Graeme Best

School of Mechanical, Industrial & Manufacturing Engineering
204 Rogers Hall
Oregon State University
Corvallis, OR 97331, USA

+1 541-740-6609
bestg@oregonstate.edu
https://web.engr.oregonstate.edu/~bestg/

Research Interests

robotics • planning • algorithms • active perception • informative path planning • sequential decision making • multi-robot systems • field robotics • environmental monitoring • machine learning • decentralised algorithms • probabilistic methods • unmanned aerial vehicles • marine robotics

Education

The University of Sydney — Sydney, Australia
Ph.D. in Engineering and IT — 2019
Advisors: Prof. Robert Fitch and Prof. Stefan Williams — Australian Centre for Field Robotics
Thesis: *Planning Algorithms for Multi-Robot Active Perception*
Examiners: Profs. Mac Schwager (Stanford), Nikolay Atanasov (UCSD), and Zack Butler (RIT)

Monash University — Melbourne, Australia
B.E. (Hons) in Electrical and Computer Systems Engineering — 2014
GPA 4.00/4.00 — First Class Honours
Thesis: *Terrain Classification by a Hexapod Robot*

Monash University — Melbourne, Australia
B.Sc. in Computer Science (Double Major) and Mathematics (Minor) — 2014
GPA 3.88/4.00

Technical University of Denmark — Copenhagen, Denmark
Study Abroad — 2012

Monash University — Kuala Lumpur, Malaysia
Study Abroad — 2010

Professional Experience

Oregon State University — Corvallis, OR USA
Postdoctoral Scholar, Robotic Decision Making Lab — 2018–present
Advisor: Prof. Geoffrey Hollinger
Main projects:

- DARPA Subterranean Challenge (Team Explorer with Carnegie Mellon University)
- Information-Aware Decision Making in Teams of Autonomous Vehicles and Humans (ONR)
- NAVFAC Autonomous Underwater Inspection with ROVs (with University of Washington)

- Mentor ∼15 graduate students

The University of Sydney	Sydney, Australia
Doctoral Scholar, Australian Centre for Field Robotics	2014–2018
Teaching Assistant, Information Technologies	2015–2017
Teaching Assistant, Aeronautical, Mechanical and Mechatronics Engineering	2016
Defence Science and Technology Organisation, Maritime Division	Sydney, Australia
Research Intern, Littoral Unmanned Systems Group	2013–2014
Monash University	Melbourne, Australia
Teaching Assistant, Electrical and Computer Systems Engineering	2013–2014
CSIRO, Computational Informatics	Brisbane, Australia
Honours Scholar, Autonomous Systems Lab	2013
Research Intern, Autonomous Systems Lab	2012–2013
The University of Melbourne	Melbourne, Australia
Class Instructor, VCE Summer School (high school)	2010, 2011
'A' 4 Maths Learning Centre	Melbourne, Australia
Mathematics Tutor (primary school to college students)	2009–2013

Awards

Conference Paper Awards

- Winner: IEEE ICRA Best Paper Award on Multi-Robot Systems, IEEE Int. Conf. on Robotics and Automation (ICRA), Xi'an, China, 2021
- Winner: IEEE ICRA Best Paper Award in Service Robotics, IEEE Int. Conf. on Robotics and Automation (ICRA), Montreal, Canada, 2019
- Finalist: IEEE ICRA Best Paper Award in Robot Vision, IEEE Int. Conf. on Robotics and Automation (ICRA), Montreal, Canada, 2019
- Winner: Best Student Paper Award, Australasian Conf. on Robotics and Automation (ACRA), Brisbane, Australia, 2016
- Finalist: IEEE IROS RoboCup Best Paper Award, IEEE Int. Conf. on Intelligent Robots and Systems (IROS), Daejeon, South Korea, 2016

Competition Awards

- DARPA Subterranean Challenge: Second Place for the Urban Circuit, 2020
- DARPA Subterranean Challenge: Winner for the Tunnel Circuit, 2019
- 'Present Around the World' Victorian Finalist, Institute of Engineering and Technology (IET), 2013

