

# Curriculum Vitae

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## Education and Professional Experience

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### Education:

- **Ph.D. Mathematics**, University of Pittsburgh (August 2010-August 2014)  
Dissertation: *Higher-Order, Strongly Stable Methods for Uncoupling Groundwater-Surface Water Flow*  
**Advisor:** William J. Layton, **GPA** 3.925/4.0 (including M.A. coursework)
- **M.A. Mathematics**, University of Pittsburgh (August 2008-August 2010)
- **B.A. Mathematics and Music**, Washington & Jefferson College (August 2003-May 2007)  
**GPA** 3.98/4.0 *Class Valedictorian, Phi Beta Kappa*

### Professional Experience:

- **Assistant Professor of Mathematics**, Middlebury College (July 2014-present, tenure-track)  
Medical events resulted in institution-approved medical leave during academic year 2016-2017 (resulting in one year tenure clock extension), and during spring semester 2022. Institution-wide one year tenure clock extension due to pandemic.
- **Graduate Student Researcher**, University of Pittsburgh (Fall 2011-Spring 2014)
- **Teaching Fellowship**, University of Pittsburgh (Fall 2010-Spring 2013)
- **Teaching Assistantship**, University of Pittsburgh (Fall 2008-Spring 2010)

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## Research and Professional Experience

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### Research Areas:

Numerical Analysis (broad), Computational Fluid Dynamics (specialty), Machine Learning (new area)

- **Numerical Methods for fully evolutionary, coupled porous media flow with pollutant transport**, resulting in PhD dissertation and six publications to date.  
**Methodologies:** temporal finite difference methods, spatial finite element method, and time filters. Numerical experiments conducted with MATLAB and FreeFEM++.
- **Application of Machine Learning to problems in Atmospheric Science:** In Spring 2020, completed 15-week NSF-sponsored CyberTraining in Big Data + High-Performance Computing + Atmospheric Sciences. Completed research project with publication on application of machine learning with feature importance analysis on environmental sounding data of supercell storms. Conducted summer research in 2021 with undergraduate students on the intersection of computational fluid dynamics and machine learning.  
**Methodologies:** Machine learning algorithms (research focused on Random Forest Classification and Convolutional Neural Network Models), high performance computing, parallel programming. Work completed using Python and MATLAB.

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## Publications

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1. Coffe, B.; Kubacki, M.; Wen, Y.; Zhang, T.; Barajas, C.; Gobbert, M. Brice. *Machine Learning with Feature Importance Analysis for Tornado Prediction from Environmental Sounding Data*. PAMM, 20, 1, (2021). <https://doi.org/10.1002/pamm.202000112>.
2. Ervin, V.; Kubacki, M.; Layton, W.; Moraiti, M.; Si, Z.; Trenchea, C. *Partitioned penalty methods for the transport equation in the evolutionary Stokes-Darcy-transport problem*. *Numer. Methods Partial Differential Eq.* 2018; 35: 349-374. <https://doi.org/10.1002/num.22303>.
3. Kubacki, M.; Tran, H. *Non-Iterative Partitioned Methods for Uncoupling Evolutionary Groundwater-Surface Water Flows*. *Fluids* 2017, 2(3). <https://www.mdpi.com/222960>.
4. Ervin, V.J.; Kubacki, M.; Layton, W.; Moraiti, M.; Si, Z.; Trenchea, C. *On Limiting Behavior of Contaminant Transport Models in Coupled Surface and Groundwater Flows*. *Axioms* 2015, 4, 518-529. <https://www.mdpi.com/116846>.
5. Kubacki, M. and Moraiti, M. *Analysis of a Second-Order, Unconditionally Stable, Partitioned Method for the Evolutionary Stokes-Darcy Model*. *Int. J. Numer. Anal. Mod.*, 12 (2015), pp. 704-730. <http://www.math.ualberta.ca/ijnam/Volume-12-2015/No-4-15/2015-04-06.pdf>.
6. Jiang, N.; Kubacki, M.; Layton, W.; Moraiti, M.; Tran, H. *A Crank-Nicolson Leapfrog stabilization: Unconditional stability and two applications*, *Journal of Computational and Applied Mathematics*, Volume 281, June 2015, Pages 263-276, ISSN 0377-0427. <https://www.sciencedirect.com/science/article/pii/S0377042714004336>.
7. Kubacki, M. *Higher-Order, Strongly Stable Methods for Uncoupling Groundwater-Surface Water Flow (Doctoral dissertation)*. University of Pittsburgh D-Scholarship Database, <http://d-scholarship.pitt.edu/21894/> (2014).
8. Kubacki, M. *Uncoupling evolutionary groundwater-surface water flows using the Crank-Nicolson Leapfrog method*. *Numer. Methods Partial Differential Eq.*, 29:1192-1216, 2013. <https://onlinelibrary.wiley.com/doi/abs/10.1002/num.21751>.

