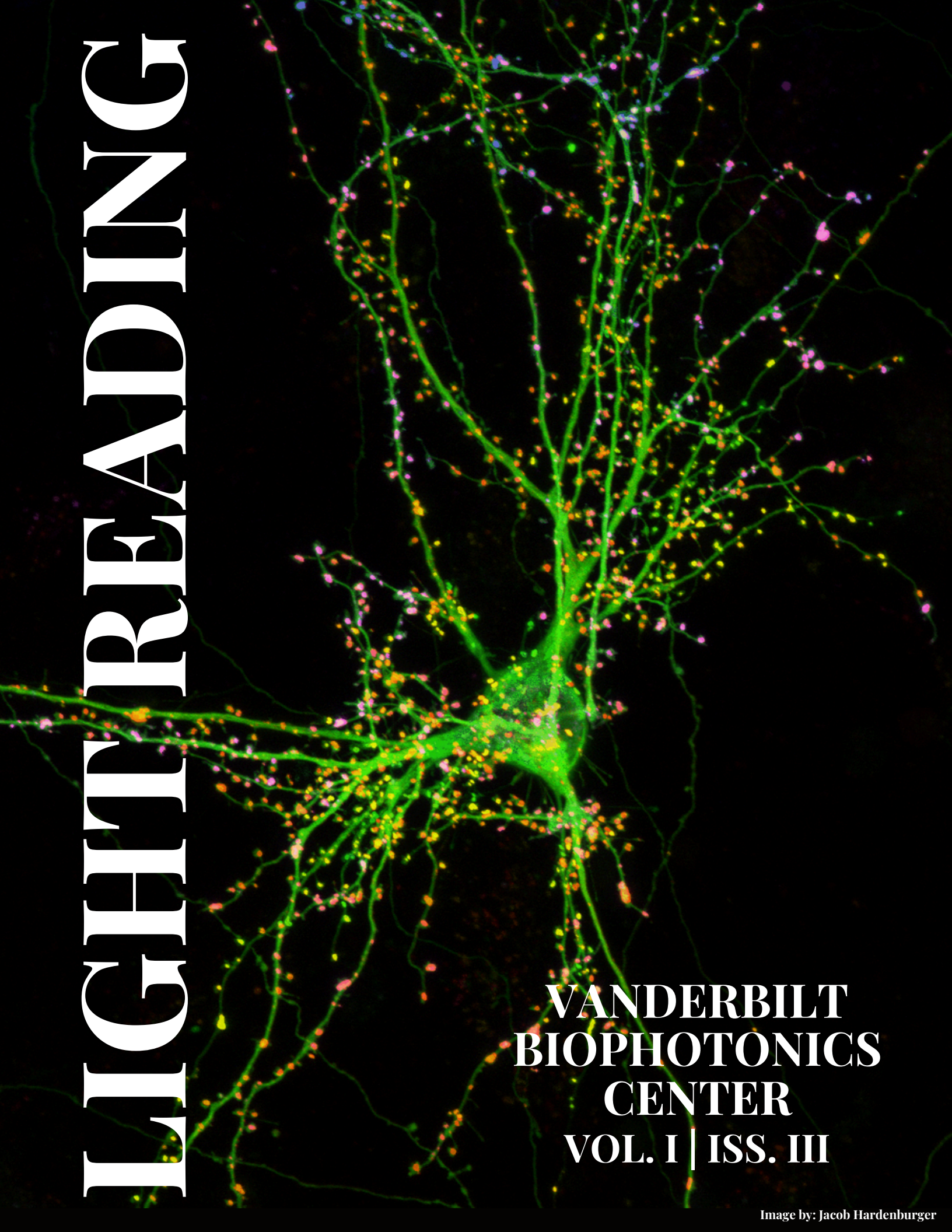
LIGHTREADING



VANDERBILT BIOPHOTONICS CENTER

VOL. I | ISS. III

Image by: Jacob Hardenburger

LIGHT READING

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DR. BOWDEN'S SWISS SCHOLARLY LEAVE

Over the past 14 years, Dr. Audrey Bowden has been a dedicated professor with a dream of taking scholarly leave. Recently motivated to pursue this dream, she has had the opportunity to spend time with her family in Switzerland, where her parents have retired. This allows her to spend time with family and develop academic partnerships at ETH Zürich University.