University Awards and Funding

- The University of Sydney (Ph.D.):
  - Vice Chancellor's Research Scholarship (AUD $35k), 2014–2018
  - Australian Postgraduate Award (AUD $90k), 2014–2018
  - Michael Forrai (co-advised) Best Honours Thesis Presentation, 2017
  - Postgraduate Research Support Scheme, 2015, 2017
  - Charles Kolling Travelling Fund award, AMME, 2015, 2016
  - Peter Nicol Russell Postgraduate Scholarship, AMME, 2015
- Monash University (B.E., B.Sc.):
  - RS Components Award: Academic excellence and best final year project, ECSE, 2014
  - Final Year Project Academic Award first prize, ECSE, 2013
  - Final Year Project Peoples' Choice Award second prize, ECSE, 2013
  - Dean's Honour List, Engineering, 2011, 2012, 2013
  - Alumni Scholarship, 2010, 2011, 2012
  - Dean's List Fellowship, Science, 2010
  - Study Abroad Scholarship, 2010, 2012

Publications

Summary: 6 refereed journal articles (published or accepted for publication), 17 refereed conference papers, and 4 refereed workshop papers. These papers have received 427 total citations with h-index 11 and i10-index 11 (according to Google Scholar).

Journal Articles

[7] S. Scherer, ..., **G. Best**, *et al.*, "Resilient and modular subterranean exploration with a team of roving and flying robots," *Field Robotics*, 2021, **Under review**.

[6] M. Saroya, **G. Best**, and G. A. Hollinger, "Roadmap learning for probabilistic occupancy maps with topology-informed growing neural gas," *IEEE Robotics and Automation Letters (RA-L) and Proc. of IEEE Int. Conf. on Robotics and Automation (ICRA)*, 2021.

[5] S. McCammon, G. Marcon dos Santos, M. Frantz, T. P. Welch, **G. Best**, R. K. Shearman, J. D. Nash, J. A. Barth, J. A. Adams, and G. A. Hollinger, "Ocean front detection and tracking using a team of heterogeneous marine vehicles," *Journal of Field Robotics (JFR)*, 2021.

[4] A. J. Smith, **G. Best**, J. Yu, and G. A. Hollinger, "Real-time distributed non-myopic task selection for heterogeneous robotic teams," *Autonomous Robots (AURO)*, vol. 43, no. 3, pp. 789–811, 2019.

[3] **G. Best**, O. Cliff, T. Patten, R. R. Mettu, and R. Fitch, "Dec-MCTS: Decentralized planning for multi-robot active perception," *International Journal of Robotics Research (IJRR)*, vol. 38, no. 2-3, pp. 316–337, 2019.

[2] **G. Best**, J. Faigl, and R. Fitch, "Online planning for multi-robot active perception with self-organising maps," *Autonomous Robots (AURO)*, vol. 42, no. 4, pp. 715–738, 2018.

[1] **G. Best**, W. Martens, and R. Fitch, "Path planning with spatiotemporal optimal stopping for stochastic mission monitoring," *IEEE Transactions on Robotics (T-RO)*, vol. 33, no. 3, pp. 629–646, 2017.

Refereed Conference Papers

[18] C. Lee, **G. Best**, and G. A. Hollinger, "Stochastic assignment for deploying multiple marsupial robots," in *Proc. of IEEE Int. Symp. on Multi-Robot and Multi-Agent Systems (MRS)*, Cambridge, UK, 2021, **Under Review**.

[17] C. Lee, **G. Best**, and G. A. Hollinger, "Optimal sequential stochastic deployment of multiple passenger robots," in *Proc. of IEEE Int. Conf. on Robotics and Automation (ICRA)*, virtual, 2021, **Winner of Best Multi-Robot Systems Paper**.

[16] E. Scheide, **G. Best**, and G. A. Hollinger, "Behavior tree learning for robotic task planning through Monte Carlo DAG search over a formal grammar," in *Proc. of IEEE Int. Conf. on Robotics and Automation (ICRA)*, virtual, 2021.

[15] **G. Best** and G. A. Hollinger, "Decentralised self-organising maps for multi-robot information gathering," in *Proc. of IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS)*, virtual, 2020.

[14] M. Saroya, **G. Best**, and G. A. Hollinger, "Online exploration of tunnel networks leveraging topological CNN-based world predictions," in *Proc. of IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS)*, virtual, 2020.

