Sara C. Troutman, Ph.D.

Hydraulic Control and Optimization Engineer
Xylem, Inc.

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EDUCATION

University of Michigan, Ann Arbor, MI
Ph.D. Environmental Engineering — August 2020
Dissertation: Coupled, data-driven, and real-time modeling and control of sewer systems and water resource recovery facilities
Advisors: Branko Kerkez & Nancy G. Love
M.S.E. Electrical and Computer Engineering — December 2019
Signal & Image Processing and Machine Learning
M.S.E. Civil Engineering — April 2017
Intelligent Systems

North Carolina State University, Raleigh, NC
B.S. Environmental Engineering — May 2015
B.S. Mathematics — May 2015
Minor: Spanish
Valedictorian, *summa cum laude*

PROFESSIONAL AND RESEARCH EXPERIENCE

Hydraulic Control and Optimization Engineer
Xylem, Inc., South Bend, IN — September 2020–Present

- Facilitate integration of digital solutions across water sectors, including coupled analysis, problem solving, and decision making across stormwater and wastewater systems
- Communicate and collaborate with teams of water resource engineers and decision makers to define problems, strategize solution approaches, and bring solutions to implementation

Graduate Research Assistant
University of Michigan, Ann Arbor, MI

Data-driven, real-time modeling and control of urban water systems — August 2015–August 2020

- Developing an automated modeling toolchain to predict wet-weather impacts on combined sewer systems and wastewater treatment plant operations and performance
- Establishing coordinated control methodologies to operate distributed sewer assets for system-wide objectives
- Elucidating how dynamic and coupled control sewer and wastewater treatment systems impact operational decisions and regional water quality outcomes

Simulation sandbox and Python package (`pystorms`) for smart stormwater — March 2019–Present

- Creating a library of anonymized stormwater networks and corresponding delineated assessment scenarios
- Constructing a streamlined programming interface for users of the package
- Hosting a web portal with forum and tutorials for broad adoption in stormwater and control communities

Energy-food-water systems — August 2015–April 2017

- Worked within REFRESCH, a University-wide interdisciplinary team, to design an off-grid recirculating aquaculture system, focusing on water, energy, and food budgets

Undergraduate Researcher
North Carolina State University, Raleigh, NC

Experimental granular activated carbon studies May 2014–May 2015

- Designed isotherm experiments for carcinogenic volatile organic compound (cVOC) removal using granular activated carbon (GAC)
- Analyzed relationships between cVOC concentrations, GAC adsorption capacity, temperature, and GAC type

Distributed water treatment train modeling and optimization January 2013–May 2015

- Examined influence of design parameters on effectiveness and costs of water treatment methods, including granular activated carbon, packed tower aeration, and advanced oxidation processes
- Constructed mathematical functions for modeling water conveyance and treatment sequences
- Analyzed monthly pumping data from groundwater wells to determine seasonal demand patterns

Environmental, Health, and Safety Co-op *Three semesters
Eaton Corporation, Middlesex, NC January 2012–August 2013*

- Collaborated with engineers and operators for the installation and troubleshooting of water recirculation systems
- Led Green Team monthly meetings to discuss and further environmental projects in industrial plant
- Calculated water and electricity usage and waste generation in industrial plant

SELECTED ACTIVITIES IN PROGRAMMING

- Proficient programmer in Python, MATLAB, Julia, LaTeX.
- Contributor to `pystorms`, a Python package and stormwater control simulation sandbox that builds on the widely used U.S. EPA Storm Water Management Model (SWMM) simulation engine and PySWMM, a Python wrapper of SWMM. github.com/kLabUM/pystorms
- Contributor to `rrcf`, a Python-based open-source implementation of the robust random cut forest algorithm for anomaly detection on streaming data. github.com/kLabUM/rrcf

PEER-REVIEWED JOURNAL PUBLICATIONS

[5] **Troutman, S. C.**, N. G. Love, B. Kerkez. 2020. Impacts of collection system control on WRRF treatment. In preparation. github.com/stroutm/sewerWRRF.