At ETH Zürich, Dr. Bowden collaborates with Dr. Daniel Razansky, becoming a part of his lab and working alongside him and his colleagues on various projects. Furthermore, she is a fellow of the Collegium Helveticum, an institute for advanced study in Switzerland. In this role, she interacts with visiting scholars from diverse disciplines worldwide, engaging in thought-provoking discussions about the future of academia and their research. Dr. Bowden is eager to continue meeting new people and exchanging ideas within the biophotonics community and beyond.

In addition to her collaborative efforts, Dr. Bowden has had the chance to diversify her skill set by pursuing an executive MBA. This program has enhanced her financial, leadership, and management skills, essential for her effectiveness as a principal investigator. These skills will also be crucial as she steps into her new role as Associate Dean of Research in the School of Engineering upon her return from leave.

Dr. Bowden, her parents, husband, and kids have been enjoying nature and lots of hiking.

During their first snowfall in Zürich, Dr. Bowden and family went sledding.

In this position, Dr. Bowden will be responsible for improving the school's research infrastructure, securing funding for faculty, leveraging external partnerships, and developing new collaborations. Her responsibilities will also include overseeing initiatives such as planning the Hall Lecture series, serving as the liaison to the office of the Vice Provost for Research, and managing the school's summer research program. Dr. Bowden looks forward to showcasing the school's hard work and research to support impactful programming.

These opportunities and career transitions have prompted Dr. Bowden to reflect on her professional journey. When asked about the key factors contributing to her success, she remarked, "Good support from my department chair has been critical throughout my promotion process. A good department chair is like a good teacher; they set realistic expectations for their faculty and help them achieve those goals. Their success is intertwined with the success of other faculty." She also highlighted the importance of having supportive colleagues at the VBC, graduate students, and postdocs with whom she has collaborated over the years. When asked what advice she would give to junior faculty seeking advancement, Dr. Bowden emphasized understanding institutional culture, building a strong research team, and developing relationships across the university.

By: Alex Cousart

LIGHT READING

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WIDENING THE LENS

During his interview for the October edition of "Light Reading", Dr. Bryan Millis elaborated two other programs he runs at Vanderbilt focused on making optical imaging available to a broader audience. These programs – Biomedical Microscopy, Immersion, Innovation, and Discovery (BioMIID) and Vanderbilt V isitors ' Immersion Program (VVIP) – are intended to give access to cutting edge imaging modalities with hands-on mentorship from the BioMIID team. The underpinning idea behind these initiatives is that the Vanderbilt Biophotonics Center's (VBC) microscopists collaborate with incoming researchers instead of functioning as a core, thereby expanding external partners' access to the technologies. Dr. Millis was very adamant throughout his interview that the ability to run these programs is due in large part to funding from the Chan Zuckerberg Initiative and Vanderbilt University's TIPS program, space provided by the School of Engineering, and Vanderbilt University Information Technology for the high data throughput infrastructure they have provided to BioMIID.

BioMIID is where all the VBC's specialized microscopes are housed. With the expertise of both Dr. Millis and Dr. John Kozub, a staff scientist at the VBC, several microscopes have been built in-house for use within the Vanderbilt ecosystem. However, unlike microscopy cores at other schools, BioMIID functions as a collaborative research center; thus,incoming researchers sit down with the BioMIID team to discuss their research needs and use their microscopes instead of being charged to use them. The choice to structure the microscopy center this way enables important and novel scientific questions to be addressed in a way that revenue-generating cores cannot; by not tying BioMIID's key performance indicators to monetary outcomes, flexibility and creativity are encouraged and leveraged for the generation of preliminary data for grant funding as well as long-term research.

