NATHAN T. BOYD

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SUMMARY

PhD candidate knowledgeable in operations research, complexity science, statistical inference, and control theory. Applied experience with water-resource networks complements this knowledge. Interested in modeling the emergent interactions among water-utilizing agents and informing nuanced policies for the water systems of tomorrow.

EDUCATION

PhD **Mechanical Engineering** Expected: May 2024
University of Maryland College Park, MD
GPA: 3.9
Focus: Operations Research - ENRE[1]
Dissertation: TBD (Proposal scheduled for May 2023)
Faculty Advisor: Dr. Steven A. Gabriel (sgabriel@umd.edu)

MS **Mechanical Engineering** Expected: August 2023
University of Maryland College Park, MD
GPA: 3.9
Focus: Operations Research - ENRE

BS **Civil Engineering Technology** May 2015
Southern Polytechnic State University Marietta, GA
GPA: 4.0

TECHNICAL EXPERIENCE

Graduate Research Assistant June 2021 – present
University of Maryland / Mechanical Engineering

Game-Theoretic Programming: Anacostia River Testbed

- Reviewed literature in an amalgam of relevant topics including water quality simulation, convex optimization, genetic algorithms, Anacostia regulatory documents, and stormwater best management practices
- Developed an integrated model featuring hydrologic simulation, stochastic optimization, and game-theoretic market interactions
- Mastered chance-constrained programming
- Organized and hosted a stakeholder workshop and incorporated their feedback into the model
- Mentored an undergraduate research assistant

[1] Energy, Natural Resources, and the Environment

Game-Theoretic Programming: Duck River Testbed
- Engaged in interdisciplinary brainstorming sessions involving academia, water resource consultants, and government agencies
- Reviewed literature in water-supply optimization
- Mastered equilibrium programming techniques
- Conceptualized novel market designs for water supply
- Discovered interplay of water reuse, demand, and capital investment
- Compiled content from technical reports into a unified model

Ramboll, Bowie, MD / Atlanta, GA Jan. 2015 – Jan. 2021
Staff Engineer
- Developed and operated a digital sewer model for a large municipality
  - Wrote formal proposals to actualize the client's vision
  - Managed approved project work
  - Supervised subcontractors
  - Created custom tools to automate data integration
  - Performed verification and validation activities
- Supported wastewater and stormwater infrastructure projects
  - Analyzed operations of large-scale sewer networks
  - Created conceptual sewer designs
  - Lead sewer condition assessments
  - Devised asset management strategies
  - Prepared stormwater compliance plans

Georgia Department of Transportation, Forest Park, GA June – July 2014
Intern
- Developed asphalt performance methods
- Administered field verification testing
- Assisted with asphalt mix designs

TEACHING EXPERIENCE

Guest Lecturer, ENME741[2] Nov. 2022
University of Maryland / Mechanical Engineering
- Taught the fundamental concepts of game theory to graduate students
- Related them to ongoing activities in the professor's research group

Hourly Course Assistant, ENME741 Aug. – Dec. 2020
University of Maryland / Mechanical Engineering
- Hosted discussion sections to reinforce lecture content
  - Illustrated difficult linear programming concepts with examples
  - Elucidated practical relevance using case studies

[2] Operations Research Models in Engineering

    - Moderated group discussions
- Evaluated and communicated students' performance
    - Graded assignments and offer constructive feedback
    - Clarified points of confusion during office-hour discussions
    - Advised students on effective study strategies

PUBLICATIONS

Accepted Journal Papers

- **N.T. Boyd**, S. A. Gabriel, G. Rest, T. Dumm. "Generalized Nash Equilibrium Models for Asymmetric, Non-cooperative Games on Line Graphs: Application to Water Resource Systems," Computers and Operations Research, 2023.

Articles in Conference Proceedings (Peer-Reviewed)

- **N.T. Boyd**, T. Dumm, "Balancing Present and Future Needs," Pipelines 2019: Planning and Design Conference Proceedings, Nashville, Tennessee, 187 – 195.

Journal Papers in Review

- S. Allen, S.A. Gabriel, **N.T. Boyd**, "Inverse Optimization for Parameterization of Linear Complementarity Problems and for Incentive Design in Markets," (under review at European Journal of Operational Research, November 2022).

Journal Papers in Preparation

- **N.T. Boyd**, S.A. Gabriel, K. Brubaker, M. Ries , "Addressing TMDL Challenges in River Systems with a Stochastic, Mixed Complementarity Problem" (anticipated submission May 2023)

GRANTS

- National Science Foundation Grant #2113891: *Game Theoretic Modeling for Improved Management of Water and Wastewater Resources Using Equilibrium Programming and Feedback Mechanisms* (Award Amount: $ 553,407).
    - Provided instrumental insights to the PI and Co-PI inspired from my unique experience in both industry and academia
    - Assisted with writing the grant proposal

SKILLS AND CERTIFICATIONS

Programming:

Python (intermediate), Microsoft Excel (intermediate), MATLAB (basic), SysML (basic)

Software Packages:

GAMS Studio (advanced), ArcGIS (advanced), InfoAsset Planner (advanced), NetLogo (intermediate), Microsoft Office (intermediate), Jupyter Notebook (intermediate), Anaconda Navigator (intermediate), Python IDLE (intermediate),

Simulink (intermediate), HSPF (intermediate), AutoCAD (basic), Cameo Systems Modeler (basic), InfoWater (basic), InfoSewer (basic)

Certifications:

Engineer-In-Training, State of Georgia	Feb. 2016
Technical Writing: Strategies and Styles, Write-Logic	Dec. 2015

