

# Andrew C. Kirby

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RESEARCH SPECIALIZATIONS	Computational Fluid Dynamics · High Performance Computing · Wind Energy · Aerospace <i>Numerical method and software development for next-generation supercomputing architectures.</i>	
EXPERIENCE	<b>Research Scientist, Assoc.</b> University of Wyoming School of Computing	January 2023 - present
	<b>Research Scientist</b> Scientific Simulations, LLC.	September 2020 - January 2023
	▷ Principal Investigator: NASA SBIR 2021 Phase I Solicitation (A1.02-1793) <i>High Fidelity Noise Prediction for Open Rotors</i>	8/22 - 1/23
	▷ Principal Investigator: NASA STTR 2021 Phase I Solicitation (T9.02-1964) <i>GPU Acceleration of an Adjoint Enabled Real Gas Hypersonic Flow Solver</i>	5/21 - 6/22
	▷ Investigator: NASA SBIR 2020 Phase I Solicitation (A1.02-5606) <i>Unstructured Overset Hybrid RANS/LES Simulations for Jet Noise Prediction</i>	8/20 - 3/21
	<b>Subcontracted Research Scientist</b> National Renewable Energy Laboratory (NREL) Exascale Computing Project (ECP) ExaWind: Overset Algorithm Development Collaborators: Michael Sprague, Ph.D.	November 2022 - November 2023
	<b>Research Scientist</b> (part time) University of Wyoming, Mechanical Engineering Principal Scientific Software Developer: <code>dg4est</code> Co-Investigator High Performance Computing Program in the High Altitude CFD Laboratory	September 2020 - January 2023
	<b>Teaching Fellow</b> Harvard University, IACS <i>CS107 - Systems Development for Computational Science</i>	August 2020 - December 2020
	<b>Postdoctoral Research Associate</b> MIT Lincoln Laboratory, Lincoln Laboratory Supercomputing Center Topic: High performance computing algorithms development for Deep Learning Supervisors: Vijay Gadepally, Ph.D., Jeremy Kepner, Ph.D.	October 2019 - September 2020
	<b>Postdoctoral Research Associate</b> Department of Mechanical Engineering, University of Wyoming Supervisor: Professor Dimitri J. Mavriplis	February 2018 - October 2019
	<b>Blue Waters Computational Graduate Fellow</b> National Center for Supercomputing Applications University of Illinois at Urbana-Champaign	September 2016 - August 2017
	<b>Visiting Research Scientist</b> NASA Ames Research Center, U.S. ARMY CREATE-AV HELIOS Team Collaborators: Andrew Wissink, Ph.D., Jay Sitaraman, Ph.D.	August 2014, March 2015, February 2016
	<b>Adjunct Mathematics Faculty</b> Laramie County Community College Course Instructor: Math 0921 - Algebra 1 Fall 2013 (two sections), Spring 2014, Summer 2014, Fall 2014	August 2013 - December 2014
EDUCATION	<b>University of Wyoming</b> <i>Ph.D., Mechanical Engineering</i> , Advisor: Professor Dimitri J. Mavriplis Dissertation: <i>Enabling High-Order Methods for Extreme-Scale Simulations</i>	Laramie, WY May 2018
	<b>Columbia University</b> <i>M.S., Applied Mathematics</i>	New York, NY February 2013
	<b>University of Wisconsin-Madison</b> <i>B.S., Mathematics, Graduation with Distinction</i>	Madison, WI December 2011

