Curriculum Vitae — Jonathan Francis MacArt

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Appointments

University of Notre Dame — Notre Dame, Indiana
Assistant Professor, Department of Aerospace and Mechanical Engineering — 2020–present

University of Illinois at Urbana–Champaign — Urbana, Illinois
Postdoctoral Research Associate — 2018–2019
Center for Exascale Simulation of Plasma-coupled Combustion

Education

Princeton University — Princeton, New Jersey
Ph.D. Mechanical and Aerospace Engineering — 2013–2018
M.A. Mechanical and Aerospace Engineering — 2013–2015

University of Notre Dame — Notre Dame, Indiana
B.S. Aerospace Engineering — 2009–2013
Magna cum laude with honors thesis

Awards & Honors

National Science Foundation CAREER Award, 2023
Summer Research Fellowship, Center for Turbulence Research, Stanford University, 2018
Graduate School Teaching Award, Princeton University, 2017
Crocco Award for Teaching Excellence, Princeton University, 2016
Sydney Kelsey Excellence Prize in Structural Mechanics, University of Notre Dame, 2013
National Science Foundation Research Experiences for Undergraduates Fellowship, 2012

Journal Articles (Refereed) – Published

1. P. Kakka, J. F. MacArt, "Neural network-augmented eddy viscosity closures for turbulent premixed jet flames," *Combustion and Flame* 278 (2025), 114241

2. M. Kryger, J. F. MacArt, "Optimization of second-order transport models for transition-continuum flows," *AIAA Journal* (2025), accepted, in press

3. A. S. Nair, S. Barwey, P. Pal, J. F. MacArt, T. Arcomano, R. Maulik, "Understanding latent timescales in neural ordinary differential equation models for advection-dominated dynamical systems," *Physica D: Nonlinear Phenomena* 476 (2025), 134650

4. S. W. Suh, J. F. MacArt, L. N. Olson, J. B. Freund, "A TVD neural network closure and application to turbulent combustion," *Journal of Computational Physics* 523 (2025), 113638

5. L. Nista, C. D. K. Schumann, P. Petkov, V. Pavlov, T. Grenga, J. F. MacArt, A. Attili, S. Markov, H. Pitsch, "Parallel implementation and performance of super-resolution generative adversarial network turbulence models for large-eddy simulation," *Computers & Fluids* 288 (2025), 106498

6. L. Nista, C. D. K. Schumann, M. Bode, T. Grenga, J. F. MacArt, A. Attili, H. Pitsch, "Influence of adversarial training on super-resolution turbulence models," *Physical Review Fluids* 9 (2024), 064601

7. X. Liu, J. F. MacArt, "Adjoint-based machine learning for active flow control," *Physical Review Fluids* 9 (2024), 013901

8. A. S. Nair, J. Sirignano, M. Panesi, J. F. MacArt, "Deep learning closure of the Navier–Stokes equations for transitional flows," *AIAA Journal* 61 (2023), 5484–5497

9. J. Sirignano, J. F. MacArt, "Deep learning closure models for large-eddy simulation of flows around bluff bodies," *Journal of Fluid Mechanics* 966 (2023), A26

10. J. Sirignano, J. F. MacArt, K. Spiliopoulos, "PDE-constrained models with neural network terms: Optimization and global convergence," *Journal of Computational Physics* 481 (2023), 112016

11. J. F. MacArt, J. Sirignano, J. B. Freund, "Embedded training of neural-network subgrid-scale turbulence models," *Physical Review Fluids* 6 (2021), 050502

12. J. F. MacArt, M. E. Mueller, "Damköhler number scaling of active cascade effects in turbulent premixed combustion," *Physics of Fluids* 33 (2021), 035103

13. J. M. Wang, J. F. MacArt, J. B. Freund, "Flow dynamics of laser-induced breakdown at a fuel–oxidizer interface and its effect on ignition," *Combustion and Flame* 229 (2021), 111375

14. J. F. MacArt, J. M. Wang, P. P. Popov, J. B. Freund, "Detailed simulation of ignition, flame acceleration, and instability transition in spherically expanding flame kernels," *Proceedings of the Combustion Institute* 38 (2021), pp. 2341–2349

15. J. Sirignano, J. F. MacArt, J. B. Freund, "DPM: A deep learning PDE augmentation method with application to large-eddy simulation," *Journal of Computational Physics* 432 (2020), 109811

16. J. Lee, J. F. MacArt, M. E. Mueller, "Heat release effects on the Reynolds stress budgets in turbulent premixed flames," *Combustion and Flame* 216 (2020), p. 1–8

17. J. F. MacArt, T. Grenga, M. E. Mueller, "Evolution of flame-conditioned velocity statistics in turbulent premixed jet flames at low and high Karlovitz numbers," *Proceedings of the Combustion Institute* 37 (2019), p. 2503–2510

18. T. Grenga, J. F. MacArt, M. E. Mueller, "Dynamic mode decomposition of a direct numerical simulation of a turbulent premixed planar jet flame: Convergence of the modes," *Combustion Theory and Modelling* 22 (2018), p. 795–811

