BROOKE E. MASON

PhD Candidate

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OBJECTIVE

I am motivated to move society towards a more just and sustainable future. Through research, I seek to improve water management by enabling the next generation of autonomous water systems by combining domain knowledge from computing, data science, machine learning, and control theory. Through service, I strive to improve diversity, equity, and inclusion at my institution and in my community.

AT A GLANCE

Systems Researcher
I am investigating the fundamental underpinnings for autonomous water systems by integrating embedded electronics, systems analysis, hydrodynamics, environmental engineering, signal processing, and control.

DEI Advocate
I am implementing diversity, equity, and inclusion (DEI) practices to create safe and supportive spaces within my lab group, department, and community.

Mentor & Educator
I am helping students achieve their goals and become global citizens through relationships built on mutual respect, listening, advising, and encouragement.

Open-Source Developer
I am creating and maintaining open-source scientific libraries, technologies, and datasets for autonomous water systems. I am also a founding member of open-storm.org, an open-source smart water consortium.

EDUCATION

Ph.D. in Civil Engineering

University of Michigan (UM)

Sept 2018 – Present Ann Arbor, MI

- Thesis: *Technology for autonomous stormwater systems*
- Focus: *Intelligent Systems*
- Courses: Dynamic Infrastructure Systems; Infrastructure Sensing; Infrastructure Systems Optimization; Open Channel Flow; Streams, Lakes, & Estuary Analysis

M.S. in Electrical and Computer Engineering

University of Michigan

Sept 2018 – Dec 2022 Ann Arbor, MI

- Focus: *Signal Processing & Machine Learning*
- Courses: Matrix Methods; Probability & Random Processes; Linear Systems Theory; Machine Learning

M.S. in Civil Engineering

University of Toledo (UT)

Jan 2017 – Aug 2018 Toledo, OH

- Thesis: *Real-time control of a bioretention cell for enhanced phosphorus capture*
- Focus: *Environmental Engineering*
- Courses: Stormwater Modeling & Monitoring; Geographic Information Systems; Advanced Engineering Systems Modeling; Drones for Environmental Sciences

HONORS

Fellowships & Scholarships

- Rackham Merit Fellowship (2018-19, 2022-2023)
- Robert Beyster Computational Innovation Graduate Fellowship (2021-22)
- DOW Sustainability Fellowship (2020)
- National Science Foundation (NSF) Graduate Research Fellowship Program Honorable Mention (2018)
- William & Jean Clark Rhodes Scholarship (2017-18)
- Engineering Alumni Affiliate Scholarship (2017-18)
- Dean Wemmer Scholarship of Excellence (2017–18)
- Special Dean Assistantship (2017)
- Gretchen Koo Memorial Scholarship (2016-17)
- Tillotson Scholarship (2016–17)
- Building Ohio's Sustainable Energy Future Scholarship (2015-16)
- Second Degree Scholarship (2015-16)
- Nontraditional Student Scholarship (2015-16)

Awards

- People's Choice Presentation Award, Clean Water Science Network (2021)
- Edward A. Bouchet Graduate Honor Society, UM (2020)
- 2nd Place Poster, Borchardt Conference (2020)
- Research Exchange Travel Award, National Science Foundation (2020)
- Outstanding Teaching Assistant, UT (2017)
- Chi Epsilon Civil Engineering Honor Society, UT (2016)
- Dean's List & President's List, UT (2015-16)
- Ciba Travel Award in Green Chemistry, American Chemical Society (2015)
- Falcon Top 10% Award, Who's Who Among American Universities & Colleges (2010–11)
- Resident Advisor of the Year, BGSU (2009–10)

Certificates

- Professional Development DEI, UM (2020-21)
- Culture of Diversity, UT (2015)

COMPETENCIES

Programming Languages

Python
C
Matlab

Hydrodynamic Modeling

EPA SWMM
PySWMM
EPANET

Embedded Platforms

Cypress PSoC
Arduino

DevOps

Git
UNIX Shell

B.S. in Environmental Engineering

University of Toledo

May 2015 – Dec 2016 Toledo, OH

B.S. in Envisonmental Policy & Analysis

Bowling Green State University (BGSU)

