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 work 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, and control theory.

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 Coder
I am creating and maintaining open-source scientific libraries 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: *Improving watershed water quality with autonomous stormwater systems*
- Focus: *Intelligent Systems*
- Courses: dynamic infrastructure systems; infrastructure sensing; open channel flow; streams, lakes, & estuary analysis

M.S. in Electrical and Computer Engineering
University of Michigan
Sept 2018 – Present Ann Arbor, MI

- Focus: *Signal Processing & Machine Learning*
- Courses: matrix methods; probability & random processes; linear systems theory

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*

B.S. in Environmental Engineering
University of Toledo
May 2015 – Dec 2016 Toledo, OH

B.S. in Environmental Policy & Analysis
Bowling Green State University (BGSU)
Aug 2008 – May 2012 Bowling Green, OH

HONORS

Fellowships & Scholarships

- Robert Beyster Computational Innovation Graduate Fellowship (2021-22)
- DOW Sustainability Fellowship (2020)
- Rackham Merit Fellowship (2018-19)
- 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
Julia

Hydrodynamic Modeling
EPA SWMM
PySWMM
EPANET

Embedded Platforms
Cypress PSoC
Arduino

DevOps
Git
UNIX Shell

PUBLICATIONS

Journal Articles

- Mason, B. E., Mullapudi, A., Gruden, C., & Kerkez, B. (2021b). Real-time control improves phosphorus removal in bioretention cells. *Urban Water Journal (submitted)*.
- Mason, B. E., Mullapudi, A., & Kerkez, B. (2021a). Stormreactor: An open-source python package for the integrated modeling of water quality and water balance. *Environmental Modelling & Software (under revision)*.
- 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 Manuscript

- Mason, B. E., Schmidt, J., & Kerkez, B. (2021c). *Insights from a real-time green infrastructure monitoring network*. Water Research & Technology (in preparation).
- Mason, B. E., & Kerkez, B. (2021d). *Emergent watershed properties resulting from real-time control*. Advances in Water Resources (in preparation).
- Tobias, M., Mason, B. E., Li, J., Nassauer, J., & Kerkez, B. (2021e). *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

- **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.
- **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 D. Apul, D. (2017). Life cycle environmental impacts of single-walled carbon nanotube PV cells. *Choose Ohio First Scholar Showcase*, Columbus, OH.
- **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.

RESEARCH OVERVIEW

Autonomous Water Systems

Introduction

- To manage stormwater and its pollutants without exponential costs, and to hedge impacts from climate change, 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

- Coordinated, autonomous stormwater systems will use sensors and actuators to adapt watersheds to individual storms, reducing flooding and maximizing treatment through real-time monitoring and control at the system-scale.
- Investigating the fundamental knowledge gaps of autonomous water systems by integrating water resources, environmental engineering, control theory, systems analysis, and machine learning.

Research Objectives

- There is a demonstrated need to accurately model water quality processes and real-time control at the system scale. To that end, I built an open-source Python package which integrates the EPA's Stormwater Management Model's water balance engine with a new water quality module. *(Completed)*
- To develop a watershed-scale control strategy, we must first understand the treatment performance of the watershed's building blocks, series and parallel infrastructure assets. Through the investigation of these building blocks, I expect to uncover fundamental insights into how flows should be routed through watersheds to maximize pollutant treatment. *(Underway)*
- Based on the data derived from the previous two objectives, I will investigate a systems framework to control water quality in real-time at the watershed scale. *(Future Work)*

Broader Impacts

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

SOFTWARE

StormReactor
Python package for modeling stormwater pollutants and water quality based real-time control.
★ 6 ⑂ 2 👁 10
Available at:
`github.com/kLabUM/StormReactor`

notoriOS
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`

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

SERVICE

Graduate Student Advisory Council Member

Department of Civil & Environmental Engineering, University of Michigan

June 2019 – Present | Ann Arbor, MI

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

Control Board Member

Women Water Nexus Committee, Environmental & Water Resources Institute

July 2020 – Present | 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.

Interview Committee Member

University of Michigan

Jan 2021 | Ann Arbor, MI

- Interviewed candidates for the new diversity, equity, and inclusion coordinator position in the Department of Civil & Environmental Engineering.

Diversity, Equity, & Inclusion Committee Student Member

University of Michigan

July 2020 – Present | Ann Arbor, MI

- On the skill building subcommittee, I am creating a departmental DEI certificate program and an assessment of DEI comfort levels.
- On the mentoring subcommittee, I organized a peer mentor training, gathered data on existing mentoring programs, and worked on a mentorship assessment.

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 reportt 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.

Sustaianbility 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

Teaching Assistant

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.

Mentor

Clean Water Science Network Mentorship Program

Sept 2020 – Present | 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.

Mentor

University of Michigan

Sept 2019 – Present | Ann Arbor, MI

- Mentor several undergraduate students through the Meet Your Mentor: Chat with a Grad Mentoring Program.
- Mentor several new graduate students through the Peer Mentoring Program.

Research Mentor

University of Michigan

Sept 2019 – May 2020 | Ann Arbor, MI

- Mentored three students through the Undergraduate Research Opportunities Program.
- Research projects focused on developing sensor firmware, web applications, and autonomous water quality sensor nodes.

PROFESSIONAL MEMBERSHIPS

- International Water Association (2021)
- SWAN's Rising Smart Water Professionals (2020)
- American Society of Engineering Education (2020)
- Women Who Code (2020)
- Association of Environmental Engineering and Science Professors (2017)
- American Society of Civil Engineering (2016)

REFERENCES

Available upon request.