LIGHT READING

Biophotonics Center

VOLUME I, ISSUE I

LETTER FROM THE DIRECTOR

More than 27 years ago, Duco Jansen and I were recruited by Tom Harris, who was the chair of Biomedical Engineering, to bring Biomedical Optics (as it was called then) to Vanderbilt and build a program at the forefront of research and education. When we moved to Nashville, I was eight months pregnant and not ready for academic life! A lot has happened during these years!

Living far away from our family, starting a new life, in a new city, as new parents with new careers was a lot to handle, but we managed. As our kids grew, our lab also grew, and many of our students became like siblings and friends. At conferences, we not only showcased our work, but we also showcased our students' successes and the growth of our kids.

This year, at Vanderbilt commencement, the VBC saw 4 students walk and get hooded. Our daughter also walked as she received her JD! Wow, it brought to light how far we have come since we moved here 27 years ago.

Now, when I reflect back, I realize how far we have come - as parents, as faculty, and as mentors, as well as how much Biophotonics has grown at Vanderbilt. We have grown from just the two Jansens with a Biomedical Optics Lab to the world-renowned Vanderbilt Biophotonics Center with more than a dozen faculty who live in the Center and many more across campus, 50+ students, both undergraduate and graduate, as well as numerous postdoctoral fellows, research scientists and support staff. All those students and postdocs, we mentored over the years have gone on to engage in a gambit of careers including academia and industry from coast to coast within the United States and beyond. We are proud of the diverse community we have built that comes together for science, social interactions, and to just have some fun. Whether it's fluids lab, the summer picnic, journal club or our after-the-holiday holiday party with the infamous gift exchange, we typically use every opportunity to connect, collaborate and push the boundaries of what light can do.

We have become empty nesters at home now (for real this time), but our lives are still filled with our passion for what we do and the students we continue to mentor. And yet once our students leave, our connections become lost. It has been more than a quarter of a century, and we thought it was time to reconnect and share stories of our growth, successes and other happenings. Light Reading is designed to do that. It is an experimental endeavor, so please send us your feedback and questions so we can make it what you want to see about the VBC and its people. In the spring (if we can get our act together), we hope to celebrate the VBC with a reunion celebration. But you know you don't have to wait for an invitation, right? Stop by when you come to Nashville (it has become a popular destination city now), and let's do fluids lab together again soon.

Cheers, Prost, and Hook 'em, uh sorry, Go Dores.
Anita aka Dr. MJ

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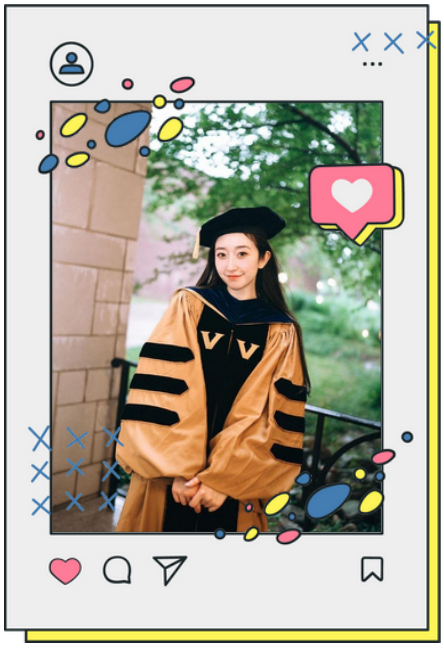
COMMENCEMENT

Left to Right : E. Duco Jansen, Alec Walter, Audrey Bowden, Shuang (Grace) Chang, Anita Mahadevan-Jansen, Sean Fitzgerald

Shuang (Grace) Chang, PhD

By: Alex Cousart



In 2018, Grace Chang started her journey to pursue a PhD in optics, driven by a passion for advancing medicine through her expertise in mathematics and physics. During her search for the right program, she encountered Dr. Audrey Bowden, who had recently transitioned from Stanford University to Vanderbilt University. Dr. Bowden emphasized the importance of collaboration and teamwork in academia, which resonated for Grace ultimately driving her to join the Bowden Biomedical Optics Lab (BBOL). As Dr. Bowden's first student, Grace played a crucial role in setting up a new lab and launched a project to enhance optical coherence tomography (OCT) for early glaucoma detection. Despite the absence of senior guidance, she independently navigated through Stanford's existing code, academic literature, and project grants to improve her research, which piqued her interest in machine learning and artificial intelligence.

