Harley Hanes | Resume

(505)715-8003 • harleyhanes97@gmail.com • harleyhanes.github.io

Education

- **North Carolina State University**
  Ph.D. in Applied Math, GPA: 3.5/4.0 *May 2026*
  Coursework: Uncertainty Quantification, Advanced Matrix Methods, Data-Driven Modeling
- **Tulane University**
  M.S. in Computational Science, GPA: 4.0/4.0 *August 2020*
  Coursework: Bayesian Methods in Statistical Learning, Large Scale Computation, Scientific Visualization
- **Tulane University**
  B.S. in Mathematics, B.S.P.H. in Public Health , GPA: 3.8/4.0 *August 2019*

Employment

- **Year-Round Graduate R&D Intern**
  Sandia National Laboratories *May 2023–Present*
  - Contributed to development of SCEPTRE photon-electron transport code in C++
  - Verified energy and spatial finite element discretizations using Method of Manufactured Solutions, improving simulation credibility
  - Supported documentation, user troubleshooting, and bug fixes
  - Developed strong understanding of deterministic transport algorithms and codebase architecture
  - Won the 2025 Intern Thunderbird Award: Purpose-Driven for my work
- **Research Assistant**
  North Carolina State University *January 2021–December 2022*
  - Analyzed sensitivity of reduced-order models for Navier-Stokes fluid flows under NASA AEROFUSION-MLUQ grant to further uncertainty quantification of atmospheric entry of Orion capsule
  - Developed novel use of penalty terms for sensitivity analysis of boundary conditions in Galerkin reduced-order models.
  - Aided in sensitivity analysis of neural network surrogates for optimal sensor placement
  - Developed `UQLibrary`, a Python library for sensitivity and identifiability analysis
- **Teaching Assistant**
  North Carolina State University *August–December 2020, January–December 2023*
  - Instructor of record for Calculus II which included lecturing, developing course materials, writing exams, and mentorship
  - Recitation leader for Calculus I and II providing supplemental lectures, holding office hours, and grading exams

Technical Skills

Analysis: model development and VVUQ
- Finite-element/difference model development
- Reduced-order model development and data refinement using POD, DMD, and neural networks
- Randomized linear algebra algorithms
- Local/ global sensitivity and identifiability analysis
- MCMC algorithms for Bayesian inference
- Verification by Method of Manufactured Solutions

Programming: Python, C++, Matlab, R, JS, HTML
- Automated testing and debugging tools
- Parallelization using MPI and OpenMP
- HPC job and data management
- Network design and training in PyTorch
- Python package management and distribution

Application Experience: Radiation transport, CFD, chemical reactors, ecology, disease transmission

Journal Publications

- **Hanes, H.**, Lee, M.W., Smith, R.C. (**In Review**). Efficient Quantification of Fluid Flow Parameter Sensitivity Using Reduced-Order Modeling. AIAA Journal.
- Carrera-Pineyro, D., **Hanes, H.**, Litzler, A. McCormack, A., Velazquez-Molina, J., Mubayi, A., Rios-Soto, K., Kribs, C. (2020). Cost analysis of vaccination in tick-mouse transmission of Lyme disease. *Journal of Theoretical Biology*. 494(7).

Conference Presentations

- **Hanes, H.**, Freno, B., Pautz, S. (2025, June 16-18). *Verification of the Finite Element Method Energy Discretization in SCEPTRE* [**Paper Presentation**]. ANS 2025 Annual Meeting, Chicago, IL.
- **Hanes, H.**, Pautz, S., Freno, B. (2024, May 13-15). *Verification and Validation of the Boltzmann-CSD Solver within the SCEPTRE package*. ASME 2024 VVUQ Symposium, College Station, TX.
- **Hanes, H.**, Lee, M.W., Ramezanian, D., Smith R.C. (2023, January 6-8). *Low-cost Quantification of Fluid Flow Parameter Sensitivity using Reduced-order Modeling* [**Paper Presentation**]. AIAA SciTech 2023 Forum, National Harbour, MD.
- **Hanes, H.**, Lebedev, Y., Smith, R.C., Zare, A. (2023, January 6-8). *Optimal Sensor Placement in Fluid Dynamics using Machine Learning and Sensitivity Analysis* [**Paper Presentation**]. AIAA SciTech 2023 Forum, National Harbour, MD.
- Carrera-Pineyro, D., **Hanes, H.**, Litzler, A. McCormack, A., Velazquez-Molina, J., Mubayi, A., Rios-Soto, K., Kribs, C. (2020, October 14-16). *Modeling the Dynamics of Lyme Disease in a Tick-Mouse System Subject to Vaccination of Mice Populations*[**Poster Presentation**]. SACNAS Diversity in STEM Conference, San Antonio, TX.
- **H. Hanes**. Hyman M. (2019). *Analysis of a Compartmental Model for Chagas Disease Transmission in the U.S.* SCALA 2019, New Orleans, LA.

Selected Research Projects

- **Effective Basis Selection for Galerkin Reduced-Order Models with Nonlinear Sources**
  North Carolina State University *March 2024–Present*
  - Developed full-order (orthogonal collocation on finite elements) and Petrov-Galerkin reduced-order models of adiabatic chemical reactor
  - Identified non-monotonic convergence of Galerkin reduced-order models on advection-dominated problems with nonlinear sources and recirculation
  - Tested alternative dimension reductions of nonlinear sources to improve convergence of reduced-order models
  - Proposed approach significantly improves convergence of reduced-order model and reduces computational cost
- **Sensitivity Equation Projection to Improve Accuracy and Efficiency in Reduced-Order Models**
  North Carolina State University *October 2024–Present*
  - Developed Petrov-Galerkin reduced-order sensitivity equation model for adiabatic chemical reactor
  - Testing suitability of POD bases from base equations as bases for sensitivity equation model
  - Expect proposed approach to significantly improve accuracy and computational cost of sensitivity analysis without increase compared to finite-difference approximation
- **Efficient Quantification of Fluid Flow Parameter Sensitivity Using Reduced-Order Modeling**
  North Carolina State University *January 2022–December 2024*
  - Aided in development of Galerkin reduced-order model of lid-driven cavity incompressible Navier-Stokes flow
  - Developed novel use of boundary penalties in Galerkin reduced-order model to estimate sensitivity of boundary parameters
  - Tested global sensitivity accuracy in transition of lid-driven cavity from regularized to non-regularized boundary conditions
  - Reduced-order model showed anticipated regions and magnitudes of sensitivity to boundary conditions as flow transitioned
- **Development and Risk Analysis of a Multi-Host Model for Chagas Disease Transmission**
  Tulane University *October 2018–May 2020*
  - Developed a compartmental ordinary differential equation model for transmission of Chagas disease through hosts in different ecological zones
  - Performed identifiability analysis to compress transmission model
  - Performed local and global sensitivity analysis to identify optimal transmission pathways for control to reduce human risk
  - Aided Chagas disease lab with field work and statistical analysis