[13] **G. Best** and G. A. Hollinger, "Decentralised self-organising maps for the online orienteering problem with neighbourhoods," in *Proc. of IEEE Int. Symp. on Multi-Robot and Multi-Agent Systems (MRS)*, New Brunswick, NJ, 2019.

[12] F. Sukkar, **G. Best**, C. Yoo, and R. Fitch, "Multi-robot region-of-interest reconstruction with Dec-MCTS," in *Proc. of IEEE Int. Conf. on Robotics and Automation (ICRA)*, Montreal, Canada, 2019, **Winner of Best Service Robotics Paper; Finalist for Best Robot Vision Paper**.

[11] **G. Best**, M. Forrai, R. R. Mettu, and R. Fitch, "Planning-aware communication for decentralised multi-robot coordination," in *Proc. of IEEE Int. Conf. on Robotics and Automation (ICRA)*, Brisbane, Australia, 2018, pp. 1050–1057.

[10] **G. Best**, S. Huang, and R. Fitch, "Decentralised mission monitoring with spatiotemporal optimal stopping," in *Proc. of IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS)*, Madrid, Spain, 2018, pp. 4810–4817.

[9] **G. Best**, O. Cliff, T. Patten, R. R. Mettu, and R. Fitch, "Decentralised Monte Carlo tree search for active perception," in *Proc. of Int. Workshop on the Algorithmic Foundations of Robotics (WAFR)*, San Francisco, CA, 2016.

[8] **G. Best**, J. Faigl, and R. Fitch, "Multi-robot path planning for budgeted active perception with self-organising maps," in *Proc. of IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS)*, Daejeon, South Korea, 2016, pp. 3164–3171, **Finalist for Best Robocup Paper**.

[7] **G. Best** and R. Fitch, "Probabilistic maximum set cover with path constraints for informative path planning," in *Proc. of Australasian Conf. on Robotics and Automation (ACRA)*, Brisbane, Australia, 2016, **Winner of Best Student Paper**.

[6] J. Faigl, R. Pěnička, and **G. Best**, "Self-organizing map-based solution for the orienteering problem with neighborhoods," in *Proc. of IEEE Int. Conf. on Systems, Man, and Cybernetics (SMC)*, Budapest, Hungary, 2016, pp. 1315–1321.

[5] **G. Best** and R. Fitch, "Bayesian intention inference for trajectory prediction with an unknown goal destination," in *Proc. of IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS)*, Hamburg, Germany, 2015, pp. 5817–5823.

[4] **G. Best**, W. Martens, and R. Fitch, "A spatiotemporal optimal stopping problem for mission monitoring with stationary viewpoints," in *Proc. of Robotics: Science and Systems (RSS)*, Rome, Italy, 2015.

[3] **G. Best** and S. Anstee, "Motion planning for autonomous underwater vehicle supervision," in *Proc. of Australasian Conf. on Robotics and Automation (ACRA)*, Melbourne, Australia, 2014.

[2] **G. Best** and P. Moghadam, "An evaluation of multi-modal user interface elements for tablet-based robot teleoperation," in *Proc. of Australasian Conf. on Robotics and Automation (ACRA)*, Melbourne, Australia, 2014.

[1] **G. Best**, P. Moghadam, N. Kottege, and L. Kleeman, "Terrain classification using a hexapod robot," in *Proc. of Australasian Conf. on Robotics and Automation (ACRA)*, Sydney, Australia, 2013.

Refereed Workshop Papers

[4] E. Scheide, **G. Best**, and G. A. Hollinger, "Learning behavior trees for robotic task planning by Monte Carlo search over a formal grammar," in *Proc. of Robotics: Science and Systems (RSS) Workshop on Learning (in) Task and Motion Planning*, virtual, 2020.

[3] C. Lee, **G. Best**, and G. A. Hollinger, "Optimal deployment of multiple passenger robots using sequential stochastic assignment," in *Proc. of Robotics: Science and Systems (RSS) Workshop on Heterogeneous Multi-Robot Task Allocation and Coordination*, virtual, 2020.

[2] F. Sukkar, **G. Best**, and R. Fitch, "Decentralised and nonmyopic next best view planning for reconstructing sparse regions of interest," in *Proc. of IEEE Int. Conf. on Intelligent Robots and Systems (IROS) 2nd Workshop on Multi-Robot Perception-Driven Control and Planning*, Madrid, Spain, 2018.

