

# Mike Wilkins

## HPC/AI Researcher

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## Education

- **Ph.D. Computer Engineering**, Northwestern University (2023)
- **M.S. Computer Engineering**, Northwestern University (2021)
- **B.S. Computer Engineering**, Rose-Hulman Institute of Technology (2019)

## Experiences

**Maria Goeppert Mayer Fellow** Oct 2024 - Present  
*Argonne National Laboratory*

- Led a research project with over \$1 million in funding titled "Holistic Machine Learning Autotuning for Massive-Scale Artificial Intelligence for Science"
- Implemented ACCLAiM, an autotuner for collective communication, and deployed it on production supercomputers such as Aurora, achieving widespread speedups of up to 35x
- Enhanced MPICH, the premier open-source MPI implementation, through significant contributions focused on collective communication

**Software Engineer** Jan-Sep 2024  
*Cornelis Networks*

- Optimized the OPX libfabric provider, achieved a 5x bandwidth improvement for GPU communication among
- other advancements
- Led the development of the reference libfabric provider for the Ultra Ethernet Consortium
- Created developer productivity tooling, including an OPX performance profiler and a runtime parameter
- autotuner

**AI Research Intern** Summer 2023  
*Meta*

- Designed and implemented an application-aware communication (NCCL) autotuner for large-scale AI workloads
- Developed an AI application emulation tool that mimics production models by overlapping communication and
- genericized compute kernels

**Research Aide/Visiting Student**  
*Argonne National Laboratory*

2020 - 2023

- Founded the MPI collective algorithm/machine learning project, initially under the supervision of Dr. Min
- Si and Dr. Pavan Balaji, later Dr. Yanfei Guo and Dr. Rajeev Thakur
- Earned perpetual external funding from ANL for the remainder of my Ph.D

**Engineering Leadership Program Intern**  
*National Instruments*

Summer 2018

- Engaged with technical leaders through field presentations to multiple companies in the Seattle area
- Assisted customers to design and troubleshoot data-acquisition applications using NI platforms

**Trailblazer Intern**  
*Flexware Innovation*

Summer 2017

- Designed an innovative RFID tracking solution to repair a malfunctioning inventory locating system
- Produced a full-stack BI database solution analyzing internal employee and revenue data

**Director of Tool Services**  
*Power Solutions International*

Summer 2016

- Organized and managed the company's inventory of CNC machining tools, valued at more than \$500,000
- Trained company technicians on new processes and managed tool services employees

## Research Projects

Here is a high-level description of my active and former research projects.

- **ML Autotuning for Generalized MPI Collective Algorithms** (Ongoing)
  - Creating new generalized MPI collective algorithms and a machine-learning autotuner that automatically selects and optimizes the best algorithm
  - Invented multiple optimizations to make ML-based MPI autotuning feasible on large-scale systems
- **High-Level Parallel Languages for HPC** (Ongoing)
  - Developing a new hardware/software co-design for the Standard ML language targeted at HPC systems and applications, including AI
  - Created a new version of the NAS benchmark suite using MPL (a parallel compiler for Standard ML) to enable direct comparison between HLPLs and lower-level languages for HPC
- **Cache Coherence for High-Level Parallel Languages** (2019-2022)
  - Identified a low-level memory property called WARD that can be introduced by construction in high-level parallel programs
  - Implemented a custom cache coherence protocol in the Sniper architectural simulator and found an average speedup of 1.46x across the PBBS benchmark suite.

- **Compiler and Runtime Memory Observation Tool (CARMOT)** (2020-2022)
  - Implemented source code-level automatic parallelization tool using compiler and runtime techniques
  - Built a pintool using the Intel pin interface to report memory locations allocated and freed within statically compiled libraries

## Publications

- **On Transparent Optimizations for Communication in Highly Parallel Systems**  
*Michael Wilkins*  
 Ph.D. Thesis  
[PDF Link](#)
- **Generalized Collective Algorithms for the Exascale Era**  
*Michael Wilkins, Hanming Wang, Peizhi Liu, Bangyen Pham, Yanfei Guo, Rajeev Thakur, Nikos Hardavellas, and Peter Dinda*  
 CLUSTER'23  
[PDF Link](#)
- **Evaluating Functional Memory-Managed Parallel Languages for HPC using the NAS Parallel Benchmarks**  
*Michael Wilkins, Garrett Weil, Luke Arnold, Nikos Hardavellas, Peter Dinda*  
 HIPS'23 Workshop  
[PDF Link](#)
- **WARDen: Specializing Cache Coherence for High-Level Parallel Languages**  
*Michael Wilkins, Sam Westrick, Vijay Kandiah, Alex Bernat, Brian Suchy, Enrico Armenio Deiana, Simone Campanoni, Umut Acar, Peter Dinda, Nikos Hardavellas*  
 CGO'23  
[PDF Link](#)
- **Program State Element Characterization**  
*Enrico Deiana, Brian Suchy, Michael Wilkins, Brian Homerding, Tommy McMichen, Katarzyna Dunajewski, Nikos Hardavellas, Peter Dinda, Simone Campanoni*  
 CGO'23  
[PDF Link](#)
- **ACCLAiM: Advancing the Practicality of MPI Collective Communication Autotuning Using Machine Learning**  
*Michael Wilkins, Yanfei Guo, Rajeev Thakur, Peter Dinda, Nikos Hardavellas*  
 CLUSTER'22  
[PDF Link](#)
- **A FACT-Based Approach: Making Machine Learning Collective Autotuning Feasible on Exascale Systems**  
*Michael Wilkins, Yanfei Guo, Rajeev Thakur, Nikos Hardavellas, Peter Dinda, Min Si*  
 ExaMPI'21 Workshop  
[PDF Link](#)

## Skills

- **Software/Scripting Languages** : C, C++, Python, Standard/Parallel ML, C#, LabVIEW, Java, SQL, Bash
- **Parallel Programming/Communication** : MPI, Libfabric, NCCL, CUDA, PyTorch, Parallel ML
- **Simulators/Tools** : Sniper, gem5, ZSim, Xilinx Vivado, Xilinx ISE, Quartus II
- **Hardware Description Languages** : Chisel, VHDL, Verilog, SPICE