19. J. F. MacArt, T. Grenga, M. E. Mueller, "Effects of combustion heat release on velocity and scalar statistics in turbulent premixed jet flames at low and high Karlovitz numbers," *Combustion and Flame* 191 (2018), p. 468–485

20. J. F. MacArt, M. E. Mueller, "Semi-implicit iterative methods for low Mach number turbulent reacting flows: Operator splitting versus approximate factorization," *Journal of Computational Physics* 326 (2016), p. 569–595

Book Chapters (Refereed)

1. L. Nista, F. Fröde, C. D. K. Schumann, M. Gowely, T. Grenga, J. F. MacArt, A. Attili, H. Pitsch, "ZipGAN: Super-Resolution-based Generative Adversarial Network Framework for Data Compression of Direct Numerical Simulations," *ECCOMAS Math to Product Series*, 2025

Conference Papers (Not Refereed)

1. P. Lo Iacono, J. Sirignano, G. Gori, J. F. MacArt, M. Panesi, "Deep Learning Based Closure Model for Rarefied Flows: Application to Two-Dimensional Shear Flow," AIAA SciTech Forum, Orlando, FL, January 12–16, 2026

2. L. Nista, C. D. K. Schumann, M. Vivenzo, T. Grenga, J. F. MacArt, L. Berger, A. Attili, H. Pitsch, "Systematic assessment of presumed PDF approach for LES of lean premixed hydrogen combustion: an a priori and a posteriori study using cGAN," 12^{th} European Combustion Meeting, Edinburgh, Scotland, UK, April 7–10, 2025

3. M. Kryger, J. F. MacArt, "Parameter Optimization and Model Comparison for Second-Order Continuum Modeling of Transition-Continuum Flows," AIAA SciTech Forum, Orlando, FL, January 6–10, 2025

4. X. Liu, T. Hickling, J. F. MacArt, "Active Control of Turbulent Airfoil Flows Using Adjoint-based Deep Learning," AIAA SciTech Forum, Orlando, FL, January 6–10, 2025

5. A. S. Nair, J. Sirignano, N. Singh, M. Panesi, J. F. MacArt, "Anisotropic deep learning transport models for two-dimensional transition-continuum flows," AIAA SciTech Forum, Orlando, FL, January 6–10, 2025

6. J. F. MacArt, "Machine Learning-Augmented Kinetics for Shock-Tube Ignition Delay Using a Variational Approach," AIAA SciTech Forum, Orlando, FL, January 6–10, 2025

7. E. West, J. F. MacArt, R. Munipalli, "Variational Data Assimilation in Shock Tube Flows," AIAA SciTech Forum, Orlando, FL, January 6–10, 2025

8. P. Kakka, J. F. MacArt, "Deep learning PDE models for augmentation of turbulent combustion simulations," 2024 Spring Technical Meeting of the Eastern States Section of the Combustion Institute, Athens, GA, March 10–13, 2024

9. A. S. Nair, D. Waidmann, J. Sirignano, N. Singh, M. Panesi, J. F. MacArt, "Adjoint-Trained Deep-Learning Closures of the Navier–Stokes Equations for 2D Nonequilibrium Flows," AIAA SciTech Forum, Orlando, FL, January 8–12, 2024

10. E. Monti, N. Singh, J. Sirignano, J. F. MacArt, M. Panesi, G. Gori, "Physics-constrained deep learning-based model for non-equilibrium flows," AIAA SciTech Forum, Orlando, FL, January 8–12, 2024

11. T. Hickling, J. Sirignano, J. F. MacArt, "Large Eddy Simulation of Airfoil Flows Using Adjoint-Trained Deep Learning Closure Models," AIAA SciTech Forum, Orlando, FL, January 8–12, 2024

12. N. Daultry Ball, M. Panesi, J. F. MacArt, J. Sirignano, "Adjoint Optimization of the BGK Equation with an Embedded Neural Network for Reduced-Order Modeling of Hypersonic Flows," AIAA SciTech Forum, Orlando, FL, January 8–12, 2024

13. P. Kakka, J. F. MacArt, "Data assimilation for reacting flows: Deep learning PDE models to augment turbulent combustion simulations," 13^{th} U.S. National Combustion Meeting, College Station, TX, March 19–22, 2023

14. A. S. Nair, J. Sirignano, M. Panesi, J. F. MacArt, "Entropy-stable Deep Learning for Navier–Stokes Predictions of Transitional-regime Flows," AIAA SciTech Forum, National Harbor, MD, January 23–27, 2023

15. J. F. MacArt, J. Sirignano, M. Panesi, "Deep Learning Closure of the Navier–Stokes Equations for Transitional Flows," AIAA SciTech Forum, San Diego, CA, January 3–7, 2022

16. P. P. Popov, M. Nishihara, A. Munafò, J. F. MacArt, G. S. Elliott, J. B. Freund, "Laser-induced breakdown ignition of low-pressure hydrogen-air premixtures," AIAA SciTech Forum, Orlando, FL, January 6–10, 2020

