Brian A. Freno

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Education

Texas A&M University, College Station, TX

- **Doctor of Philosophy** in Aerospace Engineering — December 2013 — GPA: 4.000
- **Master of Science** (Thesis) in Aerospace Engineering — May 2010 — GPA: 3.869
- **Bachelor of Science** in Aerospace Engineering, Mathematics Minor — December 2008 — GPA: 3.425

Work Experience

Sandia National Laboratories, Albuquerque, NM — **October 2015 – Present**
Principal Member of the Technical Staff — Verification, Validation, Uncertainty Quantification, and Credibility Processes

- Developed approaches to engineer features that, with machine-learning regression, can accurately predict the error incurred by reduced-order models and other approximate solutions to parameterized systems of nonlinear equations
- Formulated methods for computing symmetric triangle quadrature rules for arbitrary functions
- Created techniques to perform code verification in computational fluid dynamics (CFD) for hypersonic reacting flow in thermochemical non-equilibrium and decomposing and non-decomposing ablation
- Serving as principal investigator for the development of novel code-verification and numerical-integration techniques for computational electromagnetics (CEM)
- Providing VVUQ leadership to Oak Ridge National Laboratory for computational physics
- Strengthening Academic Alliance with Texas A&M as adjunct professor through teaching, mentoring, and recruiting
- Serving as reviewer for NNSA Advanced Simulation and Computing PSAAP III

Halliburton, Houston, TX — **June 2014 – September 2015**
Senior Technical Professional — Production Enhancement – Advanced Computational Sciences

- Developed a parallel third-order-accurate compact incompressible viscous flow solver for non-uniform grids
- Created a mesh deformation algorithm for hydraulic fracture propagation that resulted in a patent

Texas A&M University, College Station, TX — **Fall 2008 – Spring 2014**
Graduate Research Assistant — Department of Aerospace Engineering

- Conducted research in nonlinear structural dynamics and fluid mechanics for reduced-order models in computational aeroelasticity and developed software to produce 3D surface plots and movies (Spring 2009 – Spring 2014)
- Lead and planned the Aerospace Engineering Study Abroad Program in Brazil, learned basic Portuguese (Summer 2010)
- Served as teaching assistant for junior-level propulsion class in Brazil (Summer 2010)
- Served as teaching and assistant occasional lecturer for graduate-level finite element course (Spring 2009)
- Served as grader for senior-level numerical simulation course (Fall 2008)

NASA Marshall Space Flight Center, Huntsville, AL — **Summers 2012 & 2013**
Graduate Student Researchers Program Fellow — Fluid Dynamics Branch

- Conducted reduced-order modeling research as part of NASA Graduate Student Researchers Program Fellowship

Lockheed Martin Missiles and Fire Control, Orlando, FL — **Summers 2007 & 2008**
Summer Intern — Aerodynamics Department

- Developed 2D and 3D, steady and unsteady, rigid and flexible panel codes and created GUI
- Produced and analyzed aerodynamic performance plots of missile CFD, DATCOM, and wind tunnel data

Standard Aero, San Antonio, TX — **Summers 2005 & 2006**
Summer Intern — Reliability Engineering

- Developed algorithms, implementations, and communication strategies for Reliability Centered Maintenance

Journal Articles (Primary Author)