### **Technical Report**

Brice Coffe, Michaela J. Kubacki, Yixin Wen, Ting Zhang, Carlos Barajas, and Matthias K. Gobbert. *Using Machine Learning Techniques for Supercell Tornado Prediction with Environmental Sounding Data*. Technical Report HPCF-2020-18, UMBC High Performance Computing Facility, University of Maryland, Baltimore County, 2020. <http://hpcf-files.umbc.edu/research/papers/CT2020Team8.pdf>.

### **Peer-Reviewed Teaching Materials**

Kubacki, M. *Illustrating Theorem from Calculus [Teaching Activity]*. Part of *Teaching Computation in the Sciences Exemplary Teaching Activities* on the Teaching Computation with MATLAB SERC website (2021). [https://serc.carleton.edu/teaching\\_computation/workshop\\_2021/activities/245712.html](https://serc.carleton.edu/teaching_computation/workshop_2021/activities/245712.html).

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## Research Presentations and Activities

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**Attendee:** SIAM Annual Meeting  
Pittsburgh, PA, July 2022

Attended research talks on computational fluid dynamics and research talks/panels specific to diversity, equity, and inclusion initiatives in Applied Math Education.

<b>Attendee:</b> 47 <sup>th</sup> University of Arkansas Spring Lecture Series (online) May 2022	Lecture Series on “Numerical Linear Algebra: from Scientific Computing to Data Science Applications.” Research talks on topics related to Numerical Linear Algebra.
<b>Attendee and Participant</b> Joint Math. Meetings (online) April 2022	Attended research talks and panels on inclusion and mathematics education. Participant and small group discussion leader for “Navigating Parenthood Workshop.”
<b>Invited Presentation</b> UMBC Baltimore, MD, April 2020	(Engagement canceled due to pandemic) Invited Presentation at Applied Math Colloquium at UMBC.
<b>Course Participant</b> NSF Sponsored Cybertraining UMBC Baltimore, MD, Spring 2020	Paid Participant of NSF-sponsored program: Multidisciplinary Research and Education on Big Data + High-Performance Computing + Atmospheric Sciences (part of NSF initiative on Workforce Development for Cyberinfrastructure). 15 week course
<b>Attendee</b> SIAM Annual Meeting Pittsburgh, PA, July 2017	Attended sessions related to partitioned methods and other numerical approaches for coupled flow.
<b>Presentation</b> SIAM Annual Meeting Boston, MA, July 2016	“Partitioned Methods for Contaminant Transport Models in Coupled Groundwater-Surface Water Flows,” oral presentation. Session III Chair for Numerical PDEs.
<b>Invited Presentation</b> WONAPDE Concepcion, Chile, January 2016	“Partitioned Penalty Method for Contaminant Transport Models of Coupled Groundwater-Surface Water Flows.” Invited Presentation part of minisymposium on coupling of fluid flows
<b>Presentation</b> Joint Math. Meetings Seattle, WA, January 2016	“Partitioned Methods for the Evolutionary Stokes-Darcy-Transport Problem,” oral presentation at contributed paper session.
<b>Invited Presentation</b> INTERPORE Conference Padua, Italy, May 2015	“Stability and Convergence of partitioned methods for the evolutionary Stokes-Darcy Model.” Invited oral presentation part of minisymposium on coupled fluid-porous media flows.
<b>Poster Presentation</b> Joint Mathematics Meetings Baltimore, MD, January 2014	“Uncoupling Groundwater-Surface Water Flow Using Partitioned Methods,” selected poster presentation for AWM Workshop.
<b>Presentation</b> SIAM Annual Meeting San Diego, CA, July 2013	“Uncoupling Groundwater-Surface Water Flows Using Partitioned and Multi-rate Methods,” oral presentation at contributed paper session. SIAM student chapter representative.
<b>Presentation</b> Kent State University Kent, OH, Spring 2013	“Uncoupling Groundwater-Surface Water Flow Using Partitioned Methods,” oral presentation at New Frontiers in Numerical Analysis and Scientific Computing Conference.
<b>Presentation</b> Virginia Tech Blacksburg, VA, Spring 2012	“Uncoupling Groundwater-Surface Water Flow Using the Crank-Nicolson Leapfrog Method,” oral presentation at SIAM Student Conference

