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
- Served as VVUQ reviewer for Oak Ridge National Laboratory and Los Alamos National Laboratory
- Serving as principal investigator for the development of novel code-verification and numerical-integration techniques for computational electromagnetics (CEM)
- 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 and PSAAP IV

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

- Developed reduced-order models for nonlinear structural dynamics and fluid mechanics for computational aeroelasticity and created software to produce 3D surface plots and movies   Spring 2009 – Spring 2014
- Organized 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 CFD 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, R. Pfeiffer, E. Dohme, J. Kotulski, "Manufactured solutions for an electromagnetic slot model," ***Journal of Computational Physics*** *in press*, `10.1016/j.jcp.2024.113343`

- 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

Honors & Awards

- **American Institute of Aeronautics and Astronautics** Associate Fellow   Jan. 2024

- **American Society of Mechanical Engineers**
  - Heat Transfer Division Outstanding Reviewer   Nov. 2021
  - Reviewer of the Year, *Journal of Verification, Validation and Uncertainty Quantification*   Dec. 2020

- **Halliburton** Invention Disclosure Award   Sep. 2015

- **NASA** Graduate Student Researchers Program Fellowship   Sep. 2011

- **Sandia National Laboratories**

Individual Performance Award	Aug. 2017	Dec. 2018	Sep. 2020	Jun. 2023	May 2024
Employee Recognition Awards Nominee		Jan. 2020	Feb. 2021	Feb. 2023	Feb. 2024
High Performance Incentive Plan Award (ended 2023)	Dec. 2019	Oct. 2020	Oct. 2021	Oct. 2022	Oct. 2023
Thunderbird Kudos Award				Oct. 2022	Nov. 2022
Innovation and Intellectual Property Award					Nov. 2021
Critical Skills Retention Incentive					Sep. 2021

- **Texas A&M University Department of Aerospace Engineering**
  - Outstanding Young Aerospace Engineer Distinguished Alumni Award   Nov. 2022
  - Outstanding Achievement Award – Aerodynamics & Propulsion   May 2014
  - Outstanding Doctoral Student Award   May 2014
  - Boeing Graduate Fellowship   Jan. 2009
  - Stan H. Lowy Award for Excellence in Aerospace Design   Dec. 2008

Professional Societies

- Associate Fellow, **American Institute of Aeronautics and Astronautics**

- Member, **American Society of Mechanical Engineers**

- Member, **Society for Industrial and Applied Mathematics**

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," *51st 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," *50th 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," *49th AIAA Aerospace Sciences Meeting*, AIAA Paper 2011-995, Orlando, FL, January 2011

Professional Service

- **Adjunct Professor**: Texas A&M University Department of Aerospace Engineering   Dec. 2022 – Present
- **Associate Editor**: ASME Journal of Verification, Validation and Uncertainty Quantification   Feb. 2021 – Present
- **Journal Reviewer**:   Nov. 2011 – Present
  - Journal of Computational Physics (2)
  - Computer Methods in Applied Mechanics and Engineering
  - International Journal for Numerical Methods in Fluids
  - Engineering Analysis with Boundary Elements (2)
  - IEEE Transactions on Antennas & Propagation
  - Physics of Fluids (3)
  - AIAA Journal
  - ASME Journal of VVUQ (4)
  - Computational and Applied Mathematics (2)
  - Inverse Problems in Science & Engineering
- **Minisymposium Organizer**:
  - WCCM/PANACM: Verification techniques in computational physics and applied mathematics   Jul. 2024
  - ASME VVUQ Symposium: Computational electromagnetics, plasma, radiation   May 2024
  - WCCM/APCOM: Verification techniques in computational physics and applied mathematics   Jul. 2022
  - ASME VVUQ Symposium: VVUQ for advanced manufacturing, plasma, radiation transport   May 2022
  - SIAM UQ: Verification techniques in computational physics and applied mathematics   Apr. 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   Mar. 2021
  - WCCM/ECCOMAS: Verification techniques in computational mechanics and applied mathematics   Jan. 2021
  - WCCM/ECCOMAS: Improving predictive capabilities through model error quantification   Jan. 2021
  - ASME V&V Symposium: VVUQ for computational electromagnetics, plasma, radiation transport   May 2020
- **Committees**:
  - AIAA Fluid Dynamics Technical Committee, Computational Fluid Dynamics Subcommittee   May 2022 – Present
    - Organizer of AIAA Aviation Forum Flow Visualization Showcase   Jun. 2023
    - Associate organizer for AIAA Aviation Forum
      - CFD: Algorithms and Applications of Reduced Order Modeling   Jun. 2023
      - CFD: Verification, Validation, and Uncertainty Quantification   Jun. 2023
    - Session chair
      - AIAA SciTech Forum: Turbulence, Model Closures, and Surrogates   Jan. 2024
      - AIAA Aviation Forum: CFD: Verification, Validation, and Uncertainty Quantification   Jun. 2023
      - AIAA Aviation Forum: Stability and Transition: Hypersonic   Jun. 2022
    - Extended abstract reviewer
      - AIAA SciTech Forum   Jan. 2023   Jan. 2024
      - AIAA AVIATION Forum   Jun. 2023   Jul. 2024
  - University of New Mexico Hospital Patient and Family Advisory Committee   Jun. 2024 – Present
- **Program Reviewer**:
  - NNSA ASC Predictive Science Academic Alliance Program (PSAAP) III and IV   Jun. 2020 – Present
  - Los Alamos National Laboartory Level 2 Milestone   Aug. 2024
  - Sandia National Laboratories Laboratory Directed Research & Development (LDRD)
    - Nuclear Deterrence Investment Area   May 2018
    - Computing and Information Sciences Investment Area   May 2023
  - Texas A&M Engineering Project Showcase   Apr. 2022
- **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