17. A. C. Nunno, B. A. Perry, J. F. MacArt, M. E. Mueller, "Data-driven dimension reduction in turbulent combustion: Utility and limitations," AIAA SciTech Forum, San Diego, CA, January 7–11, 2019

18. J. F. MacArt, T. Grenga, M. E. Mueller, "Budgets of flame-conditioned second-order turbulence statistics in low and high Karlovitz number turbulent premixed jet flames," 2018 Spring Technical Meeting of the Eastern States Section of the Combustion Institute, State College, PA, March 5–7, 2018

19. T. Grenga, J. F. MacArt, M. E. Mueller, "Multi-modal counterflow flames under autoignitive conditions", 2018 Spring Technical Meeting of the Eastern States Section of the Combustion Institute, State College, PA, March 5–7, 2018

20. J. F. MacArt, T. Grenga, M. E. Mueller, "Karlovitz number effects on velocity and scalar statistics in turbulent premixed combustion", 10^{th} U.S. National Combustion Meeting, College Park, MD, April 23–26, 2017

21. T. Grenga, J. F. MacArt, M. E. Mueller, "Multi-Modal Counterflow Flame Structure under Autoignitive Conditions", 10^{th} U.S. National Combustion Meeting, College Park, MD, April 23–26, 2017

22. J. F. MacArt, T. Grenga, M. E. Mueller, "Effects of small-scale heat release on turbulence scaling in premixed and nonpremixed flames", 2016 Spring Technical Meeting of the Eastern States Section of the Combustion Institute, Princeton, NJ, March 13–16, 2016

Research Briefs (Not Refereed)

1. J. Sirignano, J. F. MacArt, "Dynamic Deep Learning LES Closures: Online Optimization With Embedded DNS," arXiv:2303.02338 (2023)

2. J. Sirignano, J. F. MacArt, "Deep Learning Closure Models for Large-Eddy Simulation of Flows Around Bluff Bodies," arXiv:2208.03498 (2022)

3. J. Sirignano, J. F. MacArt, K Spiliopoulos, "PDE-constrained Models with Neural Network Terms: Optimization and Global Convergence," arXiv:2105.08633 (2021)

4. J. B. Freund, J. F. MacArt, J. Sirignano, "DPM: A deep learning PDE augmentation method (with application to large-eddy simulation)," arXiv:1911.09145 (2019)

5. J. F. MacArt, M. E. Mueller, "Scaling and modeling of heat-release effects on subfilter turbulence in premixed combustion," *Center for Turbulence Research Proceedings of the Summer Program* (2018), Stanford University, p. 299–308

Invited Seminars (External)

1. J. F. MacArt, "Machine Learning Acceleration of Turbulent Combustion and Nonequilibrium Flow

Predictions," Department of Mechanical Engineering, University of Utah, Salt Lake City, UT, October 1, 2025

2. J. F. MacArt, "Solver-Embedded Deep Learning for Hypersonic Flows," Department of Mechanical and Aerospace Engineering, Princeton University, Princeton, NJ, September 26, 2025

3. J. F. MacArt, "Accelerating Predictions of Turbulent Combustion and Nonequilibrium Flows Using Solver-Embedded Deep Learning," Mathematical Institute, University of Oxford, UK, May 22, 2025

4. J. F. MacArt, "Accelerating Predictions of Turbulent Combustion and Nonequilibrium Flows Using Solver-Embedded Deep Learning, Adjoint Sensitivity Analysis, and Automatic Differentiation," Center for Design Optimization, Lawrence Livermore National Laboratory, Livermore, CA, May 15, 2025

5. J. F. MacArt, "Adjoint-Based Deep Learning for Turbulent Combustion Simulations," Institute for Combustion Technology (ITV), RWTH Aachen University, Germany, October 30, 2024

6. J. F. MacArt, "Adjoint-Based Deep Learning for Flow Prediction and Control," Department of Aeronautics and Astronautics, University of Southampton, UK, October 28, 2024

7. J. F. MacArt, "Digital Environmentalism: Behind the Veil of Big Data, AI, and Life Online," Bayer AG ML Group, St. Louis, MO, October 20, 2023

8. J. F. MacArt, "Turbulent Reacting Flow Simulation and Modeling using Machine Learning," Ansys, Inc., Lebanon, NH, July 14, 2023

9. J. F. MacArt, "Embedded Deep Learning for Prediction and Control of Complex Turbulent Flows," Mathematical Institute, University of Oxford, UK, June 5, 2023

10. J. F. MacArt, "Adjoint-Based Data Assimilation for Turbulent and Reacting Flows," Air Force Research Laboratory, Rocket Propulsion Division, Edwards Air Force Base, CA, February 15, 2023

11. J. F. MacArt, "Simulation and Modeling of Turbulent Reacting Flows: Opportunities and Challenges for Data Assimilation," Department of Aerospace Engineering, University of Illinois at Urbana–Champaign, Urbana, IL, February 9, 2023

12. J. F. MacArt, "Data Assimilation for Reacting Flows: PDE Constraints and Efficient Optimization," Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, OH, October 7, 2022