Eventually, she honed further into her passions by pursuing a dissertation project on an OCT cystoscopy system for bladder cancer detection. She enjoyed collaborating with the urologists, seeing the patients, and seeing the impact of her work in the clinic. During this project, Grace mentored 8 undergraduates and 3 high school students who in term assisted her with the advancement of the project. Additionally, the Vanderbilt Biophotonics Center (VBC) community supported Grace throughout her journey and became her family, as she had none in the United States. Some of Grace's favorite memories of her time here include events such as fluids labs, Dr. Mahadevan-Jansen's holiday parties, and Photonics West.

Reflecting on her time in Nashville, Grace advises new PhD students to enjoy the journey and explore their surroundings. As she transitions to a career as a Robotic Control Software Engineer at Medtronic in Denver, she looks back with fondness and gratitude for the experiences and relationships that shaped her, carrying memories of her VBC family, Nashville's food scene, and the city's pleasant weather.

"Working with Grace has been one of the highlights of my career and she will be strongly missed in BBOL. Her work on bladder cancer detection is poised to make a great impact to clinical care and will benefit many people in the years to come. Congratulations on your graduation and good luck with your career."

- Dr. Audrey Bowden

Sean Fitzgerald, PhD

By: Anna Funderburg

After igniting a passion for developing photonic technologies while an undergraduate research assistant with Dr. Chetan Patil, an alumni of the VBC, Sean joined Dr. Anita Mahadevan-Jansen's lab in the Fall of 2018. Attracted by the development of cutting-edge technology at the VBC, Sean embarked on his thesis to determine the feasibility of applying Raman spectroscopy for noninvasive characterization of Otitis Media, an inflammatory disease responsible for pediatric ear infections. Throughout this project, Sean gained broad experience in many aspects of medical device development from optical design to clinical feasibility studies. When asked about his favorite aspects of his research, Sean says that getting the whole experience of developing a technology through the concept phase, to prototype testing, and eventually to the clinic where it can have a tangible impact on children suffering from Otitis Media.

Throughout his time at the VBC, Sean has always been a friendly face in the lab. Despite juggling numerous aspects of his problem at a time, Sean is always available to mentor junior graduate students and was never too busy for a fellow student who needed advice on a problem. Sean holds the community of the VBC in high regards and credits it with wonderful memories with his friends and colleagues. One specific memory Sean recalls was attending SPIE Photonics West in 2022 when the majority of Dr. Mahadevan-Jansen's lab attending along with Dr. Mahadevan-Jansen being the President of SPIE for the year. Sean says "it was a meaningful experience to witness us all congregate and celebrate the accolades of Dr. Mahadevan-Jansen, but also to really understand the importance of building true relationships with like-minds".

Sean's advice to younger students is to stay curious and creative and not let failures and roadblocks get in the way of the passion for exploration that brought you to graduate school. He further elaborates to find insights in the things that fail and apply these toward the problem you are trying to solve. For his future endeavors, Sean is currently exploring his career opportunities in the photonics industry, and hopes to have a career in product development at companies whose mission it is to bring these groundbreaking technologies to the communities that need them.

"When Sean first started in our group, we were not sure what to think of this guy. We know now what we think of him - we will miss his Raman instrumentation skills of course, but we will also miss his smile, willing to help, and his abilities to get stuff done."
- Dr. Anita Mahadevan-Jansen

Alec Walter, PhD

By: Parker Willmon

Around the FEL, Dr. Alec Walter is a familiar face. He always asks piquant questions at the VBC's journal club and weekly research meetings and is frequently seen holding his signature frog mug as he gets another cup of coffee. His frequent baking is a pleasure for us all, and he once bought every flavor of Pop-tart so an international postdoc could try them all. However, what many today may not know is that Alec did not intend to pursue a Ph.D. at Vanderbilt. Originally an incoming master's student in 2017, he was invited to attend the doctoral interview weekend, a very rare occurrence, which played a significant role in his decision to attend. He says the friendly atmosphere at the FEL and his time spent with Dr. Wilson Adams helped him choose Vanderbilt and his research advisor Dr. Duco Jansen.