- B. Freno, N. Matula, "Code-verification techniques for the method-of-moments implementation of the combined-field integral equation," ***Journal of Computational Physics*** 488 (2023), 10.1016/j.jcp.2023.112231
- B. Freno, N. Matula, "Code-verification techniques for the method-of-moments implementation of the magnetic-field integral equation," ***Journal of Computational Physics*** 478 (2023), 10.1016/j.jcp.2023.111959
- B. Freno, N. Matula, "Code verification for practically singular equations," ***Journal of Computational Physics*** 470 (2022), 10.1016/j.jcp.2022.111581
- B. Freno, B. Carnes, V. Brunini, N. Matula, "Nonintrusive manufactured solutions for non-decomposing ablation in two dimensions," ***Journal of Computational Physics*** 463 (2022), 10.1016/j.jcp.2022.111237
- B. Freno, N. Matula, J. Owen, W. Johnson, "Code-verification techniques for the method-of-moments implementation of the electric-field integral equation," ***Journal of Computational Physics*** 451 (2022), 10.1016/j.jcp.2021.110891
- B. Freno, N. Matula, W. Johnson, "Manufactured solutions for the method-of-moments implementation of the electric-field integral equation," ***Journal of Computational Physics*** 443 (2021), 10.1016/j.jcp.2021.110538
- B. Freno, W. Johnson, B. Zinser, D. Wilton, F. Vipiana, S. Campione, "Characterization and integration of the singular test integrals in the method-of-moments implementation of the electric-field integral equation," ***Engineering Analysis with Boundary Elements*** 124 (2021), 10.1016/j.enganabound.2020.12.015
- B. Freno, B. Carnes, N. Matula, "Nonintrusive manufactured solutions for ablation," ***Physics of Fluids*** 33 (2021), 10.1063/5.0037245
- B. Freno, B. Carnes, V. Weirs, "Code-verification techniques for hypersonic reacting flows in thermochemical nonequilibrium," ***Journal of Computational Physics*** 425 (2021), 10.1016/j.jcp.2020.109752
- B. Freno, W. Johnson, B. Zinser, S. Campione, "Symmetric triangle quadrature rules for arbitrary functions," ***Computers & Mathematics with Applications*** 79, no. 10 (2020), 10.1016/j.camwa.2019.12.021
- B. Freno, K. Carlberg, "Machine-learning error models for approximate solutions to parameterized systems of nonlinear equations," ***Computer Methods in Applied Mechanics and Engineering*** 348 (2019), 10.1016/j.cma.2019.01.024
- B. Freno, N. Matula, R. Fontenot, P. Cizmas, "The use of dynamic basis functions in proper orthogonal decomposition," ***Journal of Fluids and Structures*** 54 (2015), 10.1016/j.jfluidstructs.2014.11.009
- B. Freno, P. Cizmas, "A proper orthogonal decomposition method for nonlinear flows with deforming meshes," ***International Journal of Heat and Fluid Flow*** 50 (2014), 10.1016/j.ijheatfluidflow.2014.07.001
- B. Freno, T. Brenner, P. Cizmas, "Using proper orthogonal decomposition to model off-reference flow conditions," ***International Journal of Non-Linear Mechanics*** 54 (2013), 10.1016/j.ijnonlinmec.2013.03.007
- B. Freno, P. Cizmas, "An investigation into the significance of the non-linear terms in the equations of motion for a cantilevered beam," ***International Journal of Non-Linear Mechanics*** 47, no. 3 (2012), 10.1016/j.ijnonlinmec.2012.01.002
- B. Freno, P. Cizmas, "A computationally efficient non-linear beam model," ***International Journal of Non-Linear Mechanics*** 46, no. 6 (2011), 10.1016/j.ijnonlinmec.2011.03.010

Patent

- B. Freno, S. Madasu, A. Lin, Simulating hydraulic fracture propagation using dynamic mesh deformation, US Patent No. 10,947,820, Issued March 16, 2021

Theses

- B. Freno, Reduced-order models for computational aeroelasticity, PhD dissertation, Texas A&M University, December 2013
- B. Freno, An efficient nonlinear structural dynamics solver for use in computational aeroelastic analysis, Master's thesis, Texas A&M University, May 2010