13. J. F. MacArt, "Embedded Deep Learning for Predictive Science," Ansys, Inc., Lebanon, NH, May 20, 2022

14. J. F. MacArt, "Embedded Deep Learning for Predictive Science and Control," Center for Hypersonics & Entry Systems Studies, University of Illinois at Urbana–Champaign, Urbana, IL, November 9, 2021

15. J. Sirignano, J. F. MacArt, "PDE Models with Neural Networks: Optimization, Global Convergence, and Applications in Fluid Mechanics," Symposium on Model-Consistent Data-Driven Turbulence Modeling, University of Michigan, Ann Arbor, MI, June 22–24, 2021

16. J. F. MacArt, J. Sirignano, J. B. Freund, "Learning sub-grid-scale turbulence models: coupling backpropagation with the adjoint flow equations," European Mechanics Society, Colloquium 614: Machine learning methods for prediction and control of turbulent flows, Paris, France, June 16–18, 2021

17. J. F. MacArt, "Turbulent reacting flow physics discovery using high-fidelity numerical tools," School for Engineering of Matter, Transport and Energy, Arizona State University, Tempe, AZ, January 13, 2021

18. J. F. MacArt, "Why trust AI?," Trinity College, Hartford, CT, October 25, 2020

19. J. Sirignano, J. F. MacArt, J. B. Freund, "Deep learning closure models for large–eddy simulation," NSF Workshop on Exuberance of Machine Learning in Transport Phenomena, Dallas, TX, February 10–11, 2020

20. J. F. MacArt, "High fidelity, (potentially) low cost: Reconciling physics-based and machine-learning-based turbulence modeling in turbulent combustion," School for Engineering of Matter, Transport and Energy, Arizona State University, Tempe, AZ, January 31, 2020

21. M. E. Mueller, J. F. MacArt, "Large Eddy Simulation Subfilter Modeling of Combustion-Affected Turbulence in Turbulent Premixed Combustion," 71$^{\text{st}}$ Annual Meeting of the APS Division of Fluid Dynamics, Atlanta, GA, November 18–20, 2018

22. J. F. MacArt, "Turbulent Combustion: Multiscale, Multiphysical Interactions and the Challenge of High-Fidelity Simulation," Department of Mechanical Science and Engineering, University of Illinois at Urbana–Champaign, Urbana, IL, September 7, 2018

23. J. F. MacArt, "Simulation and Modeling of Heat Release Effects on Turbulence in Turbulent Combustion," Design Physics Division, Lawrence Livermore National Laboratory, Livermore, CA, March 2, 2018

24. J. F. MacArt, "Simulation and Modeling of Heat Release Effects on Turbulence in Turbulent Premixed Combustion," The Center for Exascale Simulation of Plasma-coupled Combustion, University of Illinois at Urbana–Champaign, Urbana, IL, January 23, 2018

Invited Seminars (Internal)

1. J. F. MacArt, "Simulation and Modeling of Heat Release Effects on Turbulence in Turbulent Combustion," Department of Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN, February 17, 2018

Invited Panelist (External)

1. P. F. J. Lermusiaux, H. Babaee, R. Maulik, J. F. MacArt, "Data-Driven Modeling of Combustion Dynamics," AIAA SciTech Forum, Orlando, FL, January 13, 2026. Panel organized by Prof. Cheng Huang (U. Kansas) and Dr. Ramakanth Munipalli (AFRL).

Conference Presentations (Contributed)

1. A. S. Nair, N. Singh, M. Panesi, J. Sirignano, J. F. MacArt, "Data-driven transport and wall models for transition-continuum flows based on modeled distribution functions," 78$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Houston, TX, November 23–25, 2025

2. J. Jacobowitz, Y. J. Ikeda, J. F. MacArt, "Adjoint-based, in-situ optimization of neural network thermochemical manifolds," 78$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Houston, TX, November 23–25, 2025

3. M. Kryger, J. F. MacArt, "Sparse Preconditioners for Compressible Flows with Second-Order Transport: Analytic Jacobians Versus Automatic Differentiation," 78$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Houston, TX, November 23–25, 2025

4. N. Ziems, J. F. MacArt, "PDE-Constrained Optimization of Subgrid-Scale Models Applied to a Viscous Shu–Osher Analog," 78$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Houston, TX, November 23–25, 2025

5. T. Hickling, J. F. MacArt, J. Sirignano, D. Waidmann, "Online Gradient-Flow Optimization Over the Statistical Steady-State of Unsteady Turbulent Flows," 78$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Houston, TX, November 23–25, 2025

6. D. Waidmann, N. Singh, M. Panesi, J. Sirignano, J. F. MacArt, "Deep learning closure of the Navier-Stokes equations and slip-boundary conditions for transition-continuum flows," 78$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Houston, TX, November 23–25, 2025

7. L. Nista, C. D. K. Schumann, T. Grenga, J. F. MacArt, A. Attili, H. Pitsch, "Super-resolution-enhanced dynamic mixed model for turbulence closure: a priori and a posteriori assessment," 78$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Houston, TX, November 23–25, 2025