Housed within BioMIID is VVIP, which seeks to catalyze the productivity of other researchers from outside Vanderbilt. The question "are we helping researchers ask new questions and get funding for research at their own institutions?" is used to determine the alignment of their work with this mission. Like internal collaborations , the team will sit with incoming researchers to ask about the questions they want to answer. This relatively novel approach to structuring an external research program is something Dr. Millis finds great pride in as it provides a greater depth to the work being produced by researchers who do not have the expertise to build these microscopes themselves. An externally oriented program does come with challenges though, namely safety protocols with specimens being brought in and the data volume generated by these machines. Some of BioMIID's systems produce dozens of terabytes of data in a single day (1 terabyte = 1,000 gigabytes), and that's not particularly easy for visiting researchers to take with them. Furthermore, analysis software packages can also cost $20,000 per installation, making external analysis impossible given the low-resource collaborations VVIP targets. To overcome this issue, BioMIID has been equipped with high data capacity storage and remote-in infrastructure so researchers can continue to access and analyze the generated data from their home institutions – another result that would not be possible without VVIP's collaborative mission. If anyone is interested in receiving an application for VVIP, please contact Dr. Millis at bryan.a.millis@vanderbilt.edu.

The BioMIID team: (clockwise) Dr. Bryan Millis, Dr. Miguel de Jesus, Dr. Kanchana Devanathan, Han Dong, and Dr. John Kozub.

By: Parker Willmon

LIGHT READING

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FALL VBC SEMINAR SERIES

By: Anna Funderburg

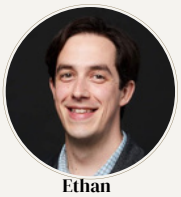
December 3rd marked the end of the Fall 2024 VBC Seminar Series, bringing world-renowned scientists to Vanderbilt to facilitate collaborations and innovations. This series spanned numerous topics, including point-of-care optical monitoring, presented by Dr. Gerard Coté from Texas A&M University, and the future of bioimaging and AI, presented by Dr. Loïc Royer from the Chan Zuckerburg Biohub. Invigorating presentations about cancer detection and surgical guidance using optical modalities were given by Dr. Laura Marcu from the University of California, Davis, and Dr. Gracie Vargas from the University of Texas Medical Branch. Dr. Vasan Venugopalan from the University of California, Irvine gave an exciting overview of his work utilizing optics to study mechanobiology. For a look into the world of start-ups and entrepreneurship, Dr. Ethan LaRochelle, the CEO and co-founder of QUEL Imaging, visited Vanderbilt to speak about the recent work of his company. Dr. Daniel Gonzales, a faculty member in the Biomedical Engineering department here at Vanderbilt, gave an introduction into the fascinating work in his lab focusing on flexible neural interfaces. Finally, for the Hoy Family Lecture, Drs. Murray Johnstone and Ruikang (Ricky) Wang from the University of Washington detailed their collaboration using innovative optical imaging for glaucoma research. While visiting Vanderbilt, seminar speakers sit down with students and post-docs for networking and career-focused mentoring and meet with faculty within the Biophotonics Center and at Vanderbilt and Vanderbilt University Medical Center. This seminar series is special as it is organized by graduate students and post-docs. Providing the organizers with vast networking opportunities with leaders in the field and organizational experience.


Gerard Coté


Murray Johnstone


Ruikang (Ricky) Wang


Daniel Gonzales


Ethan LaRochelle


Vasan Venugopalan


Laura Marcu


Loïc Royer


Gracie Vargas

VBC SPOTLIGHT

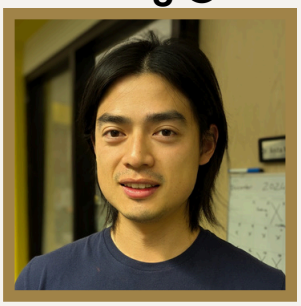
Ideator Program Microgrant Recipients

By: Anna Funderburg

VBC graduate students Han Dong and Seth Crawford were recently awarded a microgrant from the Sullivan Family Ideator Program at the The Wond'ry at Vanderbilt University. The Sullivan Family Ideator Program is focused on developing Vanderbilt-affiliated inventors and provides guidance for developing and evaluating novel technologies. Han and Seth joined the Ideator Program to gain a better understanding of how research ideas are translated from the laboratory to clinical practice. Through the program, Han and Seth have developed a novel handheld perfusion assessment tool. Seth was originally interested in the Ideator Program to "get a better understanding of entrepreneurship and how to better communicate my ideas to non-engineers". Additionally, when asked about takeaways from the program, Han states that he has learned to "formulate a way to interview doctors, surgeons, and medical supply chain experts" toward the development and deployment of novel imaging tools for the clinical space.