Awards

- Employee Recognition Awards Nominee, **Sandia National Laboratories** February 2023
- Thunderbird Kudos Award: Impactful Technical Insight, **Sandia National Laboratories** November 2022
- Outstanding Young Aerospace Engineer Distinguished Alumni Award, **Texas A&M University** November 2022
- High Performance Incentive Plan Award (FY22), **Sandia National Laboratories** October 2022
- Thunderbird Kudos Award: Engaging with Texas A&M Talent, **Sandia National Laboratories** October 2022
- Heat Transfer Division Outstanding Reviewer, **American Society of Mechanical Engineers** November 2021
- Innovation and Intellectual Property Award, **Sandia National Laboratories** November 2021
- High Performance Incentive Plan Award (FY21), **Sandia National Laboratories** October 2021
- Employee Incentive Program Discretionary Award, **Sandia National Laboratories** September 2021
- Employee Recognition Awards Nominee, **Sandia National Laboratories** February 2021
- Journal of VVUQ Reviewer of the Year, **American Society of Mechanical Engineers** December 2020
- High Performance Incentive Plan Award (FY20), **Sandia National Laboratories** October 2020
- Certificate of Excellence, **Sandia National Laboratories** September 2020
- Employee Recognition Awards Nominee, **Sandia National Laboratories** January 2020
- High Performance Incentive Plan Award (FY19), **Sandia National Laboratories** December 2019
- Specific Project or Task (SPOT) Award, **Sandia National Laboratories** December 2018
- Specific Project or Task (SPOT) Award, **Sandia National Laboratories** August 2017
- Invention Disclosure Award, **Halliburton** September 2015
- Outstanding Achievement Award – Aerodynamics & Propulsion **Texas A&M Aerospace Engineering** May 2014
- Outstanding Doctoral Student Award, **Texas A&M Aerospace Engineering** May 2014
- **NASA** Graduate Student Researchers Program Fellowship September 2011
- **Texas A&M Aerospace Engineering** Boeing Graduate Fellowship January 2009
- Stan H. Lowy Award for Excellence in Aerospace Design, **Texas A&M Aerospace Engineering** December 2008

Presented Conference Papers

- B. Freno, B. Carnes, N. Matula, "Nonintrusive manufactured solutions for ablation," *2021 AIAA SciTech Forum*, AIAA Paper 2021-1174, January 2021
- B. Freno, B. Carnes, V. Weirs, "Code-verification techniques for hypersonic reacting flows in thermochemical nonequilibrium," *2019 AIAA Aviation Forum*, AIAA Paper 2019-3705, Dallas, TX, June 2019
- B. Freno, N. Matula, R. Fontenot, P. Cizmas, "The use of dynamic basis functions in proper orthogonal decomposition," *2014 AIAA SciTech Forum*, AIAA Paper 2014-1436, National Harbor, MD, January 2014
- B. Freno, P. Cizmas, "A proper orthogonal decomposition method for nonlinear flows with deforming meshes," *51^{st} AIAA Aerospace Sciences Meeting*, AIAA Paper 2013-0055, Grapevine, TX, January 2013
- B. Freno, T. Brenner, P. Cizmas, "Proper orthogonal decomposition applied to the Reynolds-averaged Navier–Stokes equations," *50^{th} AIAA Aerospace Sciences Meeting*, AIAA Paper 2012-314, Nashville, TN, January 2012
- B. Freno, R. Brown, P. Cizmas, "The role of structural nonlinearities in wind turbine blade aeroelastic analysis," *49^{th} AIAA Aerospace Sciences Meeting*, AIAA Paper 2011-995, Orlando, FL, January 2011

Professional Service

- **Adjunct Professor**: Texas A&M University Department of Aerospace Engineering
- **Associate Editor**: ASME Journal of Verification, Validation and Uncertainty Quantification
- **Journal Reviewer**:
  - Journal of Computational Physics (2)
  - Computer Methods in Applied Mechanics and Engineering
  - International Journal for Numerical Methods in Fluids
  - Engineering Analysis with Boundary Elements
  - IEEE Transactions on Antennas & Propagation
  - Physics of Fluids
  - AIAA Journal
  - ASME Journal of VVUQ (3)
  - Computational and Applied Mathematics (2)
  - Inverse Problems in Science & Engineering
- **Minisymposium Organizer**:
  - WCCM/APCOM: Verification techniques in computational physics and applied mathematics — July 2022
  - ASME VVUQ Symposium: VVUQ for advanced manufacturing, plasma, radiation transport — May 2022
  - SIAM UQ: Verification techniques in computational physics and applied mathematics — April 2022
  - ASME V&V Symposium: VVUQ for artificial intelligence and machine learning models — May 2021
  - SIAM CSE: Numerical methods for integral and integro-differential equations — March 2021
  - WCCM/ECCOMAS: Verification techniques in computational mechanics and applied mathematics — January 2021
  - WCCM/ECCOMAS: Improving predictive capabilities through model error quantification — January 2021
  - ASME V&V Symposium: VVUQ for computational electromagnetics, plasma, radiation transport — May 2020
- **Committee**: AIAA Fluid Dynamics Technical Committee, Computational Fluid Dynamics Subcommittee
  - Reviewer of extended abstracts for AIAA SciTech Forum — January 2024
  - Associate organizer for Aviation Forum: CFD: Algorithms and Applications of Reduced Order Modeling — June 2023
  - Associate organizer for Aviation Forum: CFD: Verification, Validation, and Uncertainty Quantification — June 2023
  - Organizer of Aviation Forum Flow Visualization Showcase — June 2023
  - Session chair for Aviation Forum: CFD: Verification, Validation, and Uncertainty Quantification — June 2023
  - Reviewer of extended abstracts for AIAA AVIATION Forum — June 2023
  - Reviewer of extended abstracts for AIAA SciTech Forum — January 2023
  - Session chair for Aviation Forum: Stability and Transition: Hypersonic — June 2022
- **Program Reviewer**:
  - Sandia National Laboratories Laboratory Directed Research & Development (LDRD)
    - Nuclear Deterence Investment Area
    - Computing and Information Sciences Investment Area
  - NNSA Advanced Simulation and Computing Predictive Science Academic Alliance Program (PSAAP) III
  - Texas A&M Engineering Project Showcase
- **Guest Lecturer**:
  - TAMU ENGR 681-602: Professional Development for Non-Academic Career Path Doctoral Students — Fall 2019
  - TAMU AERO 306: Aerospace Structural Analysis II — Fall 2013
  - TAMU AERO 430: Numerical Simulation — Fall 2013
  - TAMU MEMA 646: Introduction to the Finite Element Method — Spring 2012
- **Mentor**: Undergraduate and graduate students, with an emphasis on under-represented groups

