.T., & Beck, J.C., "Logic-Based Decomposition Methods for the Travelling Purchaser Problem", *Proceedings of the Thirteenth International Conference on the Integration of Constraint Programming, Artificial Intelligence, and Operations Research, (CPAIOR2016)*, 55-64, 2016.

Refereed Workshop Papers

2. Venturelli, D., Do, M., O'Gorman, B., Frank, J., Rieffel, E., **Booth, K.E.C.**, Nguyen, T., Narayan, P., & Nanda, S., "Quantum Circuit Compilation: An Emerging Application for Automated Reasoning", *Proceedings of the Scheduling and Planning Applications Workshop (SPARK2019)*, In press.

1. **Booth, K.E.C.**, Tran, T.T., Nejat, G., Beck, J.C., "Mixed-Integer and Constraint Programming Techniques for Mobile Robot Task Planning", *Proceedings of the Workshop on Constraint Satisfaction Techniques for Planning and Scheduling (COPLAS2016)*, 1-4, London, UK, June 2016.

Refereed Extended Abstracts

2. Morin, M., Castro, M.P., **Booth, K.E.C.**, Tran, T.T., Liu, C., & Beck, J.C., "Intruder Alert! Optimization Models for Solving the Mobile Robot Graph-Clear Problem", *Proceedings of the Fifteenth International Conference on the Integration of Constraint Programming, Artificial Intelligence, and Operations Research (CPAIOR2018)*, Front Matter, XXVII, 2018.

1. **Booth, K.E.C.**, Tran, T.T., Nejat, G., & Beck, J.C., "Mixed-Integer and Constraint Programming Techniques for Mobile Robot Task Planning", *Proceedings of the Twenty-Second International Conference on Principles and Practice of Constraint Programming (CP2016)*, Journal Track, 883, 2016.

Work Experience

NASA Ames Research Center, SGT Inc. Mountain View, California, USA
Research Intern 2017

- Developed novel technique for solving quantum circuit compilation problems using a hybridization of temporal planning and constraint programming. **Research published in ICAPS2018.**
- Drafted technical report on promising areas for the development of hybrid classical combinatorial optimization and quantum computing algorithms.
- Provided initial sketch for a dynamic logic-based Benders decomposition (d-LBBD) technique for application to hard scheduling problems.

Toromont Industries Ltd. Toronto, Ontario, Canada
Manager, Product Support 2011–2014

- As a mechanical engineer and group manager, lead Caterpillar heavy-equipment product support team of roughly 20 employees.
- Designed maintenance and repair contract system for fleets of heavy equipment, utilizing life-cycle cost trending to ensure profitable product support agreements.
- Worked to successfully automate and optimize various company functions including field service vehicle dispatch and certified rebuild scheduling.

Teaching Experience

University of Waterloo 2019
Lecturer, MSCI 555: *Scheduling: Theory & Practice*
Course evaluation: 88/100 (Faculty average: 68.2/100)
Instructor evaluation: 93/100 (Faculty average: 72.9/100)

University of Toronto 2015–2018
Teaching Assistant, MIE562: *Scheduling*

University of Toronto 2017–2019
Teaching Assistant, MIE465: *Analytics in Action*

University of Toronto 2016–2017
Teaching Assistant, MIE262: *Operations Research I - Deterministic OR*

Professional Activities

- **Session Chair:** INFORMS2019
- **Program Committee Member:** ICAPS2019, AAAI2018, PlanSOpt2018, CP2016 Doctoral Program
- **Invited Journal Reviewer:** IEEE Access, Computers & Operations Research, Journal of Applied Soft Computing, Journal of Intelligent Social Robotics
- **Invited Conference Reviewer:** ICRA2019, SoCS2019, SoCS2018, CPAIOR2018, ICAPS2017

Research Presentations & Invited Talks

11. Booth, K.E.C., & Beck, J.C., "A Constraint Programming Approach to Electric Vehicle Routing with Time Windows", *Sixteenth International Conference on the Integration of Constraint Programming, Artificial Intelligence, and Operations Research (CPAIOR2019)*, Thessaloniki, Greece, June 2019.

10. Booth, K.E.C., Do, M., Beck, J.C., Rieffel, E., Venturelli, D., & Frank, J., "Comparing and Integrating Constraint Programming and Temporal Planning for Quantum Circuit Compilation", *Twenty-Eighth International Conference on Automated Planning and Scheduling (ICAPS2018)*, Delft, Netherlands, June 2018. [talk]

9. Booth, K.E.C., Mohamed, S.C., Rajaratnam, S., Nejat, G., & Beck, J.C., "Robots in Retirement Homes: Person Search and Task Planning for a Group of Residents by a Team of Assistive Robots", *Twenty-Eighth International Conference on Automated Planning and Scheduling (ICAPS2018) - Journal Presentation Track*, Delft, Netherlands, June 2018. [talk]

8. Roshanaei, V., Booth, K.E.C., Aleman, D., Urbach, D., & Beck, J.C., "Decomposition Methods for Multi-Level Operating Room Planning and Scheduling", *IISE Annual Conference & Expo (IISE2017)*, Pittsburgh, Pennsylvania, United States, May 2017.