8. P. Kakka, J. F. MacArt, "Enhancing Turbulent Premixed Flame Predictions in LES Using Deep Learning PDE Models," 20$^{\text{th}}$ International Conference on Numerical Combustion, Rome, Italy, October 15–17, 2025

9. J. Jacobowitz, J. F. MacArt, "Neural Network-Augmented Reduced Kinetics for Shock-tube Ignition Delay Predictions," 20$^{\text{th}}$ International Conference on Numerical Combustion, Rome, Italy, October 15–17, 2025

10. J. F. MacArt, "Scaling and modeling of subfilter-scale heat-release effects in turbulent premixed jet flames," 20$^{\text{th}}$ International Conference on Numerical Combustion, Rome, Italy, October 15–17, 2025

11. L. Nista, C. D. K. Schumann, T. Grenga, J. F. MacArt, A. Attili, H. Pitsch, "Modeling the filtered progress variable source term on lean premixed hydrogen flames using conditional generative adversarial networks," 20$^{\text{th}}$ International Conference on Numerical Combustion, Rome, Italy, October 15–17, 2025

12. S. W. Suh, J. F. MacArt, L. Olson, J. B. Freund, "A physics-constrained neural-network sub-grid-scale model for a flame in high-speed turbulence," 20$^{\text{th}}$ International Conference on Numerical Combustion, Rome, Italy, October 15–17, 2025

13. N. Daultry Ball, J. F. MacArt, J. Sirignano, "Machine Learning Collision Models to Accelerate Direct Molecular Simulation of Rarefied Gas Flows" (Invited), AIAA Aviation Forum, Las Vegas, NV, July 21–25, 2025

14. T. Hickling, J. F. MacArt, J. Sirignano, D. Waidmann, "Online Optimization for Time-Averaged Statistics of Unsteady Turbulent Flow Simulations," Euromech Colloquium on Data-Driven Fluid Dynamics/2$^{\text{nd}}$ ERCOFTAC Workshop on Machine Learning for Fluid Dynamics, London, UK, April 2–4, 2025 (author order alphabetical)

15. D. Dehtyriov, J. F. MacArt, J. Sirignano, "Online optimization of RANS models with embedded DNS data generation," Euromech Colloquium on Data-Driven Fluid Dynamics/2$^{\text{nd}}$ ERCOFTAC Workshop on Machine Learning for Fluid Dynamics, London, UK, April 2–4, 2025

16. N. Daultry Ball, J. F. MacArt, J. Sirignano, "Machine Learning Collision Models to Accelerate Direct Molecular Simulation of Rarefied Gas Flows," Euromech Colloquium on Data-Driven Fluid Dynamics/2$^{\text{nd}}$ ERCOFTAC Workshop on Machine Learning for Fluid Dynamics, London, UK, April 2–4, 2025

17. L. Nista, C. D. K. Schumann, T. Grenga, J. F. MacArt, A. Attili, H. Pitsch, "Dynamic mixed model based on super-resolution approach for turbulence closure modeling," Euromech Colloquium on Data-Driven Fluid Dynamics/2$^{\text{nd}}$ ERCOFTAC Workshop on Machine Learning for Fluid Dynamics, London, UK, April 2–4, 2025

18. N. Daultry Ball, J. F. MacArt, J. Sirignano, "Online Optimisation of Machine Learning Collision Models to Accelerate Direct Molecular Simulation of Rarefied Gas Flows" (Invited Minisymposium

Speaker), SIAM Conference on Computational Science and Engineering (CSE), Fort Worth, TX, March 3–7, 2025

19. S. W. Suh, J. F. MacArt, L. Olson, J. B. Freund, "A physics embedded neural-network sub-grid-scale model for simulating flames in turbulence," 77$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Salt Lake City, UT, November 24–26, 2024

20. D. Waidmann, N. Singh, M. Panesi, J. Sirignano, J. F. MacArt, "Deep learning closure of the Navier–Stokes equations for hypersonic transition-continuum flows using implicit-in-time adjoint optimization," 33$^{\text{rd}}$ International Symposium on Rarefied Gas Dynamics, Göttingen, Germany, July 15–19, 2024

21. N. Daultry Ball, J. F. MacArt, J. Sirignano, "Direct Molecular Simulation of 1D Normal Shock Waves with a Neural Network Collision Model," 33$^{\text{rd}}$ International Symposium on Rarefied Gas Dynamics, Göttingen, Germany, July 15–19, 2024

22. T. Hickling, J. Sirignano, J. F. MacArt, "Adjoint-optimized deep learning subgrid-scale models for airfoil flows," 9$^{\text{th}}$ European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS), Lisbon, Portugal, June 3–7, 2024

23. P. Kakka, J. F. MacArt, "Data assimilation for reacting flows: Deep learning PDE models to augment turbulent combustion simulations," 19$^{\text{th}}$ International Conference on Numerical Combustion, Kyoto, Japan, May 7–10, 2024

24. K. Pielemeier, C. Delgado, J. F. MacArt, "Adjoint-based optimization of chemical kinetics for prediction of ignition delay times," 19$^{\text{th}}$ International Conference on Numerical Combustion, Kyoto, Japan, May 7–10, 2024