Professional Societies

- Senior Member, **American Institute of Aeronautics and Astronautics**
- Member, **American Society of Mechanical Engineers**
- Member, **Society for Industrial and Applied Mathematics**

Presentations

- ASME International Mechanical Engineering Congress and Exposition, New Orleans, LA — October 2023
- IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting — July 2023
- ASME Verification, Validation, and Uncertainty Quantification Symposium, Baltimore, MD — May 2023
- World Congress on Computational Mechanics / Asian Pacific Congress on Computational Mechanics — July 2022
- IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting — July 2022
- Sandia National Laboratories Engineering Sciences Summer Institute Seminar Series — June 2022
- ASME Verification, Validation, and Uncertainty Quantification Symposium, College Station, TX — May 2022
- SIAM Conference on Uncertainty Quantification, Atlanta, GA — April 2022
- Texas A&M University Industrial and Applied Mathematics Seminar Series, College Station, TX — January 2022
- Texas A&M University Aerospace Practice and Professional Engineer Lecture Series, College Station, TX — January 2022
- International Conference on Electromagnetics in Advanced Applications (special session) — August 2021
- Sandia National Laboratories Engineering Sciences Summer Institute Seminar Series — July 2021
- Oak Ridge National Laboratory — June 2021
- ASME Verification and Validation Symposium: VVUQ for Computational Electromagnetics — May 2021
- ASME Verification and Validation Symposium: VVUQ for Heat Transfer — May 2021
- ASME Verification and Validation Symposium: VVUQ for Fluid Dynamics — May 2021
- Texas A&M University Aerospace Engineering Seminar Series — April 2021
- SIAM Conference on Computational Science and Engineering — March 2021
- World Congress on Computational Mechanics / European Congress on Computational Methods — January 2021
- AIAA SciTech Forum — January 2021
- IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting — July 2020
- Texas A&M University Aerospace Engineering Seminar Series, College Station, TX — January 2020
- Texas A&M University College of Engineering, College Station, TX — September 2019
- Sandia National Laboratories Machine Learning and Deep Learning Workshop, Albuquerque, NM — August 2019
- AIAA Aviation Forum, Dallas, TX — June 2019
- Sandia National Laboratories Engineering Sciences External Review Board, Albuquerque, NM — April 2019
- Texas A&M University College of Engineering, College Station, TX — March 2019
- Texas A&M University Industrial and Applied Mathematics Seminar Series, College Station, TX — March 2019
- SIAM Conference on Computational Science and Engineering, Spokane, WA — February 2019
- Sandia National Laboratories Center for Computing Research Seminar, Albuquerque, NM — October 2018
- World Congress on Computational Mechanics, New York, NY — July 2018
- SIAM Conference on Uncertainty Quantification, Anaheim, CA — April 2018
- University of Florida and Eglin AFB Research and Engineering Education Facility Campus, Shalimar, FL — May 2014
- AIAA SciTech Forum, National Harbor, MD — January 2014
- AIAA Aerospace Sciences Meeting, Grapevine, TX — January 2013
- AIAA Aerospace Sciences Meeting, Nashville, TN — January 2012
- AIAA Aerospace Sciences Meeting, Orlando, FL — January 2011
- University of Campinas (Unicamp), Campinas, São Paulo, Brazil — July 2010