**Poster Presentation**  
Carnegie Mellon University  
Pittsburgh, PA, Fall 2011

“Uncoupling Groundwater-Surface Water Flow Using the Crank-Nicolson Leapfrog Method,” poster presentation at Conference for Incompressible Fluids, Turbulence, and Mixing.

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## Other Scholarly and Pedagogical Activities

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**Celebrating Diversity in Mathematics:  
A Gallery Walk Event**  
Coming December 2022  
Middlebury, VT

Organizing a Gallery walk event celebrating diversity in mathematical modeling and numerical analysis in collaboration with Jen Crodelle. The gallery will consist of 23 student-made biography posters celebrating contributions from underrepresented individuals.

**Middlebury College  
Teaching Anti-racist  
Writing Fellowship**  
Fall 2022

One of five faculty members to receive funds and training to work towards anti-racist writing in upper level college-writing (CW) course (applied to CW course MATH0328 Numerical Linear Algebra).

**OPEN Math Online  
Workshop Participant**  
June 2022

Inclusion and Inquiry: Fostering Student Belonging and Ownership. Workshop involved 27 contact hours spread over three weeks plus outside work.

**Teaching Computation  
Online with MATLAB**  
October 2021

3-day workshop hosted by SERC and MathWorks for educators in biology, chemistry, engineering, geoscience, math, and physics. Small group leader.

**Summer 2021 Institute on  
Project-Based Learning**  
Worcester Polytechnic  
Institute (online)

Part of representative team from Middlebury College. Participated in workshop and formulating an updated action-plan for Project-Based Learning at Middlebury College

**Camp Design Online  
Workshop Participant**  
July 2020

2-week workshop hosted by Middlebury’s Office of Digital Learning and Inquiry for online and flexible course design using various tools such as Canvas, Panopto, Flipgrid, and more.

**Presentation**  
Joint Mathematics Meetings  
Baltimore, MD, Jan 2020

“Building Community and Improving Equity through Small-Group Collaborative Learning,” MAA Contributed Paper Session on Inclusive Excellence

**Participant  
SIMIODE Workshop**  
Baltimore, MD, Jan 2020

Participated in a workshop on teaching differential equations with modeling activities by SIMIODE (Systemic Initiative for Modeling Investigations & Opportunities with Differential Equations) at the Joint Mathematics Meetings.

**Introduction to MATLAB  
Workshops (ongoing)**  
Middlebury College  
Middlebury, VT

Designed and lead 2-hour introductory workshops for students using MATLAB in mathematics courses. September 2015, February 2019, Fall 2020, Fall 2022 (in collaboration with Jennifer Crodelle).

<b>Small-Group Collaborative Learning Resource</b> Middlebury College Middlebury, VT	Program Creator and Coordinator. Recruited and trained peer leaders to run weekly 1-hour small study groups as a resource for Calculus 2 students. Pilot Program ran Fall 2018. Adapted program for online implementation in Fall 2020 and Spring 2021.
<b>Math Circus Presentation</b> Middlebury College Middlebury, VT, Fall 2018	“Making Presentations on Mathematical Topics” interactive talk on tips and tricks for creating and giving math presentations.
<b>2016 NES MAA Vermont Workshop</b> St. Michael’s College Colchester, VT	Teaching Calculus Now- Current Trends and Best Practices Workshop Participant
<b>Math Circus Presentation</b> Middlebury College Middlebury, VT, Fall 2014	“From Archimedes to Atmospheric Modeling: An Overview of Numerical Analysis” talk for undergraduate students interested in mathematics.

