Assistant Professor   Office: Carnegie 206D
Department of Mathematics   Email: sdu113@syr.edu
Syracuse University   Website: https://shukaidu.github.io

RESEARCH INTERESTS

- Finite element and discontinuous Galerkin methods
- Scientific machine learning and data-driven approaches
- Symplectic and structure-preserving methods
- Adaptive mesh solver for radiative transfer
- Electromagnetic and elastic/viscoelastic waves
- Computational inverse and ill-posed problems

PROFESSIONAL EXPERIENCE

Syracuse University
- Assistant Professor   Oct 2024 – now

University of Wisconsin-Madison
- Visiting Assistant Professor   Sep 2020 – Sep 2024

University of Minnesota-Twin Cities
- Visiting Doctoral Student   Sep 2019 – June 2020

EDUCATION

University of Delaware
- Ph.D in Applied Mathematics   2020
  Advisor: Dr. Francisco-Javier Sayas
  Thesis: Generalized projection-based error analysis of hybridizable discontinuous Galerkin methods

Wuhan University
- M.S. in Computational Mathematics   2015
- B.S. in Pure Mathematics   2012

PUBLICATIONS

Submitted
19. B. Cockburn, S. Du, M. A. Sánchez. A spectral analysis of hp-hybridized mixed and HDG methods for parametric second-order elliptic problems.
18. S. Du, T. Le, S. N. Stechmann. Element learning with hp-adaptivity: Machine learning-based acceleration of hp-adaptive spectral element methods, and application to atmospheric radiative transfer.

Peer-reviewed
17. J. L. Torchinsky, S. Du, and S. N. Stechmann. Angular-spatial hp-adaptivity for radiative transfer with discontinuous Galerkin spectral element methods. J. Quant.

Spectrosc. Radiat. Transf. 348 (2026).
DOI: 10.1016/j.jqsrt.2025.109687

16. D. H. Marsico, S. Du, S. N. Stechmann. Can second-order numerical accuracy be achieved for Moist Atmospheric Dynamics with non-smoothness at cloud edge? J. Adv. Model. Earth Syst. 17 (2025).
DOI: 10.1029/2025MS005293

15. S. Du, and S. N. Stechmann. Element learning: a systematic approach of accelerating finite element-type methods via machine learning, with applications to radiative transfer. J. Comput. Math. (2024).
DOI: 10.4208/jcm.2407-m2024-0047

14. S. Du, and S. N. Stechmann. Inverse radiative transfer with goal-oriented hp-adaptive mesh refinement: adaptive-mesh inversion. Inverse Probl. 39 (2023), no. 11.
DOI: 10.1088/1361-6420/acf785

13. B. Cockburn, S. Du, M. A. Sánchez. A priori error analysis of new semidiscrete, Hamiltonian HDG methods for the time-dependent Maxwell's equations. ESAIM: M2AN 57 (2023), no.4, 2097-2129.
DOI: 10.1051/m2an/2023048

12. S. Du, and S. N. Stechmann. Fast, low-memory numerical methods for radiative transfer via hp-adaptive mesh refinement. J. Comput. Phys. 480 (2023).
DOI: 10.1016/j.jcp.2023.112021

11. S. Du, and S. N. Stechmann. A universal predictor-corrector approach for minimizing artifacts due to mesh refinement. J. Adv. Model. Earth Syst. 15 (2023).
DOI: 10.1029/2023MS003688

10. B. Cockburn, S. Du, M. A. Sánchez. Combining finite element space-discretization with symplectic time-marching schemes for linear hamiltonian systems. Front. Appl. Math. Stat. 9 (2023).
DOI: 10.3389/fams.2023.1165371

9. M. A. Sánchez, S. Du, B. Cockburn, N.-C. Nguyen, J. Peraire. Symplectic Hamiltonian finite element methods for electromagnetics. Comput. Methods Appl. Mech. Engrg. 396 (2022).
DOI: 10.1016/j.cma.2022.114969

8. B. Cockburn, M. A. Sánchez, S. Du. Discontinuous Galerkin methods with time-operators in their numerical traces for time-dependent electromagnetics. Comput. Meth. Appl. Math. (2022).
DOI: 10.1515/cmam-2021-0215

7. S. Du, and F.-J. Sayas. A note on devising HDG+ projections on polyhedral elements. Math. Comp. 90 (2021), 65-79.
DOI: 10.1090/mcom/3573

6. S. Du. HDG methods for the Stokes equation based on strong symmetric stress formulations. J. Sci. Comput. 85, 8 (2020).
DOI: 10.1007/s10915-020-01309-7

5. S. Du, and F.-J. Sayas. A unified error analysis of hybridizable discontinuous Galerkin methods for the static Maxwell equations. SIAM J. Numer. Anal. 58 (2020), no. 2, 1367–1391.
DOI: 10.1137/19M1290966