As an integral step in the development of their new technology, Han and Seth are looking for medical providers to interview. Specifically, they are looking to interview internal medicine residents, cardiologists, ICU doctors, and vascular surgeons. If you would be interested in being interviewed, please reach out to Han or Seth at han.dong@vanderbilt.edu and seth.b.crawford@vanderbilt.edu.

Han Dong



Seth Crawford

LIGHT READING

Biophotonics Center

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SPIE PHOTONICS WEST

25 January 2025

- **"Effects of Fowler's and semi-Fowler's patient posture on fNIRS neuromonitoring data"** presented by Seth Crawford (PI: Dr. Audrey Bowden)
- **"Surface-enhanced Raman spectroscopy for detection of vaginal bacteria"** presented by Anna Rourke-Funderburg (PIs: Dr. Andrea Locke & Dr. Anita Mahadevan-Jansen)
- **"Development of biochemical standards for high wavenumber Raman microspectroscopy and fiber-optic Raman applications"** presented by Ezekiel Haugen (PI: Dr. Anita Mahadevan-Jansen)
- **"Removal of combined confocal and fall-off effects from OCT B-scans for attenuation coefficient extraction in ophthalmic images"** presented by Daniel Phan (PI: Dr. Audrey Bowden)
- "**Auto-fluorescence imaging pen like probe for parathyroid identification"** presented by Han Dong (PI: Dr. Anita Mahadevan-Jansen)
- **Invited Paper: "Preliminary results of a multi-center randomized clinical trial on the effectiveness of near infrared autofluorescence for guiding endocrine surgery"** presented by Dr. Anita Mahadevan-Jansen

26 January 2025

- **"Porous silicon on paper sensors: factors affecting biosensing performance"** presented by Huijin (Ginny) An (PIs: Dr. Sharon Weiss)
- **"Investigating variability of high wavenumber Raman spectroscopy in superficial tissues"** presented by Benjamin Estes (PI: Dr. Anita Mahadevan-Jansen)
- **"Evaluating the effects of pulsed infrared light on dendritic spines of cortical neurons in vitro"** presented by Jacob Hardenburger (PI: Dr. Anita Mahadevan-Jansen)
- **"Development of an accurate, non-invasive method for rapid in vivo hydration assessment of marathon runners using high-wavenumber raman spectroscopy"** presented by Richard Liao (PI: Dr. Anita Mahadevan-Jansen)
- **"4D imaging and volume quantification of subretinal injections using intraoperative OCT"** presented by Alicia Repka (PI: Dr. Yuankai "Kenny" Tao)
- **"Analytical methods for solving heat distributions and estimating quasi-static and transient pressures in laser-irradiated biological tissue"** presented by George Grow (PIs: Drs. E. Duco Jansen and Anita Mahadevan-Jansen)

27 January 2025

- **"Extracting the combined confocal and fall-off function from multiple OCT A-scans by basis functions"** presented by Daniel Phan (PI: Dr. Audrey Bowden)
- **"Detection of Mycobacterium tuberculosis in human saliva using Raman spectroscopy"** &
- **"Differentiation and characterization of bacteria using high-wavenumber Raman spectroscopy"** presented by Dr. Alec Walter (PIs: Dr. Andrea Locke & Dr. Anita Mahadevan-Jansen)
- **"Quantitative methods to optimize lightweight and structurally robust handheld ophthalmic OCT designs for clinical translation"** presented by Jacob Watson (PI: Dr. Yuankai "Kenny" Tao)
- **"Low refractive-index 3D culture dishes for improved embryo culture and clinical integration"** presented by Yunqin Zhao (PI: Dr. Audrey Bowden)

28 January 2025

- **"Development of point of care thermographic imaging assessments of peripheral perfusion in scleroderma subjects"** presented by Dr. Justin Baba
- **Invited Paper: "Emerging properties and applications of photonic metacrystal waveguides and cavities"** presented by Dr. Sharon Weiss