Aug 2008 – May 2012 Bowling Green, OH

PUBLICATIONS

Journal Articles

- Mason, B. E., Mullapudi, A., Gruden, C., & Kerkez, B. (2022). Real-time control improves phosphorus removal in bioretention cells. *Urban Water Journal*. doi:10.1080/1573062X.2022.2108464
- Mason, B. E., Mullapudi, A., & Kerkez, B. (2021). Stormreactor: An open-source python package for the integrated modeling of urban water quality and water balance. *Environmental Modelling & Software*. doi:10.1016/j.envsoft.2021.105175
- Mason, B. E., Rufí-Salís, M., Parada, F., Gabarrell, X., & Gruden, C. (2019). Intelligent urban irrigation systems: Saving water and maintaining crop yields. *Agricultural Water Management*, *226*. doi:10.1016/j.agwat.2019.105812
- Celik, I., Mason, B. E., Phillips, A. B., Heben, M. J., & Apul, D. (2017). Environmental impacts from photovoltaic solar cells made with single walled carbon nanotubes. *Environmental Science & Technology*, *51*, 4722–4732. doi:10.1021/acs.est.6b06272

Working Manuscripts

- Mason, B. E., Schmidt, J., & Kerkez, B. (2022a). *Location over design: Measuring city-scale green infrastructure performance using internet-connected sensors in detroit*. Landscape and Urban Planning (under review).
- Tobias, M., Mason, B. E., Li, J., Nassauer, J., & Kerkez, B. (2022b). *Optimizing the human experience in real-time controlled stormwater infrastructure*. Blue-Green Systems (in preparation).

Books

- Mason, B. E. (2017). A comprehensive overview of university and college recycling programs. In A. Kumar & D.-S. Kim (Eds.), *Sustainability practice and education on university campuses and beyond* (pp. 29–49). doi:10.2174/9781681084718117010005

SELECTED TALKS

- Mullapudi, A., **Mason, B. E.**, Wu, J. X., Karos, C., Kerkez, Buahin, C., McDonnell, B. (2022). Enhancing the pollutant modeling capabilities of EPA-SWMM using *PySWMM* and *StormReactor*. *International Conference on Water Management Modeling*, Virtual.
- **Mason, B. E.** and Schmidt, J. and Kerkez, B. (2021). Sensor networks for real-time green infrastructure monitoring. *International Conference on Urban Drainage*, Virtual.
- Tobias, M. and **Mason, B. E.** and Kerkez, B. (2021). Incorporating resident perceptions into the control of autonomous stormwater systems. *International Conference on Urban Drainage 2021*, Virtual.
- **Mason, B. E.** and Kerkez, B. (2021). Emergent watershed properties resulting from real-time control. *SimHydro 2021*, Virtual.
- **Mason, B. E.**, Mullapudi, A., and Kerkez, B. (2021). Extending SWMM's water quality toolbox. *Environmental and Water Resources Institute Congress*, Virtual.
- **Mason, B. E.**, Mullapudi, A., and Kerkez, B. (2020). Improving pollutant removal with real-time control of stormwater networks. *Borchardt Conference: 25th Triennial Symposium on Advancements in Water & Wastewater*, Virtual.

RESEARCH OVERVIEW

Autonomous Stormwater Systems

Introduction

- To manage stormwater and its pollutants without exponential costs, we can leverage recent technological advances, such as sensors and real-time data algorithms, to enable the next generation of autonomous water systems.

Intellectual Merit

- I am investigating the fundamental knowledge gaps of autonomous water systems by integrating water resources, environmental engineering, control theory, systems analysis, and signal processing.
- Autonomous stormwater systems will use sensors and actuators to adapt watersheds to individual storms, reducing flooding and maximizing treatment at the system-scale.