4. S. Du, and F.-J. Sayas. New analytical tools for HDG in elasticity, with applications to elastodynamics. Math. Comp. 89 (2020), 1745-1782.
DOI: 10.1090/mcom/3499

3. S. Du, and N. Du. A factorization of least-squares projection schemes for ill-posed problems. Comput. Meth. Appl. Math. 20 (2020), no. 4, 783-798.
DOI: 10.1515/cmam-2019-0173

2. T.S. Brown, S. Du, H. Eruslu, and F.-J. Sayas. Analysis of models for viscoelastic wave propagation. Appl. Math. Nonlin. Sci. 3 (2018), no. 1, 55-96.
DOI: 10.21042/AMNS.2018.1.00006

Books

1. S. Du, and F.-J. Sayas. An invitation to the theory of the Hybridizable Discontinuous Galerkin Method. SpringerBriefs in Mathematics (2019).
DOI: 10.1007/978-3-030-27230-2

GRANTS

- NSF (DMS–2324368): Breaking the 1D Barrier in Radiative Transfer: Fast, Low-Memory Numerical Methods for Enabling Inverse Problems and Machine Learning Emulators. Senior personnel. $498,832 total, $350,000 at UW (2023–2026).
- NSF (AGS–2326631): Convective Processes in the Tropics Across Scales. Senior personnel. $768,471 total, $471,155 at UW (2024–2026).

PRESENTATIONS

Invited talks

34. Inverse radiative transfer via goal-oriented adaptive mesh refinement
SIAM New York–New Jersey–Pennsylvania Section   Nov 2025

33. Accelerating finite element-type methods with machine learning on substructures
Third HKSIAM Biennial Conference, Chinese University of Hong Kong   July 2025

32. Element learning: accelerating finite element-type methods via machine learning, with applications to radiative transfer
SIAM sectional meeting, Fort Worth, Texas   March 2025

31. Forward and inverse computation for radiative transfer via hp-adaptive mesh refinements
14th AIMS Conference, Abu Dhabi   Dec 2024

30. Inverse radiative transfer via goal-oriented hp-adaptive mesh refinement
14th AIMS Conference, Abu Dhabi   Dec 2024

29. Element learning: accelerating finite element-type methods via operator learning with cost-effective training
SIAM sectional meeting, Rochester Institute of Technology   Nov 2024

28. Forward and inverse computation for radiative transfer via hp-adaptive mesh refinement and machine learning acceleration
Analysis seminar, Binghamton University   Oct 2024

27. Element learning: a systematic approach of accelerating finite element-type methods via machine learning
CCAM seminar, Purdue University   Mar 2024

26. Element learning: a systematic approach of accelerating finite element-type methods via machine learning
Analysis and Data Science Seminar, SUNY at Albany   Feb 2024

25. Element learning: a systematic approach of accelerating finite element-type methods via machine learning
    Math Department Colloquium, Syracuse University   Jan 2024
24. Element learning: a systematic approach of accelerating finite element-type methods via machine learning
    Math Department Colloquium, Chinese University of Hong Kong   Dec 2023
23. Element learning: a systematic approach of accelerating finite element-type methods, with applications to radiative transfer
    University of Electronic Science and Technology of China   Nov 2023
22. Element learning: a systematic approach of accelerating finite element-type methods via machine learning, with applications to radiative transfer
    Scientific Computing Seminars, University of Houston   Nov 2023
21. Element learning: a systematic approach of accelerating finite element-type methods via machine learning, with applications to radiative transfer
    Applied Math seminar, University of Louisiana at Lafayette   Oct 2023
20. Element learning: a systematic approach of accelerating finite element-type methods, with applications to radiative transfer
    Numerical analysis and PDE seminar, University of Delaware   Sep 2023
19. Energy-conserving discontinuous Galerkin methods with time-operators in their traces for time-dependent electromagnetics
    17th UCNCCM, Albuquerque, NM   July 2023
18. Fast, low-memory methods for radiative transfer through hp-adaptive mesh refinement
    13th AIMS Conference, Wilmington, NC   June 2023
17. Unified analysis of HDG methods for the static Maxwell equations
    CILAMCE-PANACM 2021, Brazil   Nov 2021
16. Generalized projection-based error analysis of hybridizable discontinuous Galerkin (HDG) methods
    CEDYA2021, Spain   June 2021
15. Unified analysis of HDG methods for the static Maxwell equations
    SIAM CSE2021, Virtual Meeting   Mar 2021
14. Projection-based analysis of hybridizable discontinuous Galerkin (HDG) methods
    Wenbo Li Prize Talk, U of Delaware   Feb 2020
13. New analysis techniques of HDG+ method
    SIAM Sectional Meeting, Iowa State U   Oct 2019
12. Uniform-in-time optimal convergent HDG method for transient elastic waves with strong symmetric stress formulation
    WAVES2019, TU Wien, Vienna   Aug 2019
11. Hybridizable Discontinuous Galerkin schemes for elastic waves
    ICIAM2019, Valencia   July 2019
10. HDG for transient elastic waves
    WONAPDE2019, U of Concepcion   Jan 2019