[4] Rimer, S. P., A. Mullapudi, **S. C. Troutman**, B. Kerkez *et al*. 2020. pystorms: A simulation sandbox for the development and evaluation of stormwater control algorithms. In preparation. pystorms.org; github.com/kLabUM/pystorms.

[3] **Troutman, S. C.**, N. G. Love, B. Kerkez. 2020. Balancing water quality and flows in combined sewer systems using real-time control. *Environmental Science: Water Research & Technology*. DOI: 10.1039/c9ew00882a. github.com/stroutm/LBCsewer.

[2] Bartos, M. D., A. Mullapudi, **S. C. Troutman**. 2019. rrcf: Implementation of the Robust Random Cut Forest algorithm for anomaly detection on streams. *Journal of Open Source Software*, **4**(35): 1336. DOI: 10.21105/joss.01336. github.com/kLabUM/rrcf.

[1] **Troutman, S. C.**, N. Schambach, N. G. Love, B. Kerkez. 2017. An automated toolchain for the data-driven and dynamical modeling of combined sewer systems. *Water Research*, **126**: 88–100. DOI: 10.1016/j.watres.2017.08.065. github.com/kLabUM/DRIPS.

TECHNICAL NEWS PIECES

[1] Ewing, G., A. Mullapudi, **S. C. Troutman**, B. Kerkez, W. Barrott. 2019. Open-Storm Detroit Dynamics: Real-time stormwater controls reduce combined sewer overflows and defer millions in capital investments. *Water Environment & Technology*, **31**(7): 28–35.

CONFERENCE PRESENTATIONS **presenter*

[15] **Troutman, S. C.***, N. G. Love, B. Kerkez. Real-Time Control of Sewer Systems to Balance Flow and Water Quantity Objectives. Borchardt Conference: 25th Triennial Symposium on Advancements in Water & Wastewater. Ann Arbor, MI, USA. Feb 25–26 2020. Oral presentation.

[14] **Troutman, S. C.**, S. P. Rimer*, A. Mullapudi, B. Kerkez. A Benchmarking Library for Making Smart Stormwater Research Accessible. American Geophysical Union Fall Meeting, AGU. San Francisco, CA, USA. Dec 9–13 2019. Oral presentation.

[13] **Troutman, S. C.***, A. Mullapudi, S. P. Rimer, B. Kerkez. A Benchmarking Framework for Evaluating the Performance of Control Algorithms in Smart Stormwater Networks. 17th International Computing & Control for the Water Industry Conference, CCWI. University of Exeter, Exeter, United Kingdom. Sep 1–4 2019. Oral presentation.

[12] Mullapudi, A.*, S. P. Rimer, **S. C. Troutman**, B. Kerkez. A Benchmarking Framework for Control of Smart Stormwater Networks. 10th IWA Symposium on Modelling and Integrated Assessment, Watermatex. Copenhagen, Denmark. Sep 1–4 2019. Oral presentation.

[11] Rimer, S. P.*, A. Mullapudi, **S. C. Troutman**, B. Kerkez. A Benchmarking Framework for Smart Stormwater Systems. World Environmental & Water Resources Congress, EWRI. Pittsburgh, PA, USA. May 19–23 2019. Oral presentation.

[10] **Troutman, S. C.***, A. Mullapudi, B. Kerkez. Open-Storm Detroit Dynamics. Water@Michigan: Urban Water. University of Michigan, Ann Arbor, MI, USA. May 6 2019. Oral presentation.

[9] Rimer, S. P.*, A. Mullapudi, **S. C. Troutman**, B. Kerkez. A Benchmarking Framework for Control and Optimization of Smart Stormwater Networks. ACM/IEEE International Conference on Cyber-Physical Systems. Montreal, Canada. Apr 16–18 2019. Poster presentation.