Languages:

English (native), French (basic)

HONORS AND AWARDS

Alex Mehr Endowed Distinguished Graduate Fellowship Feb. 2023
Based on my research in systems optimization and systems engineering

Research Assistantship June 2021
Awarded because of my proposal contributions for NSF Grant #2113891

Dean's Fellowship Jan. 2021
Awarded as partial funding from my admission into the UMD PhD program

President's Distinguished Scholar Award Recipient May 2015
Awarded during spring commencement for the highest GPA in the graduating class

Georgia Engineering Technology Student of the Year Feb. 2015
Presented by the Georgia Engineering Alliance during Engineer's Week

CONFERENCE & SEMINAR PRESENTATIONS

Conference Presentations

- N.T. Boyd, S.A. Gabriel, K. Brubaker, M., Ries, Can Game Theory Improve Water-Quality Restoration Decisions? Trans-Atlantic Infraday Conference 2022, Stockholm University, Stockholm, Sweden, November 3-4, 2022, NSF Award # 2113891.
- S. Allen, S.A. Gabriel, N.T. Boyd, Inverse Optimization for Parameterization of Linear Complementarity Problems and for Incentive Design in Markets, Trans-Atlantic Infraday Conference 2022, Stockholm University, Stockholm, Sweden, November 3-4, 2022, NSF Award # 2113891.
- Steven A. Gabriel (presenter), Nathan Boyd, Generalized Nash Equilibrium Models for Asymmetric River Systems, presented at European Conference on Stochastic Optimization, Computational Management Science ECSO-CMS 2022, Venice, Italy, June 29-July 1, 2022.
- Nathan Boyd (presenter), Steven A. Gabriel, Kaye Brubaker, Matt Ries Alternative TMDL Allocation Schemes using Game-Theoretic Modeling, 2022 American Water Resources Association (AWRA) conference on April 8, 2022, Washington DC.

- Water Resources Equilibrium Programming (with Steven Gabriel, George Rest, Tom Dumm), Trans-Atlantic Infraday (TAI) Conference, Aalto University, Espoo, Finland, November 11, 2021.
- Game Theoretic Modeling For Improved Management Of Water And Wastewater Resources Using Equilibrium Programming And Feedback Mechanisms, INFORMS, Anaheim, California. October 24, 2021 (Coauthors: Steven Gabriel, George Rest, Tom Dumm, Doug Murphy).
- Balancing Present and Future Needs, ASCE Pipelines, San Antonio, Texas. August 9-11, 2020 (Coauthors: Tom Dumm).

Workshops

- Anacostia River Stakeholder Meeting: Game Theory Modeling and Market Theory for Water Management (Presentations by Matt Ries, Steven A. Gabriel, Kaye Brubaker, Stephanie Allen, and Nathan Boyd) DC Water Headquarters, October 27, 2022.

PROFESSIONAL MEMBERSHIPS AND SERVICE

- University of Maryland Research Interaction Teams Apr. 2022 – present
  - Share research progress with other PhD students
  - Manage mailing list and communication efforts
  - Give constructive feedback to other graduate students
  - Discuss current issues in operations research
  - Collaborate with universities abroad
- Trans-Atlantic Infraday Scientific Organizing Committee Sep. 2021 – present
  - Manage mailing list and communication efforts
  - Organize program and structure sections
  - Review abstracts
  - Moderate sessions and introduce speakers
- The Long Now Foundation Jan. 2016 – present
  - Foster long-term thinking to improve society
  - Provide monthly donations to fund talks and projects
  - Engage with other members in long-term thinking
    - Participate in October 2016 national meetup
    - Host local meetups in Atlanta and DC
- American Society of Civil Engineers (ASCE) Aug. 2013- Aug. 2020
  - ASCE Pipelines
    - Moderated conference sessions
    - Reviewed conference papers
  - ASCE Student Chapter – Southern Poly
    - Served as the small competitions captain
    - Served as a concrete canoe team co-captain
- Chesapeake Water Environment Association Nov. 2017 – Dec. 2018
  - Technical Education Committee Member
  - Asset Management Committee Member
- Future City Competition Jan. 2015
  - Served as a Sim City Judge for K-12 students

- Alliance Theatre Summer Camps June 2010 – July 2012
    - Middle school teaching assistant
- Conscience International - Rubble House Assistant Sept. 2011
    - Helped construct a prototype home for earthquake victims

RELATED GRADUATE COURSE WORK

- Operations Research and Game Theory
    - OR Models for Transportation Systems Analysis
    - Probability-Based Design
    - Probabilistic Optimization
    - Equilibrium Programming in Engineering
- Energy, Natural Resources, and the Environment
    - Environmental and Water Resource Systems
    - Hydrologic Analysis and Nonpoint Pollution Models
    - Introduction to Infrastructure and Resilience
- Statistical Inference and Algorithms
    - Applied Machine Learning
    - Molecular Thermodynamics
- Systems Modeling and Control
    - Systems Engineering Concepts and Processes
    - Advanced Systems Control
    - Applied Nonlinear Control

SHORT COURSE PARTICIPATION

- Santa Fe Institute, Graduate Workshop in Computational Social Science, Santa Fe, New Mexico, June 18th – June 30th , 2023.
- Trans-Atlantic Cooperation on Energy Market Modeling (TACEMM), Winter School Workshop, Oppdal, Norway, Feb. 28th – March 3rd , 2022.
- TACEMM, Flexibility in Energy Markets, Aalto University, Espoo, Finland, Nov. 8 – 12, 2021.