# 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," *under review*, `arXiv:2406.14573`

- 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**

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|---|---|---|---|---|---|
| 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," *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 — 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 (2)
    - 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