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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
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.

- Reduced risk of commercializing in-house ASIC by developing a QEMU emulator for custom hardware to accelerate development and testing.

2022–2023 **Researcher**, Smart Information Flow Technologies , 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 5 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 highs 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.
- Reduced computing costs through computational optimization of large-scale simulations.
- Developed prototype NASA cFS-compatible file system with configurable memory footprint and increased robustness for flash-based media.

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, 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. 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. "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. *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.