25. L. Nista, F. Fröde, J. F. MacArt, T. Grenga, A. Attili, H. Pitsch, "A dynamic data-driven mixed model for the subgrid stress and scalar fluxes in large-eddy simulation of turbulent lean hydrogen flames," 19$^{\text{th}}$ International Conference on Numerical Combustion, Kyoto, Japan, May 7–10, 2024

26. S. W. Suh, J. F. MacArt, L. Olson, J. B. Freund, "Physics-constrained neural-network sub-grid-scale model for a flame in isotropic turbulence," 19$^{\text{th}}$ International Conference on Numerical Combustion, Kyoto, Japan, May 7–10, 2024

27. T. Hickling, J. Sirignano, J. F. MacArt, "Equation-consistent deep learning of subgrid-scale models for LES of transitional NACA 0012 airfoil flows," 14$^{\text{th}}$ ERCOFTAC Workshop on Direct and Large-Eddy Simulation, Erlangen, Germany, April 10–12, 2024

28. L. Nista, C. D. K. Schumann, T. Grenga, J. F. MacArt, A. Attili, H. Pitsch, "Influence of adversarial training on super-resolution turbulence reconstruction," 1$^{\text{st}}$ ERCOFTAC Workshop on Machine Learning for Fluid Dynamics, Sorbonne University, Paris, France, March 6–8, 2024

29. T. Hickling, J. F. MacArt, J. Sirignano, "Adjoint-Trained Deep-Learning Subgrid-Scale Models for Large Eddy Simulation of Compressible Airfoil Flows," 1$^{\text{st}}$ ERCOFTAC Workshop on Machine Learning for Fluid Dynamics, Sorbonne University, Paris, France, March 6–8, 2024

30. T. Hickling, J. Sirignano, J. F. MacArt, "Large Eddy Simulation of Low Reynolds Number Airfoil Flows Using Adjoint-Trained Deep Learning Closure Models," 14$^{\text{th}}$ Symposium on Engineering Turbulence Modelling and Measurements, European Research Community on Flow, Turbulence, and Combustion (ERCOFTAC), Barcelona, Spain, September 6–8, 2023

31. L. Nista, F. Fröde, J. F. MacArt, T. Grenga, A. Attili, H. Pitsch, "A-posteriori investigations of a Super-Resolution Data-Driven Model for Large Eddy Simulations," International Centre for Numerical Methods in Engineering (CIMNE) Math2Product 2023, Taormina, Italy, May 30–June 1, 2023

32. S. W. Suh, J. F. MacArt, L. Olson, J. B. Freund, "Neural network sub-grid-scale models for planar turbulent premixed flames," IACM Computational Fluids Conference, Cannes, France, April 25–28, 2023

33. X. Liu, J. F. MacArt, "Robust, data-efficient active flow control using embedded deep learning," 75$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Indianapolis, IN, November 20–22, 2022

34. S. W. Suh, J. F. MacArt, L. Olson, J. B. Freund, "Adjoint-based neural network optimization for sub-grid-scale combustion modeling," 75$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Indianapolis, IN, November 20–22, 2022

35. X. Liu, J. F. MacArt, "Embedded Deep Learning for Flow Control," 2022 SIAM Annual Meeting, Pittsburgh, PA, July 11–15, 2022

36. S. W. Suh, J. F. MacArt, L. Olson, J. B. Freund, "Physics-constrained machine learning for LES of turbulent premixed flames," 18$^{\text{th}}$ International Conference on Numerical Combustion, La Jolla, CA, May 8–11, 2022

37. J. F. MacArt, "Deep Learning-Based PDE Augmentation for Large-Eddy Simulation," 2021 SIAM Annual Meeting, Spokane, WA (virtual), July 19–23, 2021

38. J. F. MacArt, J. M. Wang, P. P. Popov, J. B. Freund, "Detailed simulation of ignition, flame acceleration, and instability transition following a laser-induced breakdown," 38$^{\text{th}}$ International Symposium on Combustion, Adelaide, Australia (virtual), January 24–29, 2021

39. J. F. MacArt, "Parametric study of sub-grid-scale flame–turbulence interactions in jet flames using a simplified kinetic model," 73$^{\text{rd}}$ Annual Meeting of the APS Division of Fluid Dynamics, Chicago, IL (virtual), November 22–24, 2020

40. J. M. Wang, J. F. MacArt, J. B. Freund, "Ignition of a fuel–oxidizer interface by laser-induced breakdown," 73$^{\text{rd}}$ Annual Meeting of the APS Division of Fluid Dynamics, Chicago, IL (virtual), November 22–24, 2020

41. J. Sirignano, J. F. MacArt, J. B. Freund, "Embedded training of neural-network sub-grid-scale turbulence models," 73$^{\text{rd}}$ Annual Meeting of the APS Division of Fluid Dynamics, Chicago, IL (virtual), November 22–24, 2020