SELECTED AWARDS	<p><b>IEEE Outstanding Paper Award</b> <span style="float: right;">September 2020</span>  IEEE High Performance Extreme Computing (HPEC) Conference  Title: <i>Layer-Parallel Training with GPU Concurrency of Deep Residual Neural Networks via Nonlinear Multigrid</i></p> <p><b>MIT Green AI Hackathon Supercomputing Award</b> <span style="float: right;">January 2020</span>  <i>Satori Hack Award</i>: Most creative GPU performance programming hack</p> <p><b>Blue Waters Graduate Fellowship</b> <span style="float: right;">2016-2017</span>  Computer Science, Applied Mathematics, and Computational Science Applications  Selected <i>1 of 10</i> Nationally  50,000 Node-hours on NSF Blue Waters Supercomputer  \$50,000 Stipend</p>
HPC GRANTS	<p><b>NWSC Wyoming-NCAR Alliance Large Allocation [Co-PI]</b> <span style="float: right;">October 2016 - June 2023</span>  NWSC-2 Cheyenne ~ 5.34 Petaflops  Title: <i>Computational Study of Wind Turbine Performance and Loading Response to Turbulent Atmospheric Inflow Conditions</i>  Roles: Primary Proposal Writer (yearly), Lead Computational Developer/User  <b>140,412,200 core-hours</b></p> <p><b>ORNL Summit Early Science Project LOI [PI]</b> <span style="float: right;">January 2018 - June 2018</span>  ORNL Summit ~ 148.6 Petaflops (#1 on Top500-2018)  <b>5,000 node-hours</b></p> <p><b>Blue Waters Graduate Fellowship Allocation [PI]</b> <span style="float: right;">June 2016 - June 2018</span>  Blue Waters Supercomputer ~ 13.7 Petaflops  <b>50,000 node-hours</b> on Blue Waters, \$50,000 Stipend</p>
PROFESSIONAL SERVICE	<p><b>Ph.D. Dissertation Committee</b> <span style="float: right;">2020-2023</span>  Department of Aeronautics and Astronautics, MIT  Doctoral Student: Mohammad Shafaet Islam  Chair: Professor Qiqi Wang, MIT</p> <p><b>Postdoctoral Supervisor</b> <span style="float: right;">2020-2021</span>  Department of Mechanical Engineering, University of Wyoming  Topic: Discontinuous Galerkin Curved Mesh Software Development and Integration</p> <p><b>Journal Reviewer</b> <span style="float: right;">2022-present</span>  Journal of Computational Physics</p> <p><b>Proposal Reviewer</b> <span style="float: right;">2020-present</span>  U.S. Department of Energy, Advanced Scientific Computing Research (ASCR) Program</p> <p><b>NCAR HPC User Group Member and GPU TIGER Team Member</b> <span style="float: right;">2021-present</span>  Supercomputer User Focus Group specializing in CPU and GPU programming</p> <p><b>AIAA CFD High Lift Prediction Workshop</b> <span style="float: right;">2021-2022</span>  Hybrid RANS/LES Technology Focus Group Member</p>

PUBLICATIONS

1. Yoon, S-H., **Kirby, A. C.**, Mavriplis, D. J., "Pseudo-time Stepping Strategies for Space-Time Discontinuous Galerkin Discretizations." *AIAA SciTech 2023 Forum*, National Harbor, MD.
2. D. J. Mavriplis, Bogstad, M., **Kirby, A. C.**, "RANS and Hybrid RANS-LES Results for the Fourth High-Lift Prediction Workshop using the NSU3D Solver." *AIAA Scitech 2022 Forum*, San Diego, CA, January 2022.
3. [Presenter] Yang, Z., **Kirby, A. C.**, Mavriplis, D. J., "Comparison of Propeller-Wing Interaction Simulation using Different Levels of Fidelity." *AIAA Scitech 2022 Forum*, San Diego, CA, January 2022.

