(651) 261–2862
john.r.harwell@gmail.com
https://jharwell.github.io
Google Scholar
Github

John Harwell

Summary

- Multi-agent systems researcher/developer with 10+ years of experience in embedded systems
- Interdisciplinary collaborator, leader, mentor, and problem-solver
- Author of 9 publications in peer-reviewed journals and conferences, including 5 first-author papers

Education

2016–2022 **Ph.D. in Computer Science**, *University of Minnesota Twin Cities*.

2016–2018 **M.S. in Computer Science**, *University of Minnesota Twin Cities*.

2009–2013 **B.S. in Computer Science and Engineering**, *University of Wisconsin-Madison*.

Technical Skills

Theory	Bio-inspired modeling, stochastic processes, differential equation modeling, graph theory, queueing theory
Algorithms	Parallel, greedy, bio-inspired, graphical, task allocation
Data Structures	Graphs, trees, R-trees, Poisson queues, heaps, maps, C++ STL
Languages	**Proficient**: C (kernel/embedded systems programming) C++ (C++17, templates, metaprogramming) Python (data visualization/processing, REST) **Familiar**: Fortran, SPARC, bash, MATLAB
Interfaces	**Proficient**: Boost, OpenMP, pandas, matplotlib **Familiar**: MPI, FPGA specs, UART, I2C
Software Development	**Writing**: Design patterns, OOP, polymorphism, concurrent programming **Devops**: GitHub Actions, GitLab CI **Tools**: Intel/GNU compilers, LLVM toolchain, cmake, gdb, valgrind, VTune, git
Platforms	Linux: Ubuntu, Raspberry PI Real-time OS: RTEMS Robotics: ARGoS, ROS, Turtlebot3 High Performance Computing (HPC): SLURM, PBS

Experience

2022–present **Researcher**, Smart Information Flow Technologies , Minneapolis, MN.

- Independently solicited work and successfully executed tasks with minimal oversight.
- Contributed to business development through market research and proposal writing.
- Developed models of flocking behaviors to extract control policies and parameters automatically from trajectory data to estimate physical properties and limits of vehicles.
- Reduced debugging time by enhancing in-house tooling for efficient visualization of multi-variate spatio-temporal data of large-scale multi-agent systems.

2016–2022 **Researcher**, University of Minnesota, Minneapolis, MN.

- Derived cuboid structure model using graph theory to develop simple algorithms to provably manipulate graphs (structures) from one state to another [1].
- Demonstrated robust predictions of steady-state collective foraging behaviors up to practical engineering limits using differential equation modeling [3].
- Showed that the origin of collective intelligence in task allocating swarms lies in self-organized learning task relationships, rather than costs [4].
- Reduced development cycles and increased utility of automated design methods through of better measurements for design principles of multi-agent systems.

2016–2022 **Mentor and Advisor**, University of Minnesota, Minneapolis, MN.

- Designed engaging opportunities including contributing to published papers and large C++ software projects for high school and undergraduate students.
- Mentored undergraduate students interested in AI, robotics, and academic research to apply for grants and publish original research.

2013–2016 **Research Engineer**, Southwest Research Institute, San Antonio, TX.

- Reduced computing costs through computational optimization of large-scale simulations.
- Lead flight software developer on NASA subcontract for unmanned satellite constellation in collaboration with the University of Michigan.

Projects

2016-present **Maintainer**, Core Swarm Library, Github.

- Middleware-esque C++ library providing a common, zero-cost API to different platforms, transparently for both real and simulated robot types.
- C++17 compliant with strong focus on reusability. Integration with Boost.
- Computationally optimized: Demonstrated efficient execution with systems of over 10,000 robots on HPC clusters and on real systems of Raspberry PI-powered robots.

2017-present **Maintainer**, SIERRA: Scientific Method Automation, Github.

- Given a user query of an independent variable over a range, generate experimental inputs, run experiments, process results, and generate visualizations [2].
- Plugin-based python framework supports any agent type, platform (e.g., simulator, ROS, real robot), or execution environment (e.g., HPC cluster, real robot).

2016-2022 **Author**, FORDYCA: Foraging Robots use Dynamic Caches, Github.

- Consistent use of design principles: SOLID, DRY/WET, interface segregation, etc.
- Scalable events-based architecture to drive agent controllers.
- Novel generic event dispatch approach via compile-time reflection.

Selected Publications

[1] **J. Harwell**, L. Lowmanstone, M. Gini. "A Lattice Model of 3D Environments For Provable Manipulation". In: *Proceedings of the 22th International Conference on Autonomous Agents and MultiAgent Systems*. AAMAS '23. International Foundation for Autonomous Agents and Multiagent Systems, **2023**, XX–YY.

[2] **J. Harwell**, L. Lowmanstone, M. Gini. "SIERRA: A Modular Framework for Accelerating Research and Improving Reproducibility". In: *2023 International Conference on Robotics and Automation (ICRA)*. **2023**, XX–YY.

[3] **J. Harwell**, A. Sylvester, M. Gini. "Characterizing The Limits of Linear Modeling of Non-Linear Swarm Behaviors". In: *Autonomous Robots* **(2022)**. Under review. URL: `http://arxiv.org/abs/2110.12307`.

[4] **J. Harwell**, L. Lowmanstone, M. Gini. "Demystifying Emergent Intelligence And Its Effect On Performance In Large Robot Swarms". In: *Proc. Int'l Conf. on Autonomous Agents and Multi-Agent Systems (AAMAS)*. **May 2020**, pp. 474–482.

Fellowships and Awards

2022 DAAD AInet Fellow - AI and Robotics ($N/A)

2020–2021 UMII MnDRIVE Graduate Fellowship ($51,177)

2019–2020 GAANN Fellowship ($20,560)