## Course Instructor Experience

### Middlebury College (as Assistant Professor)

- **MATH0121 Calculus 1** (Spring 2018, Fall 2021)
- **MATH0122 Calculus 2** (Fall 2014, Fall 2015, Fall 2017, Fall 2018, Fall 2020-Spring 2021)
- **MATH0200 Linear Algebra** (Fall 2022, Future Spring 2023)  
Introduced basic use of MATLAB as part of course requirement. Developing resources for this introduction to be standardized across the department.
- **MATH0223 Multivariable Calculus** (Spring 2016)
- **MATH0226 Differential Equations** (Fall 2014, Fall 2015, Spring 2019, future Spring 2023)  
Updated department course curriculum to include utilization of MATLAB and applied projects.
- **MATH0228 Introduction to Numerical Analysis** (Spring 2015, Spring 2016, Fall 2017, Fall 2021)  
Creator and designer of this new course offering.
- **MATH0328 Numerical Linear Algebra** (Spring 2017, Spring 2019, Fall 2020, Fall 2022)  
Creator and designer of this new course offering.
- **MATH0704 Senior Thesis Advising** (Spring 2015, Fall 2017)
- **MATH0728 Senior Seminar: Mathematical Methods of Fluid Dynamics** (Spring 2018, Spring 2021)  
Creator and designer of this new course offering.

### University of Pittsburgh (as Teaching Assistant and Instructor)

- Preparation for Scientific Calculus (TA)
- Business Calculus (TA)
- Calculus 1 (TA)
- Calculus 2 (TA, Instructor)
- Multivariable Calculus (TA)
- Linear Algebra (Grader)
- Introduction Theoretical Mathematics (TA)

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## Student Research

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### Summer 2021

Conducted student research on “Machine Learning (ML) and Computational Fluid Dynamics (CFD)” with Ran Brown (‘23), Hugh Easton (‘23), and Tao You (‘23). Results of these endeavors included

- **ML and CFD Bibliography Database**
- **Student Research Projects:** Students worked on adapting existing research originally conducted with Python code to recreate results using MATLAB.
  - **Project 1:** Efficient Steady-State Laminar Flow Approximation with Deep Convolutional Neural Networks (Ran Brown, Tao You).
  - **Project 2:** Drag Prediction with a Convolutional Neural Network (Hugh Easton).

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## Professional Memberships and Service

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- **Peer Review Services for the following journals:** *Journal for Computational and Applied Mathematics*, *Journal of Mathematical Analysis and Applications*, and *Numerical Algorithms*
- **Professional Memberships:** SIAM (2008 - current), AWM (2013 - current)

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## Institutional Service

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- **Middlebury College Service**
  - **Center for Teaching, Learning, and Research (CTRL) Advisory Committee** (2020-current): Responsibilities include assisting with planning faculty development events and advising other CTRL programming
    - **Contemporary Teaching Series Organizing Committee** (2021, 2022)
    - **Middlebury Teaching and Learning Knowledge Base:** Assisted in the creation of this resource
    - **Teaching and Writing Retreat Organizing Committee** (2022)
  - **Faculty Advisory Board for C.V. Starr School Abroad in Germany** (fall 2018-present)
- **Middlebury Mathematics Department Service**
  - **Mathematics Placement Process:** redesigned procedure for incoming students’ mathematics placement, including creation of graphics and new webpages.
  - **Search Committee Member** for Assistant Professor in Mathematics/Statistics (2014, 2016, 2017 (two positions), 2018, 2019 (two positions), 2020, 2022)

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## Technical Skills

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### **Pertaining to Research:**

- Programming: MATLAB, Python, FreeFEM++, C
- Experience using High Performance Computing Clusters for research
- Experience working with Unix/Linux on a MacOS

**Teaching and Collaboration Tools:** Canvas, Desmos, Google Drive (docs, sheets, slides, forms, jamboards), Microsoft Teams, Zoom, Panopto Video, Campuswire