42. J. F. MacArt, J. M. Wang, J. B. Freund, Three-dimensional effects in vorticity production, cellular instabilities, and transition to turbulence in focused-laser-induced ignition kernels, 72$^{\text{nd}}$ Annual Meeting of the APS Division of Fluid Dynamics, Seattle, WA, November 23–26, 2019

43. J. M. Wang, D. A. Buchta, J. F. MacArt, J. B. Freund, Hydrodynamic ejection from a laser-induced breakdown and its implications for ignition, 72$^{\text{nd}}$ Annual Meeting of the APS Division of Fluid Dynamics, Seattle, WA, November 23–26, 2019

44. C. P. Byers, J. F. MacArt, M. E. Mueller, M. Hultmark, Triple-correlations in decaying isotropic turbulence, 72$^{\text{nd}}$ Annual Meeting of the APS Division of Fluid Dynamics, Seattle, WA, November 23–26, 2019

45. C. P. Byers, J. F. MacArt, M. E. Mueller, M. Hultmark, Similarity Constraints in Decaying Isotropic Turbulence, 11$^{\text{th}}$ International Symposium on Turbulence and Shear Flow Phenomena, Southampton, UK, July 30–August 2, 2019

46. J. F. MacArt, J. A. Sirignano, D. A. Buchta, J. B. Freund, Data-driven subfilter turbulence models and analysis in turbulent combustion, 17$^{\text{th}}$ International Conference on Numerical Combustion, Aachen, Germany, May 6–8, 2019

47. M. E. Mueller, B. A. Perry, A. C. Nunno, J. F. MacArt, L. Berger, Integrating data-based tools into physics-based model development for turbulent combustion, 17$^{\text{th}}$ International Conference on Numerical Combustion, Aachen, Germany, May 6–8, 2019

48. A. C. Nunno, B. A. Perry, J. F. MacArt, M. E. Mueller, A comparison of physics-based and data-based methods of dimension reduction in turbulent combustion, 71$^{\text{st}}$ Annual Meeting of the APS Division of Fluid Dynamics, Atlanta, GA, November 18–20, 2018

49. C. P. Byers, J. F. MacArt, M. E. Mueller, M. Hultmark, Similarity in decaying isotropic turbulence: Functional forms, constraints in single- and two-time evolution, and DNS results, 71$^{\text{st}}$ Annual Meeting of the APS Division of Fluid Dynamics, Atlanta, GA, November 18–20, 2018

50. J. F. MacArt, T. Grenga, M. E. Mueller, Evolution of flame-conditioned velocity statistics in turbulent premixed jet flames at varying Karlovitz number, 37$^{\text{th}}$ International Symposium on Combustion, Dublin, Ireland, July 29–August 3, 2018

51. J. F. MacArt, M. E. Mueller, Flame-conditioned turbulence modeling for reacting flows, 70$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Denver, CO, November 19–21, 2017

52. T. Grenga, J. F. MacArt, M. E. Mueller, Dynamic mode decomposition of a turbulent premixed planar jet flame, 10$^{\text{th}}$ Mediterranean Combustion Symposium, Naples, Italy, September 17–21, 2017

53. J. F. MacArt, T. Grenga, M. E. Mueller, Heat Release Effects on Turbulence Statistics in Premixed and Nonpremixed Flames, 16$^{\text{th}}$ International Conference on Numerical Combustion, Orlando, FL, April 3–5, 2017

54. T. Grenga, J. F. MacArt, M. E. Mueller, Dynamic Mode Decomposition of Turbulent Non-reacting and Reacting Nonpremixed Jets, 16$^{\text{th}}$ International Conference on Numerical Combustion, Orlando, FL, April 3–5, 2017

55. J. F. MacArt, T. Grenga, M. E. Mueller, Conditional budgets of second-order statistics in nonpremixed and premixed turbulent combustion, 69$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Portland, OR, November 20–22, 2016

56. T. Grenga, J. F. MacArt, M. E. Mueller, Three dimensional dynamic mode decomposition of premixed turbulent jet flames, 69$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Portland, OR, November 20–22, 2016

57. J. F. MacArt, M. E. Mueller, Computationally-efficient schemes for large-scale simulations of turbulent reacting flows, 1$^{\text{st}}$ Annual Research Computing Day, Princeton Institute for Computational Science and Engineering, Princeton, NJ, October 14, 2016

58. J. F. MacArt, M. E. Mueller, Semi-implicit iterative methods for low Mach number turbulent reacting flows, 68$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, Boston, MA, November 22–24, 2015

59. J. F. MacArt, M. E. Mueller, Analysis of operator splitting errors for DNS of low Mach number turbulent reacting flows, 67$^{\text{th}}$ Annual Meeting of the APS Division of Fluid Dynamics, San Francisco, CA, November 23–25, 2014

60. J. F. MacArt, K. Matouš, Modeling of energetic composites under small-strain chemo-thermo-mechanical loading, 2012 Undergraduate Research Summer Symposium, University of Notre Dame, Notre Dame, IN, August 3, 2012

Undergraduate Teaching

Instructor, University of Notre Dame

- AME 30332: Compressible Aerodynamics (Spring 2025)
- AME 30332: Compressible Aerodynamics (Spring 2024)
- AME 30332: Compressible Aerodynamics (Spring 2023)
- AME 30332: Compressible Aerodynamics (Spring 2021)