Research Objectives

- No computational toolchains existed to evaluate the potential of autonomous water systems due to the overlapping need to model flow, water quality, and controls. To address this need, I built an open-source Python package, *StormReactor*, which couples the popular EPA's Stormwater Management Model with a new generation water quality module. *(Completed)*
- Partnering withe the Sierra Club, I developed an *Internet of Things* stormwater infrastructure sensing network using open-source solutions to monitor flooding in Detroit, Michigan. A network of 20+ sensor nodes has created an unprecedented dataset of stormwater infrastructure performance at a high spatial and temporal scale. *(Completed)*
- Real-time flood inundation modeling is critical for informing citizens and emergency services of hazardous flash flood conditions. To that end, I am combining my lab's open-source sensor data, USGS stream gauge data, and publicly accessible GIS datasets to develop a real-time flood inundation model for southeast Michigan. *(Underway)*

Broader Impacts

- Developing an interdisciplinary, integrated systems framework for autonomous water systems.
- Improving the ability of water system managers to make informed decisions by providing real-time monitoring and control capabilities.

SOFTWARE

StormReactor

Lead Developer: Python package for modeling stormwater pollutants and water quality based real-time control.

★ 13 5 10

Available at:
`github.com/kLabUM/StormReactor`

notoriOS

Co-Lead Developer: A non-preemptive operating system for sensor nodes that includes the ability to take measurements, control attached devices, and communicate with a web server.

★ 2 1 3

Available at:
`github.com/kLabUM/notoriOS`

- **Mason, B. E.**, Building Smarter Stormwater Systems. (2020). *ASCE EWRI Women Water Nexus Short Conference Session*, Virtual.
- **Mason, B. E.**, Water + Tech = 'Smart' Water. (2020). University of Washington, Seattle, Washington.
- McCaffery, R., Montgomery, J., Bartos, M., **Mason, B. E.**, Love, N., and Kerkez, B. (2019). A first-year college course on smart water systems. *AEESP Education & Research Conference*, Tempe, AZ.
- **Mason, B. E.**, Mullapudi, A., Kerkez, B. and Gruden, C. (2018). Pollutant treatment with real-time control of rain gardens. *Ohio Stormwater Conference*, Sandusky, OH.
- **Mason, B. E.**, Mullapudi, A., Kerkez, B. and Gruden, C. (2017). Real-time control of bioretention cells for enhanced phosphorus removal. *Research & Education Symposium, Michigan State University*, East Lansing, MI.
- **Mason, B. E.**, Celik, I., Phillips, A., Heben, M., and Apul, D. (2017). Life cycle environmental impacts of single-walled carbon nanotube PV cells. *20th Annual Green Chemistry & Engineering Conference*, Portland, OR.
- **Mason, B. E.**, Ilke, C., Phillips, A., Heben M., and Apul, D. (2015). Life cycle analysis of carbon nanotube photovoltaic cells. *GreenUp: Michigan Green Chemistry and Engineering Conference*, University of Michigan, Ann Arbor, MI.

SERVICE

Contributing Member

Diversity, Equity, & Inclusion Committee , Department of Civil & Environmental Engineering, University of Michigan

July 2020 – Present Ann Arbor, MI

- Helping with DEI departmental communication and incident reporting.
- On the skill building subcommittee, helped create a departmental DEI certificate program for students, faculty, and staff.
- On the mentoring subcommittee, organized a peer mentor training, gathered data on existing mentoring programs, and worked on a mentorship assessment.

Vice President

CEE DEI collAboRative (CEDAR), University of Michigan

July 2020 – Present Ann Arbor, MI

- We seek to hold ourselves and the department accountable to the values of DEI.
- We are committed to creating a more welcoming culture within the department and contributing to positive change both within and outside of the University of Michigan.

Graduate Student Representative

Faculty Search Committee, Department of Civil & Environmental Engineering, University of Michigan

September 2021 – April 2022 Ann Arbor, MI

- Reviewing, selecting, and interviewing candidates for a tenure-track faculty position in the Department of Civil & Environmental Engineering.

Control Board Member

Women Water Nexus Committee, Environmental & Water Resources Institute, American Society of Civil Engineers

July 2020 – July 2022 Virtual

- Developing a network of women scientists and engineers to promote water research with a focus on the education of future women scientists.
- Helped organize, plan, and moderate sessions for a virtual research lecture series.