[1] M. Forrai, **G. Best**, and R. Fitch, "Communication planning for decentralised coordination with limited resources," in *Proc. of Robotics: Science and Systems (RSS) Workshop on Robot Communication in the Wild: Meeting the Challenges of Real-World Systems*, Cambridge, MA, 2017.

Theses

[2] **G. Best**, "Planning algorithms for multi-robot active perception," PhD thesis, Australian Centre for Field Robotics, The University of Sydney, 2019.

[1] **G. Best**, "Terrain classification using a hexapod robot," BE final year project, Department of Electrical and Computer Systems Engineering, Monash University, 2013.

Invited Talks

- "Planning algorithms for multi-robot active perception,"
  - Maryland Robotics Center, University of Maryland, College Park MD, USA, Aug 2019.
  - Agent Technology Center, Czech Technical University in Prague, Prague, Czech Republic, June 2019.
  - Sequential Decision Making class, Oregon State University, Corvallis OR, USA, Mar 2019.
  - Australian Centre for Field Robotics, The University of Sydney, Sydney, Australia, May 2018.
  - Multi-Robot Systems Lab, Stanford University, Palo Alto CA, USA, Dec 2017.
  - CoRIS Institute, Oregon State University, Corvallis OR, USA, Dec 2017.
  - Field Robotics Center, Robotics Institute, Carnegie Mellon University, Pittsburgh PA, USA, Nov 2017.

  - ACT lab, University of Southern California, Los Angeles CA, USA, Dec 2016.
  - AMPR group, University of New Mexico, Albuquerque NM, USA, Dec 2016.
- "Information-aware decision making in teams of autonomous vehicles and humans,"
  - Science of Autonomy Program Review, Office of Naval Research (ONR), Arlington VA, USA, Aug 2019.
  - Science of Autonomy Program Review, Office of Naval Research (ONR), Arlington VA, USA, Aug 2018.
- "Multi-robot active perception: Dec-MCTS, objective functions, and applications,"
  - Robotics: Science and Systems workshop on Informative Path Planning and Adaptive Sampling, Freiburg, Germany, June 2019.
- "Team coordination for the DARPA Subterranean Challenge,"
  - Mobile Robot Development for Subterranean Environments class, Robotics Institute, Carnegie Mellon University, Pittsburgh PA, USA, Aug 2018.
- "Decentralised Monte Carlo tree search for active perception,"
  - Robotics: Science and Systems workshop on Challenges and Opportunities for Resilient Collective Intelligence in Subterranean Environments, Carnegie Mellon University, Pittsburgh PA, USA, June 2018.
- "Online planning for multi-robot active perception with self-organising maps,"
  - Collaborative Decision-Making Reading Group, University of Technology Sydney, Sydney, Australia, May 2018.

Teaching

Teaching Assistant — 2015, 2016, 2016, 2017, 2017
Engineering Computing (introduction to MATLAB) — The University of Sydney

Reading Group Coordinator — 2017
Collaborative Decision-Making Reading Group — USyd, UTS, DSTO

Teaching Assistant — 2016, 2017
Data Structures (in Java) — The University of Sydney

Teaching Assistant — 2016
Mechatronics (introduction to C) — The University of Sydney

Teaching Assistant — 2014
Engineering Design (robotics competition) — Monash University

Teaching Assistant — 2013, 2014
Computer Systems (microprocessors) — Monash University

Class Instructor — 2010, 2011
VCE Summer School for disadvantaged High School students — The University of Melbourne

Mathematics Tutor 2009–2013
Coach for primary school through college-level students 'A' 4 Maths Learning Centre, Melbourne

Funding

- **Under Review:** Adaptable and robust multi-robot decision making through generalized sequential stochastic task assignment, National Science Foundation (NSF) Foundational Research in Robotics program, PI: G. Hollinger (OSU). Proposed funding for 2021-2024.