4. [Outstanding Paper Award][Presenter] Kirby, A. C., Samsi, S., Jones, M., Reuther, A., Kepner, J., and Gadepally, V., "Layer-Parallel Training with GPU Concurrency of Deep Residual Neural Networks via Nonlinear Multigrid." IEEE High Performance Extreme Computing Conference (HPEC), September 2020.
5. [Presenter] Kirby, A. C., and Mavriplis, D. J., "GPU-Accelerated Discontinuous Galerkin Methods: 30x Speedup on 345 Billion Unknowns." IEEE High Performance Extreme Computing Conference (HPEC), September 2020.
6. Kara, K., Kirby, A. C., Mavriplis, D. J., and Duque, E.. "Hover Predictions of HVAB Rotor Using a High-Order Discontinuous Galerkin Off-Body Discretization." Applied Aerodynamics: Special Session: Rotor-in-Hover Simulation Sessions, *AIAA Scitech 2021 Forum*, Nashville, TN, January 2021.
7. Kara, K., Kirby, A. C., Mavriplis, D. J.. "Hover Predictions Using a High-Order Discontinuous Galerkin Off-Body Discretization." AIAA Paper 2020-0771, *AIAA Scitech 2020 Forum*, Orlando, FL, January 2020.
8. [Presenter] Kirby, A. C., Brazell, M., Yang, Z., Roy, R., Ahrabi, B. R., Mavriplis, D. J., Sitaraman, J., and Stoellinger, M.. "Wind Farm Simulations Using an Overset *hp*-Adaptive Approach with Blade-Resolved Turbine Models." *The International Journal of High Performance Computing Applications*, 33(5), 897-923, doi: 10.1177/1094342019832960.
9. Edmonds, A. P., Hassanzadeh, A., Kirby, A. C., Mavriplis, D. J., and Naughton, J. W.. "Effects of Blade Load Distributions on Wind Turbine Wake Evolution Using Blade-Resolved Computational Fluid Dynamics Simulations." AIAA Paper 2019-2081, *AIAA Scitech 2019 Forum*, San Diego, CA, January 2019.
10. Stoellinger, M. K., Edmonds, A. P., Kirby, A. C., Mavriplis, D. J., and Heinz, S. "Dynamic SGS modeling in LES using DG with kinetic energy preserving flux schemes." AIAA Paper 2019-1648, *AIAA Scitech 2019 Forum*, San Diego, CA, January 2019.
11. [Presenter] Kirby, A. C., Hassanzadeh, A., Mavriplis, D. J., and Naughton, J. W.. "Wind Turbine Wake Dynamics Analysis Using a High-Fidelity Simulation Framework with Blade-Resolved Turbine Models." AIAA Paper 2018-0256, *2018 Wind Energy Symposium*, Kissimmee, FL, January 2018.
12. [Presenter] Kirby, A. C., Yang, Z., Mavriplis, D. J., Duque, E., and Whitlock B.. "Visualization and Data Analytics Challenges of Large-Scale High-Fidelity Numerical Simulations of Wind Energy Applications." AIAA Paper 2018-1171, *56th AIAA Aerospace Sciences Meeting*, Kissimmee, FL, January 2018.
13. Hassanzadeh, A., Kirby, A. C., Roy, R., and Naughton, J. W.. "Design and Simulation of Small Scale Wind Turbine Blade for Wind Tunnel Wake Testing." *2017 International Conference on Future Technologies for Wind Energy*, Boulder, CO, October 2017.
14. [Presenter] Kirby, A. C., Brazell, M., Yang, Z., Roy, R., Ahrabi, B. R., Mavriplis, D. J., Sitaraman, J., and Stoellinger, M.. "Wind Farm Simulations Using an Overset *hp*-Adaptive Approach with Blade-Resolved Turbine Models." AIAA Paper 2017-3958, *23rd AIAA Computational Fluid Dynamics Conference*, Denver, CO, June 2017.
15. Brazell, M., Kirby, A. C., and Mavriplis, D. J.. "A high-order discontinuous Galerkin octree-based AMR solver for overset simulations." AIAA Paper 2017-3944, *23rd AIAA Computational Fluid Dynamics Conference*, Denver, CO, June 2017.
16. [Presenter] Kirby, A. C., Brazell, M., Sitaraman, J., and Mavriplis, D. J.. "An Overset Adaptive High-Order Approach for Blade-Resolved Wind Energy Applications." *AHS Forum 72*, West Palm Beach, FL, May 2016.
17. [Presenter] Brazell, M., Kirby, A. C., Sitaraman, J., and Mavriplis, D. J.. "A multi-solver overset mesh Approach for 3D mixed element variable order discretizations." AIAA Paper 2016-0053, *54th AIAA Aerospace Sciences Meeting*, San Diego, CA, January 2016.

18. [Presenter] Kirby, A. C., Mavriplis, D., Wissink, A.. “An adaptive explicit 3D discontinuous Galerkin solver for unsteady problems.” AIAA Paper 2015-3046, *22<sup>rd</sup> AIAA Computational Fluid Dynamics Conference*, June 2015.
19. Brazell, Ma., Brazell, M., Stoellinger, M., Mavriplis, D. J., and Kirby, A. C.. “Using LES in a Discontinuous Galerkin method with constant and dynamic SGS models.” AIAA Paper 2015-0060, *53<sup>rd</sup> AIAA Aerospace Sciences Meeting*, Kissimmee, FL, January 2015.
20. [Presenter] Bernstein, A., Kirby, A. C., McLean, A., and Rodenberg, A.. “Development of an Ozone Inhalation Model.” *2012 Joint Mathematics Meetings*, Boston, MA, January 2012.