Department Representative

Graduate Student Advisory Council, Department of Civil & Environmental Engineering, University of Michigan

June 2019 – Oct 2021 Ann Arbor, MI

- Advised the department in matters of student climate and serving as an information resource to current students.
- Organized social and professional events for graduate students.
- Served as the departmental liaison to the College of Engineering's Graduate Student Advisory Council.

PySWMM
Contributor: Python wrapper for the Stormwater Management Model (SWMM5).
★ 181 ⑂ 102 👁 30
Available at:
`github.com/OpenWaterAnalytics/pyswmm`

Stormwater-Management-Model
Contributor: SWMM is a dynamic hydrology-hydraulic water quality simulation model.
★ 75 ⑂ 135 👁 33
Available at:
`github.com/OpenWaterAnalytics/Stormwater-Management-Model`

swmm-python
Contributor: SWIG based wrappers for the swmm-solver and swmm-output libraries.
★ 25 ⑂ 19 👁 13
Available at:
`github.com/OpenWaterAnalytics/swmm-python`

perfect-cell
Contributor: General purpose firmware for cellular-enabled PSoC motes.
★ 12 ⑂ 8 👁 6
Available at:
`github.com/open-storm/perfect-cell`

TEACHING & MENTORSHIP

Research Mentor

University of Michigan

Sept 2019 – Present Ann Arbor, MI

- Mentored five students through the Undergraduate Research Opportunities Program.
- Research projects focused on developing sensor firmware, web applications, and new sensor nodes.

Graduate Student Mentor

Department of Civil & Environmental Engineering, University of Michigan

Sept 2020 – Present Ann Arbor, MI

- Mentor several new graduate students through the CEE Peer Mentoring Program.

Mentor

Clean Water Science Network Mentorship Program

Sept 2020 – July 2021 Virtual

- Mentor an undergraduate student in Latin America to deepen their knowledge on water and different environmental issues and provide information on pursuing graduate studies in water-related degrees in the US.

Sensor Lab Instructor

Department of Civil & Environmental Engineering, University of Michigan

Aug 2019, Sept 2019 Toledo, OH

- Instructed a CEE 575 lab on how to get a computer and a Photon (Particle's Internet of Things hardware development kit) to communicate.
- Aided in instruction for the "Open Source Urban Hydrology Sensor Bootcamp" in partnership with the Consortium of Universities for the Advancement of Hydrologic Science, Inc.

Student Co-Chair

AEESP Research & Education Conference

May 2017 – June 2017 Ann Arbor, MI

- Selected to work with the student chairs from surrounding colleges and universities to help organize and promote the conference.

EMPLOYMENT

Engineering Intern

Brendle Group

June 2016 – Aug 2017 Denver, CO

- QA/QC'd greenhouse gas data and wrote the annual report for the National Ski Area Association's (NSAA) 2016 Climate Challenge.
- Organized and hosted three educational seminars for the ski resorts on a variety of topics.
- Drafted the annual contract, project budget, project timeline, marketing timeline, and more for the 2017 Climate Challenge.

Sustainability Specialist

University of Toledo

Aug 2012 – May 2015 Toledo, OH

- Coordinated the utility rebate program and other sustainability and energy reduction projects. Secured over $435,000 in rebates, $25,000 in recycling revenue, and $96,000 in grants.
- Completed the first comprehensive greenhouse gas inventory and a plan to reduce emissions by 7% with savings of $1 million.
- Managed the processing of over one million pounds of recycling with one full-time and nine student employee direct reports.

Teaching Assistant

Department of Civil & Environmental Engineering, University of Toledo

Jan 2017 – Dec 2017 Toledo, OH

- Courses: statics, fluid mechanics, professional development, and freshman orientation.
- Tasks included teaching, grading, Blackboard management, quiz creation, exam revisions, holding office hours and exam review sessions, and developing lesson plans.

PROFESSIONAL MEMBERSHIPS

- International Water Association (2021)
- SWAN's Rising Smart Water Professionals (2020)
- Women Who Code (2020)
- American Society of Civil Engineering (2016)

REFERENCES

Available upon request.