Presentations

- World Congress on Comp. Mechanics / Pan American Congress on Comp. Mechanics, Vancouver, BC .... Jul. 2024
- ASME Verification, Validation, and Uncertainty Quantification Symposium, College Station, TX .... May 2024
- ASME International Mechanical Engineering Congress and Exposition, New Orleans, LA .... Nov. 2023
- IEEE Int. Sym. on Antennas and Propagation and North American Radio Sci. Meeting, Portland, OR .... Jul. 2023
- ASME Verification, Validation, and Uncertainty Quantification Symposium, Baltimore, MD .... May 2023
- World Congress on Computational Mechanics / Asian Pacific Congress on Computational Mechanics .... Jul. 2022
- IEEE Int. Sym. on Antennas and Propagation and North American Radio Sci. Meeting, Denver, CO .... Jul. 2022
- Sandia National Laboratories Engineering Sciences Summer Institute Seminar Series .... Jun. 2022
- ASME Verification, Validation, and Uncertainty Quantification Symposium, College Station, TX .... May 2022
- SIAM Conference on Uncertainty Quantification, Atlanta, GA .... Apr. 2022
- Texas A&M University Industrial and Applied Mathematics Seminar Series, College Station, TX .... Jan. 2022
- Texas A&M University Aerospace Practice and Professional Engineer Lecture Series, College Station, TX .... Jan. 2022
- International Conference on Electromagnetics in Advanced Applications .... Aug. 2021
- Sandia National Laboratories Engineering Sciences Summer Institute Seminar Series .... Jul. 2021
- Oak Ridge National Laboratory Computational Sciences and Engineering Division .... Jun. 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 .... Apr. 2021
- SIAM Conference on Computational Science and Engineering .... Mar. 2021
- World Congress on Computational Mechanics / European Congress on Computational Methods .... Jan. 2021
- AIAA SciTech Forum .... Jan. 2021
- IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting .... Jul. 2020
- Texas A&M University Aerospace Engineering Seminar Series, College Station, TX .... Jan. 2020
- Texas A&M University College of Engineering, College Station, TX .... Sep. 2019
- Sandia National Laboratories Machine Learning and Deep Learning Workshop, Albuquerque, NM .... Aug. 2019
- AIAA Aviation Forum, Dallas, TX .... Jun. 2019
- Sandia National Laboratories Engineering Sciences External Review Board, Albuquerque, NM .... Apr. 2019
- Texas A&M University College of Engineering, College Station, TX .... Mar. 2019
- Texas A&M University Industrial and Applied Mathematics Seminar Series, College Station, TX .... Mar. 2019
- SIAM Conference on Computational Science and Engineering, Spokane, WA .... Feb. 2019
- Sandia National Laboratories Center for Computing Research Seminar, Albuquerque, NM .... Oct. 2018
- World Congress on Computational Mechanics, New York, NY .... Jul. 2018
- SIAM Conference on Uncertainty Quantification, Anaheim, CA .... Apr. 2018
- University of Florida and Eglin AFB Research and Engineering Education Facility Campus, Shalimar, FL .... May 2014
- AIAA SciTech Forum, National Harbor, MD .... Jan. 2014
- AIAA Aerospace Sciences Meeting, Grapevine, TX .... Jan. 2013
- AIAA Aerospace Sciences Meeting, Nashville, TN .... Jan. 2012
- AIAA Aerospace Sciences Meeting, Orlando, FL .... Jan. 2011
- University of Campinas (Unicamp), Campinas, São Paulo, Brazil .... Jul. 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* 58 (2020), `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* 321 (2017), `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 Experience

- **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 University Student Engineers' Council – Legislation Committee
- Texas A&M University Student Senate – Caucus Leader and Senator for College of Engineering
- Texas A&M University Wind Symphony – Performed in Carnegie Hall and Europe
- Volunteering – Church and community
- Boy Scouts of America – Eagle Scout, 4 Palms, Order of the Arrow