INVITED  
PRESENTATIONS,  
POSTERS, NEWS  
RELEASES

1. [Presentation] SIAM Conference on Computational Science and Engineering (CSE23), “Multiscale Fluid Dynamics Enabled by Adaptive Mesh Refinement in Aerospace and Wind Energy Applications.” Parallel Adaptive Mesh Refinement Mini-Symposium, March 2023. Amsterdam, Netherlands.
2. [Presentation] NASA SBIR Phase I Kickoff, “High-fidelity Noise Prediction of Open Rotors.” NASA Glenn Research Center, August 2022.
3. [Presentation] NASA STTR Phase I Meeting, “GPU Acceleration of an Adjoint Enabled Real Gas Hypersonic Flow Solver.” NASA Langley Research Center, July 2022.
4. [Presentation] SIAM Conference on Parallel Processing for Scientific Computing (PP22), “Leveraging Parallel AMR Capabilities in Overset Grid Simulations of Aerospace and Wind Energy Applications.” Challenges in Parallel Adaptive Mesh Refinement Mini-Symposium, February 2022.
5. [Presentation] MIT Lincoln Laboratory, “Enabling High-Order Numerical Methods for Extreme-Scale Simulations.” January 2019.
6. [News Release] Science Node, “Can HPC unlock the future of wind power? The use of supercomputing in wind power is solving problems you probably didn’t know we had.” Published 23 February 2018.
7. [Poster] Kirby, A. C., Yang, Z., Brazell, M., Ahrabi, B., Sitaraman, J., and Mavriplis, D. J.. “High-Fidelity Blade-Resolved Wind Plant Modeling.” *SC18*, Denver, CO, November 2017.
8. [Presentation] Duque, E., and Kirby, A. C.. “HPC Powers Wind Energy.” HPC Impact Showcase, *SC18*, Denver, CO, November 2017.
9. [Presentation] Kirby, A. C., and Mavriplis, D. J.. “High Fidelity Blade-Resolved Wind Plant Modeling.” *2017 Blue Waters Symposium*, Sun River, OR, May 2017.
10. [Poster] Kirby, A. C., Brazell, M., and Mavriplis, D. J.. “High Fidelity Blade-Resolved Wind Plant Modeling.” *2017 Blue Waters Symposium*, Sun River, OR, May 2017.
11. [Presentation] Kirby, A. C.. “Development of High Fidelity CFD Methods in Aerodynamics and Wind Energy Using NWSC’s Yellowstone.” *SC14*, New Orleans, LA, November 2014.
12. [Guest Lecture] Kirby, A. C. APMA 4301 Numerical Methods for Partial Differential Equations, Columbia University. New York, NY, October 16, 2014.
13. [Presentation] Kirby, A. C. “An Explicit 3D Cartesian Discontinuous Galerkin Spectral Element Compressible Navier-Stokes Solver.” *Advanced Modeling & Simulation Seminar Series*, NASA Advanced Supercomputing Division. NASA Ames Research Center, CA, August 12, 2014.
14. [Presentation] Kirby, A. C., Rodenberg, A., Bernstein, A., and McLean, A., “Development of an Ozone Inhalation Model.” MAA General Contributed Paper Session: Modeling and Applications of Mathematics, II. (1077-VG-1195). *2012 Joint Mathematics Meetings*, Boston, MA, January 2012.
15. [Poster] Kirby, A. C., Rodenberg, A., Bernstein, A., and McLean, A., “Development of an Ozone Inhalation Model.” Mathematical Association of America, Undergraduate Poster Session. *2012 Joint Mathematics Meetings*, Boston, MA, January 2012.

COMPUTATIONAL	○ Argonne National Laboratory GPU Hackathon 2021	February 2021
SCIENCE	○ The <b>p4est</b> software for parallel AMR Hausdorff School	July 2020
TRAINING	○ MIT Green AI 2020: Tutorial and Hackathon [ <b>Mentor</b> ]	January 2020
	○ XSEDE International High Performance Computing Summer School	June 2017
	○ NVIDIA 2-day GPU Programming Workshop and Poster Session	February 2016
	○ DOE Argonne Training Program for Extreme-Scale Computing (ATPESC)	August 2015

SOFTWARE

**Principal Developer**

- WAKE3D CFD Software

High Fidelity Computational Fluid Dynamics Software for Wind Energy and Aerospace Applications  
500,000+ lines of code

**Computer Programming**

- C, C++, Fortran
- Python, Julia, MATLAB, BASH
- MPI, OpenMP, LibOCCA, CUDA, HIP, OpenCL, OpenACC
- Scientific Visualization: VisIt, Paraview, Tecplot