

John Harwell

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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 6 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, ARM Cortex-M9, Arduino Linux: Ubuntu, Raspberry PI Real-time OS: FreeRTOS, RTEMS Robotics: ARGoS, ROS1, Turtlebot3 High Performance Computing (HPC): SLURM, PBS
Languages	Proficient: C (kernel/embedded systems/firmware programming) C++ (C++17, templates, metaprogramming) Python (data visualization/processing, REST) Familiar: Fortran, SPARC, bash, MATLAB
Interfaces	Proficient: Boost, OpenMP, QEMU, pandas, matplotlib Familiar: MPI, FPGA specs, UART, I2C
Software Development	Writing: Design patterns, OOP, polymorphism, concurrent programming Devops: GitHub Actions, GitLab CI, Ansible Tools: Intel/GNU compilers, LLVM toolchain, cmake, gdb, valgrind, VTune, git, svn

Experience

- 2023–present **Senior Embedded Software Engineer**, [SATELLES](#), Minneapolis, MN.
- Architecture, implementation, and maintenance of a custom QEMU emulator to (a) reduce risk in commercializing custom in-house ASIC and (b) support prototype development and testing.
 - Leveraged reusable software modules for bare metal, embedded applications to accelerate development and meet aggressive deadlines. Hardware, software driver debugging.
- 2022–2023 **Postdoctoral Researcher**, [SIFT](#), Minneapolis, MN.
- 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.
 - Contributed to business development through market research and proposal writing.

- 2016–2022 **Researcher**, UNIVERSITY OF MINNESOTA, Minneapolis, MN.
- Achieved publication of 9 papers at top conferences and journals, including 6 first author papers, through strong writing and organization skills, and collaboration with other researchers.
 - 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 **Research Group Leader**, UNIVERSITY OF MINNESOTA, Minneapolis, MN.
- Mentored high school and undergraduate students interested in AI, robotics, and academic research to apply for grants, publish original research, and present at workshops.
 - Managed parallel undergraduate research projects through weekly meetings, check-ins. Helped students to develop as independent researchers: fostered excitement in research through freedom of topic choice and technical approach, and clarity in student goals through project scoping.
- 2013–2016 **Research Engineer**, SOUTHWEST RESEARCH INSTITUTE, San Antonio, TX.
- Led flight software development on NASA subcontract for Cyclone Global Navigation Satellite System (CYGNSS) in collaboration with the University of Michigan.
 - Developed prototype NASA cFS-compatible file system with configurable memory footprint and increased robustness for flash-based media.

Projects

- 2016-present **Author**, CORE SWARM LIBRARY, .
- Middleware-esque C++ library providing a transparent, zero-cost API to different robotics platforms (ROS1, ARGoS, etc.), for both real and simulated robot types.
 - Computationally optimized for efficient execution with systems of over 10,000 robots on HPC clusters and on real systems of Raspberry PI-powered TurtleBot3 robots.
- 2016-present **Author**, C/C++ DEVELOPMENT CORE, C , C++ .
- Focused on reusability to kickstart development on any C/C++ project.
 - C++ modules: metric collection, logging, spatial reasoning, data structures.
 - C++ generic design patterns: decorator, factor, FSM, prototype, singleton, visitor.
 - C modules: data structures, minimal stdlib, publisher/subscriber bus, logging mechanisms for bare-metal/embedded applications.
- 2017-present **Author**, SIERRA: SCIENTIFIC METHOD AUTOMATION, .
- 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, ROS1, real robot), or execution environment (e.g., HPC cluster, real robot).
- 2013–2016 **Lead Developer**, CYGNSS.
- Developed LEON2 SPARC bootstrap (bare metal) for custom board bring up.
 - Delivered system device drivers: UART, I2C, SpaceWire, FPGA.
 - Integrated system and application software in RTEMS OS using 4MB memory, 50 Mhz processor.

Selected Publications

- [1] **J. Harwell**, L. Lowmanstone, M. Gini. "Provably Manipulable 3D Structures using Graph Theory". In: *Proc. Int'l Conf. on Autonomous Agents and Multiagent Systems (AAMAS)*. **2023**, pp. 2550–2552.
- [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**, pp. 9111–9117.
- [3] **J. Harwell**, A. Sylvester, M. Gini. "An empirical characterization of ODE models of swarm behaviors in common foraging scenarios". In: *Autonomous Robots (July 2023)*.
- [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.