7. Booth, K.E.C., Tran, T.T., G. Nejat, & Beck, J.C., "A Constraint Programming Approach to Multi-Robot Task Allocation and Scheduling in Retirement Homes", *Twenty-Second International Conference on Principles and Practice of Constraint Programming (CP2016)*, Toulouse, France, September 2016. [talk]

6. Booth, K.E.C., Tran, T.T., G. Nejat, & Beck, J.C., "Mixed-Integer and Constraint Programming Techniques for Mobile Robot Task Planning", *Twenty-Second International Conference on Principles and Practice of Constraint Programming (CP2016) - Journal Presentation Track*, Toulouse, France, September 2016.

5. Booth, K.E.C., Tran, T.T., G. Nejat, & Beck, J.C., "Mixed-Integer and Constraint Programming Techniques for Mobile Robot Task Planning", *Constraint Satisfaction Techniques for Planning and Scheduling, (COPLAS2016)*, London, England, June 2016.

4. Booth, K.E.C., "Optimization Approaches to Multi-Robot Planning and Scheduling", *Twenty-Sixth International Conference on Automated Planning and Scheduling (ICAPS 2016) - Doctoral Consortium*, London, England, June 2016.

3. Booth, K.E.C., Roshanaei, V., Aleman, D., Urbach, D., & Beck, J.C., "Optimal Operating Room Allocation to Multiple Surgical Specialties Using Decomposition Methods", *Canadian Operations Research Society Annual Conference, (CORS2016)*, Banff, Alberta, Canada, May 2016.

2. Booth, K.E.C., Tran, T.T., & Beck, J.C., "Logic-Based Decomposition Methods for the Travelling Purchaser Problem", *Thirteenth International Conference on the Integration of Constraint Programming, Artificial Intelligence, and Operations Research (CPAIOR2016)*, Banff, Alberta, Canada, May 2016.

1. Booth, K.E.C., Tran, T.T., & Beck, J.C., "Decomposition Methods for the Travelling Purchaser Problem: A Computational Study", *International Symposium on Artificial Intelligence and Mathematics, (ISAIM2016)*, Fort Lauderdale, USA, January 2016.

Mentoring

All students were co-advised with Professor J. Christopher Beck.

Undergraduate Thesis Students (Full year)

1. Mengli Duan, Division of Engineering Science 2018–2019
   Thesis: "Task Allocation Strategies for Robotic Mobile Fulfillment Systems".

Research Project Students (Single semester)

2. Kejie Zhao, Division of Engineering Science Summer 2017
   Project: "Online Task Allocation Strategies for Autonomous Order Fulfillment".

1. Alice Nuz, Division of Engineering Science Summer 2016
   Project: "Variable State Independent Decaying Sum in Logic-based Benders Decomposition".

Honors & Awards

- Ontario Graduate Scholarship 2019–2020
- Journal presentation track, ICAPS 2019
- Ontario Graduate Scholarship 2018–2019
- APSC Graduate Student Endowment Fund Award 2018
- Journal fast-track and Distinguished Paper Award, CPAIOR 2018
- Journal presentation track, ICAPS 2018
- Edmond G. Odette Scholarship 2017–2018
- Mart Liinve Graduate Scholarship 2016–2017
- Journal presentation track, CP 2016
- Distinguished Student Paper Award, CP 2016

Leadership

The Operations Research Challenge (TORCH) Toronto, Ontario, Canada
President (2018, 2019), Chief Information Officer (2017) 2016–2019

- President of leadership team for annual hackathon (www.orchallenge.com).
- Introduced roughly 150 high school students each year to field of operations research.
- Lead initiative to automate core TORCH functions in an effort to transition competition away from paper-based entry and grading to web user interface and back-end.

University of Toronto Operations Research Group (UTORG) Toronto, Ontario, Canada
Co-President (2016-2017), Webmaster (2015-2017) 2015–2017

- Responsible for growth of student group focused on the promotion of operations research (OR) and related fields at the University of Toronto.
- Founded annual *Optapalooza* constraint satisfaction and optimization hackathon and developed associated web user interface and back-end.

Other Attended Events

5. Summer School on Cognitive Robotics, *Massachusetts Institute of Technology* 2017
   Cambridge, Massachusetts, USA
4. Summer School on Planning and Scheduling, *ICAPS, King's College London* 2016
   London, United Kingdom
3. Doctoral Consortium, *ICAPS, King's College London* 2016
   London, United Kingdom
2. Master Class on Decomposition Methods, *CPAIOR* 2016
   Banff, Alberta, Canada
1. Summer School on Constraint Programming, *ACP, University of Toronto* 2015
   Toronto, Ontario, Canada

Technical Skills

Programming	C, C++, Python, MATLAB/Octave, R, PHP, Javascript
Scientific	Pandas, NumPy, Jupyter/Anaconda
Databases	MySQL, SQL, MongoDB, Amazon Redshift
Optimization	CPLEX, CP Optimizer, Gurobi, SCIP, OR-Tools, MiniZinc
Inference	Scikit-learn, XGBoost, PyTorch, TensorFlow
Environments	Linux, Windows