[8] Ewing, G.*, A. Mullapudi, **S. C. Troutman**, B. Kerkez, W. Barrott, C. Nastally. Open-Storm Detroit Dynamics. LIFT Intelligent Water Systems Challenge, WEFTEC. New Orleans, LA, USA. Oct 1–3 2018. Oral presentation. **Award: 1st Place.**

[7] **Troutman, S. C.***, N. G. Love, B. Kerkez. Evaluating Market-Based Algorithms for System-Level TSS Control. 13th International Conference on Hydroinformatics, HIC. Palermo, Italy. Jul 1–6 2018. Oral presentation.

[6] **Troutman, S. C.***, N. G. Love, B. Kerkez. Market-Based Real-Time Control of TSS across Large Sewer Systems. World Environmental & Water Resources Congress, EWRI. Minneapolis, MN, USA. Jun 4–7 2018. Oral presentation.

[5] **Troutman, S. C.***, N. G. Love, B. Kerkez. Controlling a Sewer Network as an Extension of the Wastewater Treatment Plant. AEESP Research and Education Conference: Advancing Healthy Communities through Environmental Engineering and Science. Ann Arbor, MI, USA. Jun 20–22 2017. Oral presentation.

[4] **Troutman, S. C.***, N. G. Love, B. Kerkez. Understanding Combined Sewer Flow Dynamics through Data-Driven Modeling. World Environmental & Water Resources Congress, EWRI. Sacramento, CA, USA. May 21–25 2017. Oral presentation.

[3] **Troutman, S. C.***, N. Schambach, B. Kerkez, N. G. Love. Use of Real-Time Sensor Data in City-Scale Water Modeling. Poster presentation at:

- Borchardt Conference: 24th Triennial Symposium on Advancements in Water & Wastewater, Ann Arbor, MI, USA, Feb 21–22 2017;
- Michigan Institute for Data Science Annual Symposium, University of Michigan, Ann Arbor, MI, USA, Nov 15–16 2016 (Award: Most Likely Health Impact);
- CUAHSI Biennial Symposium, Shepherdstown, WV, USA, Jul 24–27 2016.

[2] **Troutman, S. C.***, N. Schambach, B. Kerkez, N. G. Love. Predicting Combined Sewer Flow through the Use of Real-Time, City-Scale Sensor Data. World Environmental & Water Resources Congress, EWRI. West Palm Beach, FL, USA. May 22–26 2016. Oral presentation.

[1] **Troutman, S. C.***, D. Knappe, H. Chmielewski, R. Ranjithan. Informing Water Treatment Designs through Mathematical Modeling. Water Resources & Environmental Engineering Graduate Research Symposium, North Carolina State University. Raleigh, NC, USA. Mar 7 2014. Poster presentation.

INVITED PRESENTATIONS

[1] Invited speaker: Real-time control for smart wastewater systems. ASCE Women-Water Nexus, Intelligent Systems and Smart Water Applications. Online short-conference session. May 21 2020.

AWARDS AND HONORS

WRF & WEF LIFT Intelligent Water Systems Challenge — 2018
Open-Storm Detroit Dynamics Team
Placed 1st out of 19 teams, $25,000 prize

National Science Foundation Graduate Research Fellowship — 2016

Scholarly Achievement Senior Award (CCEE, NCSU) — 2015
Awarded to one graduating undergraduate student in CCEE department each year

Phi Beta Kappa, Honor Society — 2014

Tau Beta Pi, Engineering Honor Society — 2012

LEADERSHIP AND SERVICE

Member, Graduate Student Advisory Council (CEE, UM) — 2017–2019

Secretary, GrEENPEAS (CEE, UM) — 2016–2017
(Graduate Environmental Engineering Network of Professionals, Educators, and Students)

Corresponding Secretary, Tau Beta Pi (NCSU) — 2013–2014

Cataloger, Tau Beta Pi (NCSU) — 2012–2013

CERTIFICATIONS

Engineer in Training, North Carolina — 2015