Additional Publications (Secondary Author)

- J. Ray, S. Kieweg, D. Dinzl, B. Carnes, V. Weirs, **B. Freno**, M. Howard, T. Smith, I. Nompelis, G. Candler, Estimation of inflow uncertainties in laminar hypersonic double-cone experiments, *AIAA Journal*, doi:10.2514/1.J059033
- S. Reddy, **B. Freno**, P. Cizmas, S. Gokaltun, D. McDaniel, G. Dulikravich, Constrained reduced-order models based on proper orthogonal decomposition, *Computer Methods in Applied Mechanics and Engineering*, doi:10.1016/j.cma.2017.03.038
- A. Krueger, B. Lance, **B. Freno**, R. Wagnild, Verification Studies of the Multi-Fidelity Toolkit, *2022 AIAA SciTech Forum*, AIAA Paper 2022-2009, San Diego, CA, January 2022
- B. Lance, A. Krueger, **B. Freno**, R. Wagnild, Validation Study of the Multi-Fidelity Toolkit, *2022 AIAA SciTech Forum*, AIAA Paper 2022-1574, San Diego, CA, January 2022
- J. Ray, S. Kieweg, D. Dinzl, B. Carnes, V. Weirs, **B. Freno**, M. Howard, T. Smith, I. Nompelis, G. Candler, Estimation of inflow uncertainties in laminar hypersonic double-cone experiments, *2019 AIAA SciTech Forum*, AIAA Paper 2019-2279, San Diego, CA, January 2019
- S. Kieweg, J. Ray, V. Weirs, B. Carnes, D. Dinzl, **B. Freno**, M. Howard, E. Phipps, W. Rider, T. Smith, Validation assessment of hypersonic double-cone flow simulations using uncertainty quantification, sensitivity analysis, and validation metrics, *2019 AIAA SciTech Forum*, AIAA Paper 2019-2278, San Diego, CA, January 2019
- F. Carpenter, T. Brenner, **B. Freno**, P. Cizmas, A reduced-order model for turbomachinery flows using proper orthogonal decomposition, *ASME Turbo Expo 2013*, GT2013-94914, San Antonio, TX, June 2013
- P. Cizmas, **B. Freno**, T. Brenner, G. Worley, A high-fidelity nonlinear aeroelastic model for aircraft with large wing deformations, *International Forum on Aeroelasticity and Structural Dynamics*, IFASD-2009-098, Seattle, WA, June 2009

Research Areas

- **Physics Disciplines**
  - Computational fluid dynamics (CFD)
    - Compressible and incompressible
    - Viscous and inviscid
  - Ablation and heat transfer
  - Nonlinear structural dynamics
  - Aeroelasticity
  - Computational electromagnetics (CEM)
- **Meshing**
  - Elliptic and Schwarz–Christoffel grid generation
  - Mesh deformation
- **Surrogate Modeling**
  - Reduced-order modeling
  - Proper orthogonal decomposition
  - Machine learning
- **Numerical Methods**
  - Code verification
  - Post-processing
  - Numerical integration

Student Activities and Service

- Sigma Gamma Tau (National Aerospace Engineering Honor Society) – President, Vice President (Texas A&M Chapter)
- American Institute of Aeronautics and Astronautics – Chair, Vice Chair (Texas A&M Chapter)
- Texas A&M Student Engineers' Council – Legislation Committee
- Texas A&M Student Senate – Caucus Leader and Senator for College of Engineering
- Texas A&M Wind Symphony – Performed in Carnegie Hall and Europe
- Volunteering – Church and community
- Boy Scouts of America – Eagle Scout, 4 Palms, Order of the Arrow