Assistant in Instruction, Princeton University

- MAE 335, Fluid Dynamics (Fall 2016)

- MAE 427/ENE 427, Energy Conversion and the Environment (Spring 2016)
- MAE 335, Fluid Dynamics (Fall 2015)

Graduate Teaching

Instructor, University of Notre Dame

- AME 60614: Numerical Methods (Fall 2025)
- AME 60614: Numerical Methods (Fall 2023)
- AME 60730: Turbulent Reacting Flows (Fall 2022)
- AME 60614: Numerical Methods (Fall 2021)
- AME 60614: Numerical Methods (Spring 2020)

Assistant in Instruction, Princeton University

- APC 523/MAE 507: Numerical Algorithms for Scientific Computing (Spring 2018)
- APC 523/MAE 507: Numerical Algorithms for Scientific Computing (Spring 2015)

Postdoctoral Advisees

University of Notre Dame

1. Yue Hao, AME, 2025–present
2. Katherine Pielemeier, AME, 2023–2024

Graduate Advisees – Completed

University of Notre Dame – Ph.D.

1. Xuemin Liu, AME Ph.D., Sept. 2021–Nov. 2024; dissertation title: "Active Control of Laminar and Turbulent Flows using Adjoint-based Machine Learning" (defended 11/26/24); currently AI Research Engineer, Shanghai, China

University of Notre Dame – M.S.

2. Matthew McHugh, AME M.S., Aug. 2020–Dec. 2021; currently Research Engineer, Applied Materials Inc., Kalispell, MT

Graduate Advisees – Current

University of Notre Dame

1. Nathan Ziems, AME Ph.D. student, June 2024–present; anticipated completion: 2029
2. Mikolaj Kryger, AME Ph.D. student, Aug. 2023–present; anticipated completion: 2028
3. J. Jacobowitz, AME Ph.D. student, Aug. 2022–present; anticipated completion: 2027
4. Ashish Nair, AME Ph.D. student, July 2021–present; anticipated completion: 2026
5. Priyesh Kakka, AME Ph.D. student, Dec. 2021–present; anticipated completion: 2025; currently Research Engineer, Ansys, Inc., Pittsburgh, PA

Undergraduate Advisees

1. Mary Titterton (Undergraduate Research; Notre Dame AE '25), 2025–present
2. Liam Wood (Undergraduate Research; Notre Dame AE '25), 2025–present
3. Y. Jonah Ikeda (Undergraduate Research; Notre Dame AE '25), 2025–present
4. Saif Elmaleh (Undergraduate Research; Notre Dame AE '26), 2024–present
5. Conrad Delgado (Undergraduate Research; Notre Dame AE '24), 2023–2024; currently UIUC Ph.D. student
6. William Sinclair (Undergraduate Research; Notre Dame AE '26), 2023
7. Alex Aragon (Undergraduate Research; Notre Dame ME '24), 2023
8. Katherine Fink (Undergraduate Research; Notre Dame AE '22), 2021–2022; currently Research Engineer, Boeing Company, St. Louis, MO
9. Aidan Oblepias (Building Bridges; Notre Dame '25), 2021
10. Ian Guajardo (Building Bridges; Notre Dame '24), 2020
11. Omkar B. Shende (Princeton BSE '18, with M. E. Mueller), 2017–2018; currently Postdoctoral Research Associate, Los Alamos National Laboratory

High School Research Advisees

1. Thomas Caudle, 2025–present

Professional Service

Journal Reviewer: *Combustion and Flame*; *Combustion Science and Technology*; *Computers and Fluids*; *Journal of Computational Physics*; *Journal of Fluid Mechanics*; *Physical Review E*; *Physical Review Fluids*; *Proceedings of the Combustion Institute*

Conference Local Organizing Committees

- 20^{th} International Conference on Numerical Combustion, Rome, Italy, October 14–17, 2025
- 75^{th} Annual Meeting of the APS Division of Fluid Dynamics, Indianapolis, IN, November 20–22, 2022
- 73^{rd} Annual Meeting of the APS Division of Fluid Dynamics, Chicago, IL, November 22–24, 2020

Colloquium Co-Chair

- 41^{st} International Symposium on Combustion, Kyoto, Japan, July 23–31, 2026

Minisymposium Co-Organizer

- "Deep Learning for Predictive Science and Design" (with Justin Sirignano, University of Oxford), 2021 SIAM Annual Meeting, July 19–23, 2021, Spokane, WA

Outreach

- Coordinator, MATHCOUNTS middle-school regional mathematics competition, 2022–present

Professional Memberships

American Institute of Aeronautics and Astronautics (AIAA), 2019–present
Society for Industrial and Applied Mathematics (SIAM), 2017–present
The Combustion Institute, 2016–present
American Physical Society (APS) Division of Fluid Dynamics, 2014–present
Sigma Gamma Tau, 2012–present
Tau Beta Pi, 2012–present

Updated: September 19, 2025