Contributed talks
9. Element learning: accelerating finite element methods via operator learning
   FEM Circus, U of Notre Dame   Oct 2023
8. Three-dimensional radiative transfer: fast, low-memory numerical methods
   Collective Madison Meeting, Madison, WI   Aug 2022

7. Projection-based analysis of HDG methods with reduced stabilization
   DelMar Num Day 2019, U of Maryland   May 2019
6. Projection-based error analysis of HDG methods for transient elastic waves
   FEM Circus, U of Delaware   Nov 2018
5. Devising a tailored projection for a new HDG method in linear elasticity
   FEM Circus, U of Tennessee   Mar 2018
4. A new HDG projection and its applications
   Mid-Atlantic Numerical Analysis Day, Temple U   Nov 2017

Poster presentation
3. Fast, low-memory numerical methods for radiative transfer: forward and inverse problems
   New Trends in Computational and Data Sciences, Caltech   Dec 2022
2. Hybridizable Discontinuous Galerkin methods in transient elastodynamics
   FACM2018, New Jersey Institute of Technology   Aug 2018
1. Building a computational code for 3D viscoelastic wave simulation
   Mid-Atlantic Numerical Analysis Day, Temple U   Nov 2016

TEACHING
Instructor
- Methods of Numerical Analysis II (MAT684) at Syracuse University   Spring 2026
- Applied Linear Algebra (MAT532) at Syracuse University   Fall 2025
- Multivariable calculus (MAT397) at Syracuse University   Spring 2025
- Linear Algebra and Differential Equations (Math320) at UW-Madison   Spring 2023

Teaching Assistant
- Analytic Geometry and Calculus C (Math243)   Fall 2016 & Fall 2017
- Analytic Geometry and Calculus B (Math242)   Spring 2017
- Calculus I (Math221)   Spring 2018
- Review of Advanced Mathematical Problems
  (summer courses offered to incoming graduate students)   Fall 2018

MENTORING ACTIVITIES
Graduate mentorship
- Jason Torchinsky (co-mentored with S. N. Stechmann)   2022 – 2023

Undergraduate mentorship
- WISCERS project at the University of Wisconsin-Madison   2023
- GEMS summer research project at the University of Delaware   Fall 2016

JOURNAL REFEREE
Journal of Scientific Computing • SIAM Journal on Scientific Computing • SIAM Multiscale Modelling and Simulation • ESAIM: Mathematical Modelling and Numerical Analysis • Inverse Problems and Imaging • Computers and Mathematics with Applications • Frontiers in Applied Mathematics and Statistics

AWARDS AND HONORS

Wenbo Li Prize	2020
University Doctoral Fellowship Award at the University of Delaware	2019
ICIAM2019 travel grant	2019
Graduate Enrichment Fellowship at the University of Delaware	2018
GEMS project fund at the University of Delaware	Summer 2016
National Scholarship for Graduate Students of China	2013
People's Scholarship of Wuhan University	2011
Outstanding Student of Wuhan University	2009 – 2011

SERVICES

- Organizing minisymposium "Recent Developments on Hybrid Methods Combining Neural Networks with Classical Numerical Methods"
  SIAM Pacific Northwest Section — Oct 2025

- Mentor for SIAM Virtual Resume Building Workshop — Oct 2024

CODING PROJECTS

Fast, low-memory methods for radiative transfer — 2020 – 2022

- Built a cell-based structured adaptive mesh refinement (AMR) data structure

- Implemented discontinuous Galerkin (DG) methods with hp-adaptivity for the full radiative transfer equation

Hybridizable Discontinuous Galerkin (HDG) methods — 2016 – 2020
(based on HDG3D library: github.com/team-pancho/HDG3D)

- Built Matlab codes of high order HDG methods on computing cluster for transient elastic/viscoelastic waves and Maxwell equations
- Wrote documentation with detailed implementation procedures for HDG methods for Maxwell equations

Finite Element Method (FEM) — 2016
(based on Team Pancho FEM library: team-pancho.github.io)

- Built Matlab codes of high order FEM methods on computing cluster for simulation of viscoelastic waves.

Multiscale modeling — 2013 – 2015

- Implemented algorithms to calculate Cauchy stress tensor based on micro-scale molecular dynamics information

COMPUTER SKILLS

Theory
Data Structures ● Algorithm ● Object Oriented Programming
Languages & Software
Matlab ● Python ● C ● C++ ● Fortran ● openMPI ● LISP ● Linux Shell