29 January 2025

- **"Shearing interferometric fluorescence tomography (SIFT) for depth- and spectrally-resolved volumetric imaging"** presented by Jet Rostykus (PI: Dr. Yuankai "Kenny" Tao)
- **"A basis method for single-shot recovery of the combined confocal and fall-off function from multiple OCT A-scans"** presented by Daniel Phan (PI: Dr. Audrey Bowden)
- **Invited Paper: "Meta-optics for edge computing"** presented by Dr. Jason Valentine

LIGHT READING

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VIBES SUMMER INTERSHIP

May 27th 2025 - August 1st 2025

Vanderbilt Internship in Biophotonics for Emerging Scholars

VIBES is a 10-week summer research program for undergraduate students at the Vanderbilt Biophotonics Center.
Students will gain hands on research experience in a clinical or lab setting, working alongside faculty and researchers at the forefront of biophotonics technology.

- **$5,000 stipend**, and on-campus housing
- **Mentorship** by Vanderbilt Biophotonics Center faculty and graduate students
- **Gain valuable skills** and knowledge in the field of biophotonics, which has numerous applications in diagnostics and treatment

The VIBES program provides participants with hands-on research experience and the opportunity to work alongside faculty and researchers at the forefront of biophotonics technology. Students will be exposed to a variety of cutting-edge projects and techniques, including:

- Optical neuromodulation and immune response
- Multimodal optical imaging for retinal diseases
- Advanced OCT imaging and analysis
- Optical monitoring of patent ductus arteriosus
- Optical biomarkers for embryo viability
- Low-cost and portable diabetic eye disease diagnosis
- Portable brain imaging
- Photon propagation and thermal imaging

Click here to learn more.

APPLY HERE

APPLICATIONS CLOSE JANUARY 15th, 2025

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RECENT PUBLICATIONS & PRESENTATIONS

Publications

- A rapid and low-cost method to fabricate well of the well (WOW) dishes with arbitrary 3D microwell shapes for improved embryo culture
  - Yunqin Zhao, Audrey Bowden
- Customizable optode attachments to improve hair clearance timing and inclusiveness in functional near-infrared spectroscopy research
  - Seth Crawford, Tiffany-Chau Le, Audrey Bowden
- Label-Free Optical Technologies to Enhance Noninvasive Endoscopic Imaging of Early-Stage Cancers
  - Shuang (Grace) Chang, Halina Krzyzanowska, and Audrey Bowden
- Optimizing cystoscopy and transurethral resection of bladder tumor: enhanced imaging and artificial intelligence
  - Camella Carlson, Shuang (Grace) Chang, Audrey Bowden
- Deep-learning-based acquisitional denoising for Raman spectroscopy using CNN and transformer
  - Marilyn Lionts, Ezekiel Haugen, Anita Mahadevan-Jansen, Yuankai Huo

Presentations

American Society for Reproductive Medicine Scientific Congress & Expo

- "Fabrication of Low-aberration 3D Well-of-the-well (WOW) Microwell Dishes for *in situ* Embryo Imaging", Yunqin Zhao

Biomedical Engineering Society Annual Conference

- “Design of a paper-based surface-enhanced Raman spectroscopy substrate for bacteria detection in biofluid”, Sophia Juarez

SciX

- "Culture-free Detection of Bacteria in Biofluids", Andrea Locke
- "Spatially offset high wavenumber Raman spectroscopy for physiological hydration assessment in vivo", Anita Mahadevan-Jansen
- "Correlating in vivo spectral signatures with tissue biochemistry and architecture in eosinophilic esophagitis as a pathway to therapeutic monitoring", Anita Mahadevan-Jansen

Vanderbilt University Undergraduate Research Fair

- “Detecting Changes in Hydration Across Varying Tissue Properties: A Phantom Study”, Benjamin Estes
- "Analysis of Vaginal Fluid using Raman Spectroscopy" , Kate Goncalves
- "Design of a paper-based surface-enhanced Raman spectroscopy substrate for bacteria detection in biofluid" , Sophia Juarez

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ANNOUNCEMENTS

Congratulations to Han Dong for winning the Lai Sulin Scholarship, an endowed scholarship from the Vanderbilt Graduate School.

Welcome Miguel de Jesus to the VBC!

UPCOMING EVENTS

Spring VBC Seminar Series:

- February 4: Changhuei Yang
- February 18: Wes Legant