Service

Editorial and Review Service

- Area Chair:
  - IEEE Int. Symp. on Multi-Robot and Multi-Agent Systems (MRS), 2021
- Associate Editor:
  - IEEE Int. Conf. on Robotics and Automation (ICRA), 2021
  - IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS), 2019, 2021
- Program Committee:
  - IEEE Int. Conf. on Robotics and Automation (ICRA) Advanced Marine Robotics TC Workshop: Active Perception, 2021
  - Int. Conf. on Autonomous Agents and Multiagent Systems (AAMAS), 2019, 2021
  - Robotics: Science and Systems (RSS) Pioneers Workshop, 2019, 2020
  - Robotics: Science and Systems (RSS) Workshop on Informative Path Planning and Adaptive Sampling 2, 2019
  - IEEE Int. Conf. on Robotics and Automation (ICRA) Workshop on Informative Path Planning and Adaptive Sampling, 2018
- Session Chair:
  - IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS), 2015
- Reviewer (Journals):
  - IEEE Transactions on Robotics
  - Journal of Field Robotics
  - Autonomous Robots
  - IEEE Transactions on Automation Science and Engineering
  - IEEE Robotics and Automation Magazine
  - Robotics and Autonomous Systems
  - IEEE Robotics and Automation Letters
  - Journal of Autonomous Agents and Multi-Agent Systems
  - IEEE Transactions on Cybernetics
  - Journal of Systems Architecture
  - Journal of Intelligent and Robotic Systems
- Reviewer (Conferences):
  - Robotics: Science and Systems (RSS)
  - Workshop on the Algorithmic Foundations of Robotics (WAFR)

- IEEE Int. Conf. on Robotics and Automation (ICRA)
- IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS)
- Int. Symp. on Multi-Robot and Multi-Agent Systems (MRS)
- Int. Conf. on Autonomous Agents and Multiagent Systems (AAMAS)
- IEEE Int. Conf. on Automation Science and Engineering (CASE)
- IEEE Int. Conf. on Robot and Human Interactive Communication (RO-MAN)

Workshop Organisation

- "Informative Path Planning and Adaptive Sampling (WIPPAS2)," co-organised with J. J. Chung, N. Lawrance, A. Quattrini Li, and S. Kemna, Robotics: Science and Systems (RSS) workshop, Frieburg, Germany, 2019.
- "Informative Path Planning and Adaptive Sampling (WIPPAS)," co-organised with S. Kemna, J. J. Chung, and N. Lawrance, Int. Conf. on Robotics and Automation (ICRA) workshop, Brisbane, Australia, 2018.

Community Engagement

- Volunteer, OSU150 Futures Focus Symposium: The Promise and the Peril of AI and Robotics, Oregon State University, 2018
- Panelist, CAS Postgrad Studies Expo, University of Technology Sydney, 2017
- Panelist, ACFR Postgrad Studies Expo, The University of Sydney, 2016
- Volunteer, IEEE Agricultural Robotics Summer School, The University of Sydney, 2015
- Robotics lab tour guide, The University of Sydney Open Day, 2015
- Invited talk, IET Present Around The World Victorian Final, Melbourne, 2013
- Tour guide, Monash University Orientation Day, 2010
- Physics lab demonstrator, Monash University Open Day, 2009

Outreach

- Judge for MATE ROV Competition for school students, Lincoln City OR, 2019
- Capstone project interviewee at Lone Pine Elementary School, Medford OR, 2018
- Mentor at Aboriginal Robotics Workshop for primary school students, National Centre of Indigenous Excellence, Sydney, 2015
- Tutor for High-School Introduction to Electrical Engineering, Monash ECSE, Melbourne, 2013
- Volunteer tutor at VCE Summer School for disadvantaged high school students, The University of Melbourne, 2011
- Volunteer tutor at VCE Summer School for disadvantaged high school students, The University of Melbourne, 2010

Summer School Participation

- IEEE Multi-Robot Systems Summer School, National University of Singapore, Singapore, 2016

- NICTA Machine Learning Summer School, The University of Sydney, Sydney, Australia, 2015
- IEEE Agricultural Robotics Summer School, The University of Sydney, Sydney, Australia, 2015
- Robotics and Autonomous Systems Winter School, Queensland University of Technology, Brisbane, Australia, 2014

Software

- Most Proficient: C++; Python; MATLAB; C; Linux; Robot Operating System (ROS); Latex
- Some Experience: Java; Arduino; Android; Perl; Verilog; VHDL; OpenGL; CAD packages

Personal

- Citizenship: Australia
- Hobbies: drums, cycling, hiking, board games, guitar, cricket, travel

Referees

Available upon request.