

John Waczak

PHYSICIST · DATA SCIENTIST

3700 Walnut Drive, Bedford, Texas, 76021

☎ (+1) 503-330-1280 | ✉ john.louis.waczak@gmail.com | 📷 john-waczak | 🌐 john-waczak

Summary

Dedicated scientist with over 5 years of interdisciplinary research experience across applied physics, machine learning, real-time sensor networks, and remote sensing. Proficient in utilizing advanced models to analyze terabyte-scale datasets, delivering actionable insights to drive innovation and decision-making. Seeking opportunities to apply these skills in both industry and research environments to contribute to pioneering advancements and transformative technologies.

Education

University of Texas at Dallas

PH.D. IN APPLIED PHYSICS - GPA: 3.96

Richardson, Texas

Expected Dec. 2024

- *Dissertation:* Physical Sensing and Physics-based Machine Learning for Actionable Environmental Insights

Oregon State University

B.S. IN PHYSICS AND B.S. IN MATHEMATICS - *Summa Cum Laude* - GPA: 3.94

Corvallis, Oregon

June 2019

- *Thesis:* Simulating the Brownian Dynamics of a Two-Dimensional Model for the Dynein Motor Protein

Experience

MINTS Research Group

GRADUATE RESEARCH ASSISTANT

University of Texas at Dallas

Sep. 2019 - Present

- Developed parallelized georectification software for *real-time* analysis of drone-based hyperspectral imagery, improving processing speeds by over 90%.
- Utilized machine learning to combine drone-based hyperspectral imagery with autonomous *in situ* sensing to quantify concentrations of water contaminants at $\mu\text{g}/\text{m}^3$ resolutions.
- Successfully demonstrated ability to map centimeter-scale variability of water composition by analyzing 10+ terabytes of hyperspectral images.
- Devised a new unsupervised machine learning algorithm to identify nonlinear spectral signatures enabling the rapid localization of unique pollution sources.
- Crafted a scalable, containerized data pipeline for a low-cost air quality sensor network, delivering *real-time* visualization and analysis dashboards for over 100 sensors across Texas.
- Created data-driven time series models to identify intermittent pollution events and provide short-term air quality forecasts.
- Led three teams of computer science students through their senior capstone projects, teaching software containerization methods and performing regular code reviews.

ActivePure

RESEARCH SCIENTIST

Dallas, Texas

March. 2022 - Jan. 2024

- Designed a real-time data collection pipeline synchronizing complex measurements from over 30 reference-grade instruments to comprehensively evaluate efficacy of air quality remediation technologies.
- Deployed containerized control software for air quality chamber testing, combining real-time data visualization with automated alerts to extend operation time from 1 hour periods to continuous, 24 hour testing.
- Implemented an advanced *chemical data assimilation* framework simulating over 16,000 chemical reactions for over 5,000 chemical species to infer concentrations of hard-to-measure reactive species affecting indoor air quality.

The Center for Astrophysics | Harvard & Smithsonian

UNDERGRADUATE RESEARCH ASSISTANT

Cambridge, Massachusetts

Jun. - Aug. 2018

- Combined simulations of non-equilibrium ionization processes in coronal plasma with observations from the Solar Dynamics Observatory to model the spherical structure of shocks generated by coronal mass ejections.
- Wrote a Python wrapper for underlying Fortran code to enable automated analysis of years of high-resolution solar observations.

Roundy Research Group

UNDERGRADUATE RESEARCH ASSISTANT

Oregon State University

March. 2016 - Jan. 2019

- Developed a novel physical model for the Brownian motion of the dynein motor protein to examine the impact of microtubule binding on forward motion.
- Optimized the code to enable embarrassingly parallel execution on a local compute cluster via Slurm, facilitating the rapid evaluation of thousands of simulations.
- Modelled various protein conformations with additional tail forces to explore the impact of cellular cargo on protein locomotion.

SailBri Cooper, Inc.

INTERN

Beaverton, Oregon

Dec. 2015 - Aug. 2018

- Implemented MODBUS serial communication protocol for the Xact 625i Ambient Multi-Metals Monitor, providing an external interface to live sensor data and quality flags.
- Programmed PID control logic for instrument vacuum pumps to ensure steady flow rates regardless of ambient air conditions.
- Designed automatic analysis software for wire harness continuity checks, accelerating instrument production time.

Skills

Science	Mathematical modeling, numerical analysis, high performance computing, machine learning, data analysis, data assimilation, data visualization, remote sensing, sensor networking, project management, scientific writing
Software	Julia, Python, Scikit-learn, Pytorch, Rust (familiar), C/C++ (familiar), SQL, Docker, Linux, Slurm, Git, CI/CD, \LaTeX
Hardware	Microcontrollers, Single-board Computers, LoRaWAN, MQTT, 3D-Printing
Instrumentation	Hyperspectral Imagers, CRDS Gas Analyzers, Aerosol Mass Spectrometers, SIFT mass spectrometers, UV-VIS spectrometers, Optical Particle Counters, Ion Counters

Selected Publications

Generative Simplex Mapping: Nonlinear Endmember Extraction and Spectral Unmixing for Hyperspectral Imagery

JOHN WACZAK, DAVID J. LARY

<https://doi.org/10.20944/preprints202410.1139.v1>

Preprint

2024

Unsupervised Characterization of Water Composition with UAV-based Hyperspectral Imaging and Generative Topographic Mapping

JOHN WACZAK, ADAM AKER, LAKITHA O. H. WIJERATNE, SHAWHIN TALEBI, ASHEN FERNANDO, PRABUDDHA M. H. DEWAGE, MAZHAR IQBAL, MATTHEW LARY, DAVID SCHAEFER, GOKUL BALAGOPAL, DAVID J. LARY

<https://doi.org/10.3390/rs16132430>

Remote Sensing

2024

Characterizing Water Composition with an Autonomous Robotic Team Employing Comprehensive In Situ Sensing, Hyperspectral Imaging, Machine Learning, and Conformal Prediction

JOHN WACZAK, ADAM AKER, LAKITHA OH WIJERATNE, SHAWHIN TALEBI, ASHEN FERNANDO, PRABUDDHA MH DEWAGE, MAZHAR IQBAL, MATTHEW LARY, DAVID SCHAEFER, DAVID J LARY

<https://doi.org/10.3390/rs16060996>

Remote Sensing

2024

Honors & Awards

2021 **Teaching Assistant of the Year**, Department of Physics

UT Dallas

2019 **WIC Culture of Writing in Physics Award**, Honorable Mention

OSU