Los Alamos, NM
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Joseph M. Coale

Links: My Website
ResearchGate
Google Scholar
ORCID

Ph.D. Nuclear Engineer with **7 publications** among several conferences and journals, **7 presentations** at various academic venues and **4 internships** at US national laboratories.

Areas of Research

- Computational Physics
- Model Order Reduction
- Particle Transport Theory
- Radiation & Nuclear Reactor Physics
- Numerical Analysis
- High Energy Density Physics

Technical Skills & Experience

Software Development Skills

Programming Languages	FORTRAN, Python, C, C++, Bash, HTML
Known Software & Tools	Git, VERA, SCALE, Cassio, Capsaicin, PyTorch, Scikit-Learn
Contributed Development	Capsaicin

Mathematics & Theory

Particle Transport Theory	Multilevel Nonlinear Projective-Iterative Techniques (Quasidiffusion), Variable Eddington Factor Method, Iterative Acceleration Schemes, Discrete-Ordinates, Spherical Harmonics
Dimensionality Reduction & Data-Driven Methods	Proper Orthogonal Decomposition (POD), Multilinear POD, Dynamic Mode Decomposition, Deep Neural Networks

Education

Ph.D., Nuclear Engineering, North Carolina State University, GPA: 3.89/4.00 **Dec 2019 — June 2022**
Minor: Mathematics
Dissertation Topic: *Model Order Reduction for Thermal Radiative Transfer Problems Based on Nonlinear-Projective Techniques Combined with Data-Driven Methodologies.*

M.S., Nuclear Engineering, North Carolina State University, GPA: 3.64/4.00 **Aug 2018 — Dec 2019**
Thesis: *Reduced-Order Models for Thermal Radiative Transfer Problems Based on Low-Order Transport Equations and the Proper Orthogonal Decomposition*

B.S., Nuclear Engineering, North Carolina State University, GPA: 3.73/4.00 **Aug 2015 — May 2018**

Work Experience

Postdoc **June 2022 — Present**
Los Alamos National Laboratory, CCS-2 Los Alamos, NM

- Development of acceleration schemes for radiation-hydrodynamics simulations

Research Assistant **Aug 2018 — June 2022**
North Carolina State University - Graduate Advisor: Dr. Dmitriy Anistratov Raleigh, NC

- Investigating model-order reduction techniques for nonlinear thermal radiative transfer problems.
- Developing several novel reduced-order models founded on a combination of nonlinear multilevel projection techniques with methods of data-based model reduction.

Internship **May 2021 — Aug 2021**
Los Alamos National Laboratory - Mentor: Dr. James Warsa Los Alamos, NM

- Investigated the decoupled diffusion synthetic acceleration scheme for neutral-particle Boltzmann transport, working under the CCS-2 division at LANL.
- Implemented the decoupled diffusion synthetic acceleration method in the Capsaicin code project. Performed analysis of this method in 2D geometry.

Internship **May 2020 — Aug 2020**
Los Alamos National Laboratory - Mentor: Dr. James Warsa Los Alamos, NM

- Investigated several novel acceleration schemes for neutral-particle Boltzmann transport under the CCS-2 division at LANL.
- Performed Fourier analysis and designed a stand-alone code to test two novel acceleration schemes in 1D geometry. Co-authored two articles in the proceedings of the 2021 International conference on mathematics and computational methods applied to nuclear science and engineering (M&C 2021).

Internship **June 2019 — Aug 2019**
Los Alamos National Laboratory - Mentor: Dr. Todd Urbatsch Los Alamos, NM

- Investigated uncertainties present in supersonic radiation shock-wave experiments under the XTD division at LANL.
- Utilized the radiation-hydrodynamics code Cassio to simulate a laser-driven radiation shock through a foam target modeled from an experiment designed at LANL. Considered uncertainties included the angular and frequency distributions of the radiation drive.

