Alexander James Gray M.S.

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Summary: Biomedical Engineer specializing in **biomedical imaging, optics, and automation for clinical and research applications**. Extensive experience in **hardware/software integration, optical system development, and medical imaging technologies**. Developed a **high-throughput birefringence imaging system for real-time myelin histology** and an **intraoperative image-guided surgical device used in clinical studies**. Proficient in **optical alignment, imaging automation, bioimaging techniques, and experimental system prototyping**. Passionate about **developing novel imaging solutions to improve patient care**.

Education

Boston University, Boston, MA

Ph.D. in Biomedical Engineering | Boston University | Expected April 2025 | GPA: 4.00/4.00

- Dissertation: *Quantifying Pathological Changes to Myelin with High-Resolution Birefringence Microscopy and Deep Learning*

M.S. in Biomedical Engineering | Boston University | January 2021 | GPA: 4.00/4.00

B.S. in Biomedical Engineering | University of Rhode Island | May 2019 | Class Rank: 1 | GPA: 3.99/4.00

Research Experience

Doctoral research Fellow | Biomedical Optics Lab | September 2021-Present (expected April 2025)

- Designed a fully automated birefringence microscope with real-time imaging capabilities**,** enabling high-throughput imaging for biomedical research and diagnostics
- Developed high throughput image analysis pipeline using deep learning to quantify the strcutuarl damage in neurodegenerative models of Alzheimer's disease, CTE and stroke and the effect of various therapeutic interventions.

Graduate Research Assistant | Biomedical Optics Lab | September 2019-September 2021

- Developed a scanning spectroscopy system for intraoperative cancer margin assessment**,** now clinically deployed and validated for surgical applications
- Spearheaded the development of a hyperspectral camera scanning system for colorectal imaging.
- Applied product development knowledge to ensure compliance with safety and usability standards.
- Provided technical leadership and supported hardware and software integration across research Projects (Hyperspectral endoscopy/anoscopy, real-time cancer detection with elastic spectroscopy)

Technical Skills

- **Optical & Bioimaging Systems:** Optical alignment, widefield microscopy, confocal microscopy, hyperspectral imaging
- **Programming & Data Processing:** MATLAB, Python (Numpy, Pandas Scikit), C++, ImageJ, OpenCV
- **Medical Image Processing & Automation:** Deep learning (YOLOv4, CNNs), feature extraction, real-time imaging pipelines
- **Hardware & Prototyping:** Eagle, 3D printing, CAD (SolidWorks, OnShape), optomechanical system design
- **Experimental & Clinical Imaging:** Spectroscopy, image-guided surgical devices, medical device compliance (IEC 60601)

Professional Experience

Software Engineer | **Early-Stage Startup (Stealth Mode)** | **September 2024-present**

- Developed software interfaces for ultrasonic transducer control and data acquisition.
- Implemented signal generation and real-time filtering for A-scan ultrasound measurements.
- Integrated hardware-software communication protocols for real-time system operation.

Software Consultant (Contract)| **Concur Biophotonics** | 2022-Present

- Led the development of software and algorithms for real-time spectroscopic imaging systems used during surgery.
- Designed and optimized user interfaces to improve surgical workflow integration.

Spectroscopy Science Intern, Analog Garage | **Analog Devices Inc.** | Summer 2017,2018

- Investigated novel methodologies for spectroscopy applications, including bio-fluid and water analysis using various machine learning models (random forest, KNN)
- Conducted a clinical study validating an optical system for diagnostic use in an ICU use at Brigham and Women's Hospital
- Collaborated with interdisciplinary teams to propose design for optical systems **(Patent pending)**

Key Projects

- **Ph.D. Research (2020–Present)**: Designed a fully automated birefringence microscope, managing the entire development lifecycle, from concept to execution, for imaging and utilizing deep learning to quantify the spatial distribution of myelin pathology in neurodegenerative diseases
- **M.S. Thesis (2019–2021)**: Automated Spectroscopy Acquisition System – Developed real-time spectral analysis algorithms that dynamically calibrated acquisition system, enabling real-time decision-making in surgical settings
- **Senior Capstone Design Project (2018–2019)**: Led an interdisciplinary team to develop a disposable reflective photoplethysmogram (PPG) system for neonatal heart rate monitoring during resuscitation.

Publications

Alexander J. Gray, Rhiannon Robinson, Evan Mackie et al. *Label-free quantitative assessment of myelin degradation in a rhesus monkey model of cortical injury with birefringence microscopy and deep learning [**In preparation**]*

Ting Xie, Anna Novoseltseva, **Alexander J. Gray**, Irving J. Bigio, Birefringence Microscopy for Quantifying Birefringence of Myelin in Thin Brain Section [**In preparation**]

Gray, Alexander*; Aslan, Mete*; Packard, Logan; GIORGETTA, Caeden; Bigio, Irving Ünlü, M. Selim; (2025). Impact of uniform illumination in widefield microscopy and mesoscopy: An efficient flat-field imaging solution. **Optica Open.** Preprint. https://doi.org/10.1364/opticaopen.28192331.v1

Alexander J. Gray*, Nathan Blanke*, Rhiannon E. Robinson, Anna Novoseltseva, Douglas L. Rosene, Irving J. Bigio; Practical considerations for birefringence microscopy of myelin structure: Microscope design and tissue processing for effective imaging. ***Imaging Neuroscience* 2024**; 2 1–22. doi: https://doi.org/10.1162/imag_a_00186

Alexander J. Gray; Design and Implementation of a miniaturized Elastics Scattering Spectroscopy (mESS) System with scanning modality for oral cancer deep margins assessment, M.S. Thesis**, Boston University** 2021, https://open.bu.edu/handle/2144/41922

Presentations

Gray, A; Robinson, R; Novoseltseva, A; Li, S; Berghol, S; Moore, T; Rosene, D.L.; Bigio, I.J. Quantifying Myelin Degradation Using Quantitative Birefringence Microscopy and Deep Learning; Poster presented at Optica Biophotonics Congress: Biomedical Optics; Ft. Lauderdale, FL 2024.

Gray, A; Robinson, R; Novoseltseva, A; Berghol, S; Moore, T; Rosene, D.L.; Bigio, I.J. Quantifying Myelin Degradation Using Quantitative Birefringence Microscopy and Deep Learning; Poster presented at Neurophotonics center symposium; Boston, MA 2024.

Gray,A; Blanke,N; Robinson, R; Rosene, D.L.; Bigio, I.J. Birefringence Microscope Design and Sample Preparation Exigencies for High-resolution Imaging of Myelin Degradation Oral presentation at Optica Biophotonics Congress: Optics in the Life Sciences; Vancouver BC 2023.

Honors & Awards

- Nelson C. White '25 Excellence in Engineering Award (University of Rhode Island)
- John J. Murray Memorial Scholarship Endowment (University of Rhode Island)
- Centennial Tuition Scholarship (University of Rhode Island)
- Engineering Graduate Scholarship (Boston University)