

# John Harwell

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

## 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
Platforms	Bare-metal: SPARC LEON2, Arduino Linux: Ubuntu, Raspberry PI Real-time OS: RTEMS Robotics: ARGoS, ROS, Turtlebot3 High Performance Computing (HPC): SLURM, PBS
Languages	<b>Proficient:</b> C (kernel/embedded systems/firmware programming) C++ (C++17, templates, metaprogramming) Python (data visualization/processing, REST) <b>Familiar:</b> Fortran, SPARC, bash, MATLAB
Interfaces	<b>Proficient:</b> Boost, OpenMP, pandas, matplotlib <b>Familiar:</b> MPI, FPGA specs, UART, I2C
Software Development	<b>Writing:</b> Design patterns, OOP, polymorphism, concurrent programming <b>Devops:</b> GitHub Actions, GitLab CI <b>Tools:</b> Intel/GNU compilers, LLVM toolchain, cmake, gdb, valgrind, VTune, git



## Experience

2022–present **Researcher**, SMART INFORMATION FLOW TECHNOLOGIES, Minneapolis, MN

- Independently identified project 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 multivariate 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 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, publish original research, and present at workshops.
- 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 Cyclone Global Navigation Satellite System (CYGNSS) 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).
- 2013–2016 **Lead Developer**, CYGNSS: CYCLONE GLOBAL NAVIGATION SATELLITE SYSTEM,
- Developed LEON2 SPARC bootstrap (bare metal) for custom board bring up.
  - Delivered system device drivers: UART, I2C, SpaceWire, FPGA. Hardware, software driver debugging.
  - Integrated system and application software in RTEMS OS using 4Mb memory, 50 Mhz processor.

## Selected Publications

- [1] **J. Harwell**, L. Lowmanstone, M. Gini. "A Lattice Model of 3D Environments For Provable Manipulation". In: *Proc. Int'l Conf. on Autonomous Agents and Multiagent Systems (AAMAS)*. **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*. arXiv:2110.12307v2 [cs.RO]. **2022**.
- [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)