

# WILLIAM ANDERSON

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## EDUCATION

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### North Carolina State University, Raleigh, NC

Ph.D. Applied Mathematics

June 2023

Thesis: *Reduced-order Nonlinear Solutions for Time-Dependent PDEs.*

Advisor: Dr. Mohammad Farazmand

### Montclair State University, Montclair, NJ

M.S. Mathematics

August 2018

Thesis: *An Enthalpy Model for the Dynamics of a Deltaic System Under Base-Level Change*

Advisor: Dr. Jorge Lorenzo-Trueba

B.S. Mathematics

May 2017

## PUBLICATIONS

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1. **W. Anderson**, M. Farazmand. *Fisher information and shape-morphing modes for solving the Fokker-Planck equation in higher dimensions.* Submitted. <https://arxiv.org/abs/2306.03749>
2. **W. Anderson**, M. Farazmand. *Fast and scalable computation of shape-morphing nonlinear solutions with application to evolutionary neural networks.* Submitted. <https://arxiv.org/abs/2207.13828>
3. **W. Anderson**, M. Farazmand. *Shape-morphing reduced-order models for nonlinear Schrodinger equations.* Nonlinear Dynamics, vol 108, pp. 2889–2902, 2022
4. **W. Anderson**, M. Farazmand. *Evolution of nonlinear reduced-order solutions for PDEs with conserved quantities.* SIAM J. on Scientific Computing, vol. 44, pp. A176-A197, 2022
5. **W. Anderson**, J. Lorenzo-Trueba, V.R. Voller. *A geomorphic enthalpy method: Description and application to the evolution of fluvial-deltas under sea-level cycles.* Computers & Geosciences, vol. 130, pp. 1-10, 2019

## RESEARCH EXPERIENCE

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### Reduced-order Nonlinear Solutions (RONS)

North Carolina State University, Raleigh, NC

September 2020 - Present

Advisor: Dr. Mohammad Farazmand

- Developed new framework to build reduced-order models for PDEs through evolving an ansatz which depends nonlinearly on time-dependent parameters.
- Applied framework to several problems, including the nonlinear Schrödinger equation, 2D Euler equations for ideal fluids, and high-dimensional Fokker-Plank equations
- RONS provides improved accuracy over traditional reduced-order modeling techniques such as the proper orthogonal decomposition
- Recently applied RONS to evolve weights/biases of shallow neural networks over time
- Improved accuracy/speed over similar approaches by up to four orders of magnitude
- Gained experience in MATLAB, Python, Shell scripting for HPC, and Mathematica

### A Geomorphic Enthalpy Method

Montclair State University, Montclair, NJ

May 2016 - August 2019

Advisor: Dr. Jorge Lorenzo-Trueba

- Developed numerical model for the growth of fluvial deltas, analogous to a Stefan problem with two moving boundaries
- Applied deforming and fixed-grid finite-difference techniques

- Extended technique from linear 1D case to account for nonlinear and 2D diffusion
- Gained interdisciplinary experience working and developing models with geologists
- Developed and led workshops to teach theory/numerics of differential equations to other students in the lab group

## CONFERENCE TALKS AND POSTERS

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1. *Fast and Scalable Computation of Reduced-Order Nonlinear Solutions for PDEs*, 2023 SIAM Conference on Computational Science and Engineering, February 2023, Amsterdam, NL
2. *Nonlinear Reduced-Order Solutions for PDEs With Conserved Quantities*, 2022 SIAM Annual Meeting, July 2022, Pittsburgh, PA
3. *Nonlinear Reduced-Order Solutions for PDEs With Conserved Quantities: Applications to Fluid Dynamics*, 74th Annual Meeting of the APS Division of Fluid Dynamics, November 2021, Phoenix, Arizona
4. *A geomorphic enthalpy method in 3D: Application to the evolution of deltas under sea-level rise*, Middle States Division American Association of Geographers 2018 Meeting, October 2018, Montclair, NJ (poster)
5. *A generalized Stefan problem exhibiting two moving boundaries with application to the evolution of fluvial deltas under sea-level change*, SIAM Conference on the Mathematics of Planet Earth, September 2018, Philadelphia, PA (poster)
6. *On the Application of an Enthalpy Method to the Evolution of Fluvial Deltas Under Sea-Level Changes*, American Geophysical Union Fall 2017, December 2017, New Orleans, LA (poster)

## SEMINAR TALKS

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1. *Shape-morphing reduced-order models for nonlinear Schrödinger equations*, Randomized Numerical Analysis Research Training Group, April 2022, North Carolina State University
2. *Evolving reduced-order nonlinear solutions for PDEs*, Graduate and Undergraduate Student Seminar, February 2022, University of Iowa
3. *RONS: Evolution of nonlinear reduced-order solutions for PDEs with conserved quantities*, Randomized Numerical Analysis Research Training Group, September 2021, North Carolina State University
4. *Evolution of nonlinear reduced-order solutions for PDEs with conserved quantities*, Nonlinear Dynamics Seminar, June 2021, ETH Zürich
5. *On the application of an enthalpy method to the evolution of fluvial deltas under sea-level changes*, Montclair Student Research Symposium, April 2018, Montclair, NJ (poster)

## HONORS AND AWARDS

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1. SIAM Student Paper Prize (2022)  
Awarded to 3 students annually for most outstanding SIAM student papers
2. Winton–Rose Award, North Carolina State University (2022)  
Awarded annually to recognize excellence in graduate research
3. *Provost Fellowship*, North Carolina State University (2019)
4. *CSAM Recognition of Excellence*, Montclair State University (2019)  
Awarded to 8 students in the College of Science and Mathematics

## TEACHING EXPERIENCE

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### North Carolina State University

Fall 2023 Instructor, MA107 – Precalculus I  
Fall 2021 Recitation Leader, MA141 – Calculus I  
Fall 2020 Instructor, MA114 – Introduction to Finite Mathematics

### Montclair State University

Fall 2018 Adjunct Instructor, MA106 – Contemporary Applied Mathematics  
Spring 2018 Graduate Assistant, MA100 – Intermediate Algebra  
Spring 2018 Graduate Assistant, MA103 – The Development of Mathematics  
Spring 2018 Graduate Assistant, MA109 – Statistics  
Fall 2017 Graduate Assistant, MA100 – Intermediate Algebra  
Fall 2017 Graduate Assistant, MA103 – The Development of Mathematics  
Fall 2017 Graduate Assistant, MA109 – Statistics  
Fall 2017 Teaching Assistant, MA590– Mathematical Modeling

## ASSOCIATIONS

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Society for Industrial and Applied Mathematics

American Mathematical Society