Curriculum Vitae

Michaela J. Kubacki
Assistant Professor of Mathematics
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Pronouns: she/her/hers

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. studies)

- **M.A. Mathematics**, University of Pittsburgh (August 2008-August 2010)

- **B.A. Mathematics and Music**, Washington and Jefferson College (August 2003-May 2007)
  GPA 3.98/4.0 *Class Valedictorian*, *Phi Beta Kappa*

Research and Professional Experience

<u>**Research Area:**</u> Numerical analysis (broad area) and **computational fluid dynamics** (focused area)

- Creating, analyzing, and implementing numerical methods for fully evolutionary, **coupled fluid-porous media flow with pollutant transport**, resulting in PhD dissertation and **six publications** to date.

  Methodologies: finite difference methods, finite element method, and time filters for numerical approximations. 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. Current interests lie in utilizing machine learning algorithms for parameter estimation.

  Methodologies: Machine learning algorithms (focused on Random Forest, Convolutional Neural Networks), Parallel Programming (MPI). Work completed using Python (TensorFlow, Keras).

<u>**Professional Experience**</u>

- **Assistant Professor of Mathematics**, Middlebury College (July 2014-present) (tenure-track)
  A medical event resulted in an institution-approved medical leave during academic year 2016-2017.

- **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)

Publications

1. Coffer, 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).

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). `http://www.mdpi.com/journal/fluids/special_issues/turbulence`.

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.

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.

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.

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.

Technical Reports

- Coffer, B.; **Kubacki, M.**; Wen, Y., Zhang, T.; Barajas, C.; and Gobbert, M. Using machine learning techniques for supercell tornado prediction with environmental sounding data, Tech. Rep. HPCF–2020–18, UMBC High Performance Computing Facility, University of Maryland, Baltimore County, 2020. `http://hpcf.umbc.edu`.

Selected Research Activities, Presentations, and Workshops

Invited Presentation UMBC Baltimore, MD, April 2020	(engagement canceled due to pandemic) Invited presentation at Applied Math Colloquium at UMBC
Course Participant 15 week course NSF Sponsored CyberTraining UMBC Baltimore, MD, Spring 2020	Paid participant in competitive, NSF-sponsored, CyberTraining program: *Multidisciplinary Research and Education on Big Data + High-Performance Computing + Atmospheric Sciences* (part of NSF Intiative on Workforce Development for Cyberinfrastructure)

Attendee SIAM Annual Meeting Pittsburgh, PA July 2017	Attended sessions related to partitioned methods and other approaches for coupled flow.
Presentation 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.
Invited Presentation WONAPDE Concepcion, Chile, January 2016	"Partitioned Penalty Method for Contaminant Transport Models in Coupled Groundwater-Surface Water Flows." Invited presentation part of minisymposium on coupling of fluid flows with porous media.
Presentation Joint Math. Meetings Seattle, WA, January 2016	"Partitioned Methods for the Evolutionary Stokes-Darcy-Transport Problem,"oral presentation.
Invited Presentation 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 at 7th International INTEPORE meeting.
Poster Presentation AWM Workshop Baltimore, MD, January 2014	"Uncoupling Groundwater-Surface Water Flow Using Partitioned Methods," selected poster presentation for Association for Women in Mathematics Workshop at Joint Mathematics Meetings.
Presentation SIAM Annual Meeting San Diego, CA, July 2013	"Uncoupling Groundwater-Surface Water Flows Using Partitioned and Multi-rate Methods," oral presentation and SIAM student chapter representative for University of Pittsburgh.
Presentation 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.
Presentation Virginia Tech Blacksburg, VA, Spring 2012	"Uncoupling Groundwater-Surface Water Flow Using the Crank-Nicolson Leapfrog Method," oral presentation at the SIAM Student Conference.
Poster Presentation Carnegie Mellon University Pittsburgh, PA, Fall 2011	"Uncoupling Groundwater-Surface Water Flow Using the Crank-Nicolson Leapfrog Method," Conference for Incompressible Fluids, Turbulence and Mixing.

Pedagogical Activities, Presentations, and Workshops

- **Presentation January 2020 at Joint Mathematics Meetings:** MAA Contributed Paper Session on Inclusive Excellence
  "Building Community and Improving Equity through Small-Group Collaborative Learning"

- **SIMIODE Workshop 2019 at Joint Math. Meetings 2019**: Participated in a workshop on teaching differential equations with modeling activities.

- **Development of Applied Mathematics Curriculum at Middlebury College**:

- **New Course: MATH0228 Introduction to Numerical Analysis**
  Calculus-based introduction to numerical methods/analysis course using MATLAB software.
- **New Course: MATH0328 Numerical Linear Algebra**
  Emphasis is on iterative methods such as Jacobi, Gauss-Seidel, and Conjugate Gradient Method. Project-oriented, college-writing course.
- **New Course: MATH0728 Mathematical Methods in Fluid Dynamics**
  (senior seminar) 6-week overview of governing equations and essential components of fluid dynamics, with introduction into finite-difference and finite element methods. Project-oriented.
- **MATLAB Teaching Materials:** First to utilize MATLAB in undergraduate courses in the department. Developed numerous materials for using MATLAB in four applied mathematics courses.

- **Introduction to MATLAB Workshops:** Designed and lead a 2 hour introductory workshop for students using MATLAB in mathematics courses. September 2015, February 2019

- **Small-Group Collaborative Learning Session Pilot Program Coordinator**
  (Fall 2018): Recruited and trained 6 peer-leaders to run weekly 1 hour study groups for small groups of 3-4 students in Calculus courses. The pilot program had 32 student participants.

- **Presentations for Middlebury Mathematics Department Math Circus** (for undergraduates interest in mathematics): "From Archimedes to Atmospheric Modeling: An Overview of Numerical Analysis "(Fall 2014), "Making Presentations on Mathematical Topics "(Fall 2018)

- **Courses Taught at Middlebury College**: $\star$ indicates a course utilizing MATLAB software

  - MATH0121 Calculus I (Spring 2018)
  - MATH0122 Calculus II (Fall 2014, Fall 2015, Fall 2017, Fall 2018)
  - MATH0223 Multivariable Calculus (Spring 2016)
  - MATH0225* Differential Equations (Fall 2014, Fall 2015, Spring 2019)
  - MATH0228* Introduction to Numerical Analysis (Spring 2015, Spring 2016, Fall 2017)
  - MATH0328* Numerical Linear Algebra (Spring 2017, Spring 2019)
  - MATH0704 Senior Thesis Advising (Spring 2015, Fall 2017)
  - MATH0728* Senior Seminar: Mathematical Methods of Fluid Dynamics (Spring 2018)
- **STEM Pedagogy Group** (member Fall 2018-present): This group consists of STEM faculty at Middlebury interested in best practices in STEM pedagogy. We are especially interested in developing and sharing practices to promote diversity and inclusion within STEM courses.

Other Professional and Scholarly Activities

- **Peer Reviewer for the following journals:** *Journal for Computational and Applied Mathematics*, and *Journal of Mathematcal Analysis and Applications*

- **Professional Memberships:** SIAM, AWM

- **Service to Middlebury College:** Health Professions Committee (2015-2016, 2017-2018), Faculty Advisory Board for C.V. Starr School Abroad in Germany (fall 2018-present), Search Committee Member for the Department of Mathematics for 4 positions.

- **Officer of University of Pittsburgh SIAM Student Chapter:** Secretary (2010-2011), Vice-President (2011-2012), President (2012-2013)

Technical Skills

- Programming Languages and Software: MATLAB, FreeFEM++, Python, C

- Other: LaTeX, Desmos