BROOKE E. MASON

PhD Candidate

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in brookemason01 github.com/bemason

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, environmental engineering, 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: *Autonomous control of stormwater quality*
- 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 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. (2021c). *Insights from a real-time green infrastructure monitoring network*. Sensors (in preparation).
- Mason, B. E., & Kerkez, B. (2021d). *A control model for dissolved oxygen in urban watersheds*. Environmental Science & Technology (in preparation).
- Mason, B. E., & Kerkez, B. (2021e). *Linear feedback control of dissolved oxygen in an urban watershed*. Journal of Water Resources Planning and Management (in preparation).
- Tobias, M., Mason, B. E., Li, J., Nassauer, J., & Kerkez, B. (2021f). *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 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.
- I am investigating the fundamental knowledge gaps of autonomous water systems by integrating water resources, environmental engineering, control theory, systems analysis, and signal processing.

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 with the Detroit Sierra Club, I developed an "Internet of Things" stormwater infrastructure sensing network using open-source solutions to monitor flooding in Detroit. A network of 20+ sensor nodes has created the largest dataset of stormwater infrastructure performance to date, shedding a light on stormwater dynamics at an unprecedented spatial and temporal scale. *(Underway)*
- Although autonomous control can mitigate flooding and particulate pollutants, it has not yet been evaluated for other water quality parameters. Unfortunately, the application of control theory for water quality is not yet feasible due to the nonlinearities inherent in most stormwater models. To address this limitation, I am formulating a water quality control model for the system-level control of stormwater networks. *(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
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`

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 Contributing 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.

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.

perfect-cell

General purpose firmware for cellular- enabled PSoC motes.

★ 12 8 6

Available at:
`github.com/open-storm/perfect-cell`

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.