Andrew C. Kirby

Scientific Simulations, LLC.

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RESEARCH SPECIALIZATIONS	Computational Fluid Dynamics · High Performance Computing · Wind Energy · Aerospace
	Numerical method and software development for next-generation supercomputing architectures.

EXPERIENCE

Research Scientist — September 2020 - present
Scientific Simulations, LLC.

▷ Principal Investigator: NASA SBIR 2021 Phase I Solicitation (A1.02-1793) — 8/22 - 1/23
High Fidelity Noise Prediction for Open Rotors — $125,000.00
▷ Principal Investigator: NASA STTR 2021 Phase I Solicitation (T9.02-1964) — 5/21 - 6/22
GPU Acceleration of an Adjoint Enabled Real Gas Hypersonic Flow Solver — $124,950.00
▷ Investigator: NASA SBIR 2020 Phase I Solicitation (A1.02-5606) — 8/20 - 3/21
Unstructured Overset Hybrid RANS/LES Simulations for Jet Noise Prediction — $118,105.00

Subcontractor, Research Scientist — September 2022 - present
National Renewable Energy Laboratory (NREL)
Exascale Computing Project (ECP) ExaWind: Overset Algorithm Development
Collaborators: Michael Sprague, Ph.D.

Research Scientist (part time) — September 2020 - present
University of Wyoming
Mechanical Engineering
Principal Scientific Software Developer: `dg4est`
Co-Investigator High Performance Computing Program in the High Altitude CFD Laboratory

Teaching Fellow — August 2020 - December 2020
Harvard University, IACS
CS107 - *Systems Development for Computational Science*

Postdoctoral Research Associate — October 2019 - September 2020
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.

Postdoctoral Researcher Associate — February 2018 - October 2019
Department of Mechanical Engineering
University of Wyoming
Supervisor: Professor Dimitri J. Mavriplis

Blue Waters Computational Graduate Fellow — September 2016 - August 2017
National Center for Supercomputing Applications
University of Illinois at Urbana-Champagne
Topic: High-Fidelity Blade-Resolved Wind Farm Simulations

Visiting Research Scientist — August 2014, March 2015, February 2016
NASA Ames Research Center, U.S. ARMY CREATE-AV HELIOS Team
Collaborators: Andrew Wissink, Ph.D., Jay Sitaraman, Ph.D.

Adjunct Mathematics Faculty — August 2013 - December 2014
Laramie County Community College
Course Instructor: Math 0921 - Algebra 1
Fall 2013 (two sections), Spring 2014, Summer 2014, Fall 2014

EDUCATION

University of Wyoming — Laramie, WY
Ph.D., *Mechanical Engineering*,   Advisor: Professor Dimitri J. Mavriplis — May 2018
Dissertation: *Enabling High-Order Methods for Extreme-Scale Simulations*

Columbia University — New York, NY
M.S., *Applied Mathematics* — February 2013

University of Wisconsin-Madison — Madison, WI
B.S., *Mathematics*, *Graduation with Distinction* — December 2011

SELECTED AWARDS	**IEEE Outstanding Paper Award**	September 2020

IEEE Outstanding Paper Award — September 2020
IEEE High Performance Extreme Computing (HPEC) Conference
Title: *Layer-Parallel Training with GPU Concurrency of Deep Residual Neural Networks via Nonlinear Multigrid*

MIT Green AI Hackathon Supercomputing Award — January 2020
Satori Hack Award: Most creative GPU performance programming hack

Blue Waters Graduate Fellowship — 2016-2017
Computer Science, Applied Mathematics, and Computational Science Applications
Selected *1 of 10* Nationally
50,000 Node-hours on NSF Blue Waters Supercomputer
$50,000 Stipend

HPC GRANTS

NWSC Wyoming-NCAR Alliance Large Allocation [Co-PI] — October 2016 - June 2023
NWSC-2 Cheyenne $\sim$ 5.34 Petaflops
Title: *Computational Study of Wind Turbine Performance and Loading Response to Turbulent Atmospheric Inflow Conditions*
Roles: Primary Proposal Writer (yearly), Lead Computational Developer/User
140,412,200 core-hours

ORNL Summit Early Science Project LOI [PI] — January 2018 - June 2018
ORNL Summit $\sim$ 148.6 Petaflops (#1 on Top500-2018)
5,000 node-hours

Blue Waters Graduate Fellowship Allocation [PI] — June 2016 - June 2018
Blue Waters Supercomputer $\sim$ 13.7 Petaflops
50,000 node-hours on Blue Waters, $50,000 Stipend

PROFESSIONAL SERVICE

Ph.D. Dissertation Committee — 2020-2023
Department of Aeronautics and Astronautics, MIT
Doctoral Student: Mohammad Shafaet Islam
Chair: Professor Qiqi Wang, MIT

Postdoctoral Supervisor — 2020-2021
Department of Mechanical Engineering, University of Wyoming
Topic: Discontinuous Galerkin Curved Mesh Software Development and Integration

Journal Reviewer — 2022-present
Journal of Computational Physics

Proposal Reviewer — 2020-present
U.S. Department of Energy, Advanced Scientific Computing Research (ASCR) Program

NCAR HPC User Group Member and GPU TIGER Team Member — 2021-present
Supercomputer User Focus Group specializing in CPU and GPU programming

AIAA CFD High Lift Prediction Workshop — 2021-2022
Hybrid RANS/LES Technology Focus Group Member

PUBLICATIONS

1. [Submitted] Kara, K., **Kirby, A. C.**, Mavriplis, D. J., Duque, E., "Hover Prediction of the HVAB Rotor Using a High-Order Discontinuous Galerkin Off-Body Discretization." *AIAA SciTech 2023 Forum*, National Harbor, MD.

2. [Submitted] 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.

3. 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.

4. [**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.

5. [**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.

6. [**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.

7. 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.

8. 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.

9. [**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.

10. 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.

11. 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.

12. [**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.

13. [**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.

14. 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.

15. [**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.

16. 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.

17. [**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.

18. [**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.

19. [**Presenter**] **Kirby, A. C.**, Mavriplis, D., Wissink, A.. "An adaptive explicit 3D discontinuous Galerkin solver for unsteady problems." AIAA Paper 2015-3046, *22rd AIAA Computational Fluid Dynamics Conference*, June 2015.

20. 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, *53rd AIAA Aerospace Sciences Meeting*, Kissimmee, FL, January 2015.

21. [**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 SCIENCE TRAINING	○ Argonne National Laboratory GPU Hackathon 2021 February 2021
	○ The `p4est` software for parallel AMR Hausdorff School July 2020
	○ MIT Green AI 2020: Tutorial and Hackathon [**Mentor**] 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