Internship **June 2018 — Aug 2018**
Oak Ridge National Laboratory - Mentor: Dr. William Wieselquist Oak Ridge, TN

- Worked with the Consortium for Advanced Simulation of Light water reactors (CASL), with a majority focus on the neutronics codes MPACT and SCALE, working under the reactor physics group in the reactor and nuclear systems division.
- Investigated the effects of several accident-tolerant nuclear reactor fuel and cladding materials on criticality and power distribution for multiple simple reactor cores.
- Demonstrated that MPACT could correctly simulate advanced materials in reactor cores by comparison with SCALE.

Publications

1. J. M. Coale & D. Y. Anistratov. Reduced Order Models for Nonlinear Radiative Transfer Based on Moment Equations and POD/DMD of Eddington Tensor. *preprint on arXiv: 2107.09174v1, math.NA.* (2021).
2. J. M. Coale & D. Y. Anistratov. *Reduced-Order Models for Thermal Radiative Transfer Based on POD-Galerkin Method and Low-Order Quasidiffusion Equations* in *Proc. of Int. Conf. on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2021)* (Raleigh, NC, October 3-7, 2021), 10 pp.
3. D. Y. Anistratov & J. M. Coale. *Implicit Methods with Reduced Memory for Thermal Radiative Transfer* in *Proc. of Int. Conf. on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2021)* (Raleigh, NC, October 3-7, 2021), 10 pp.
4. D. Y. Anistratov, J. M. Coale, J. S. Warsa & J. H. Chang. *Multilevel Second-Moment Methods with Group Decomposition for Multigroup Transport Problems* in *Proc. of Int. Conf. on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2021)* (Raleigh, NC, October 3-7, 2021), 10 pp.
5. J. S. Warsa, J. M. Coale, D. Y. Anistratov & J. H. Chang. *Variations on Diffusion-Based Synthetic Acceleration for Multigroup S_N Transport* in *Proc. of Int. Conf. on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2021)* (October 3-7, Raleigh, NC, 2021), 7 pp.
6. J. Coale & D. Anistratov. Data-Driven Grey Reduced-Order Model for Thermal Radiative Transfer Problems Based on Low-Order Quasidiffusion Equations and Proper Orthogonal Decomposition. *Transactions of the American Nuclear Society* **121,** 836–839 (2019).
7. J. Coale & D. Anistratov. *A Reduced-Order Model for Thermal Radiative Transfer Problems Based on Multilevel Quasidiffusion Method* in *Proc. of Int. Conf. on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2019)* (Portland, OR, August 25-29, 2019), 10 pp.

Presentations

1. Invited Talk, Los Alamos National Laboratory - Los Alamos, NM - January 2022:
   Dimensionality Reduction for Thermal Radiative Transfer Problems Using a Moment-Based Approach Combined with the Proper Orthogonal Decomposition
2. Invited Talk, Los Alamos National Laboratory - Los Alamos, NM - October 2021:
   Model Order Reduction for Nonlinear Radiative Transfer Based on Moment Equations and Data-Driven Approximations of the Eddington Tensor
3. The International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering - Raleigh, NC - October 2021:
   Reduced-Order Models for Thermal Radiative Transfer Based on POD-Galerkin Method and Low-Order Quasidiffusion Equations
4. The International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering - Raleigh, NC - October 2021:
   Variations on Diffusion-Based Synthetic Acceleration for Multigroup S_N Transport

5. SIAM Conference on Computational Science and Engineering (CSE) - Virtual conference - March 2021:
   Reduced-Order Models for Nonlinear Radiative Transfer Problems Based on Nonlinear Projection Approach and Proper Orthogonal Decomposition

6. ANS Winter Meeting 2019 - Washington, DC - November 2019:
   Data-Driven Grey Reduced-Order Model for Thermal Radiative Transfer Problems Based on Low-Order Quasidiffusion Equations and Proper Orthogonal Decomposition

7. The International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering - Portland, OR - August 2019:
   A Reduced-Order Model for Thermal Radiative Transfer Problems Based on Multilevel Quasidiffusion Method

Grants & Fellowships

2018-2019 NCSU Provost's Doctoral Fellowship

Memberships & Affiliations

American Nuclear Society
Society for Industrial and Applied Mathematics
M&C 2021 student program committee (co-chair)