Alec's status as a master's student allowed him to work on a new and small project Dr. Jansen was just starting up – anti-microbial photodynamic therapy – for killing infections using light to prevent the spread of antibiotic resistant strains. Along the way, Alec decided to pursue a Ph.D. and proposed the addition of spatial frequency domain imaging for determining the dose of light reaching the bacteria based on the optical properties of a patient's skin (e.g., skin tone and age). From here, his research "kind of devolved into a lot of… phantom work," which despite his phrasing, he greatly enjoyed. It required a lot of trial and error to develop robust shelf-stable optical phantoms for a variety of skin tones, but the work was impactful enough to catch the eye of NIST and the FDA, who are now looking to develop this work further.

In closing, Alec was asked to reflect on his experience and offer advice to new and future graduate students; he urged students to have or develop a side-project they are passionate about to provide motivation and distraction during times of difficulty on their main project. Now that his Ph.D. work is complete, Alec is putting that advice to use. He has transitioned to a post-doctoral position under Dr. Anita Mahadevan-Jansen and is expanding his research experience to Raman spectroscopy for various applications. His end goal is a tenure-track professorship pursuing various optical modalities for treatment and diagnosis, and for this reason he intends to obtain another post-doctoral appointment to further broaden his toolbelt before seeking a permanent position.

"Alec initially joined my lab, dead set on just doing a MS degree and then going on to Medical School. That – in my view – would have been a real waste of his incredible talent, so I'm glad I was able to convince him to stay and pursue his PhD degree and it is great to see him accomplish that. He has been a wonderful PhD student who has made significant contributions to the challenging field of tissue optics, revisiting some problems we thought we understood 30 years ago."
- Dr. Duco Jansen

Simon Ward, PhD

By: Parker Willmon

Simon's journey at Vanderbilt began in 2019 when he decided to join the lab of Dr. Sharon Weiss. Coming from across the pond, Simon was drawn from his home in England to work with a well-renowned professor in an interdisciplinary lab of material science, optics, and biosensing while putting his own spin of machine learning on a project. But while he came for the research, he says the friends he made both at Vanderbilt and at conferences, are what he truly treasures when he reflects on his time here. Whether it was watching various American sports, attending conferences, participating in the Clinton Global Initiative, or simply availing himself of the free food offered on campus, he managed to make great memories and lasting friendships.

If you look Simon's work up on Google Scholar, it comes as no surprise that he eventually earned a Ph.D. His most cited paper (388 times) comes from 2004, when he was only 10 years old! This paper looked at the capacity of 10-year-olds to drive their own research, and it is quite poetic that he earned his doctorate 20 years later. However, Simon's research over the past several years did not focus on the development of children as researchers but rather the use of statistics and machine learning to improve medical diagnostic tests. When applying his technique to tests, he managed to speed up test times by a factor of more than 5 using learning-based time-series forecasting, he reduced the dimensionality of data for better biomarker detection, and he even invented a signal processing algorithm that improved test sensitivity by more than an order of magnitude.

The next goal for Simon is to work in industry solving pressing problems using machine learning, but he will be sticking around in Nashville as his wife also completes her Ph.D. For the new students showing up, Simon says you should listen to some of the live music and try Nashville hot chicken! However, when it comes to actual research advice, he suggests establishing healthy habits early on whether it be a hobby or relaxation in order to reduce stress as you work through graduate school.

"His innovation in bridging complementary disciplines to find creative solutions to research challenges sets an outstanding example for the type of cutting-edge, interdisciplinary research that can be accomplished at Vanderbilt. In addition to his research accomplishments, Simon was a stand-out mentor to several undergraduate researchers and was recently recognized with a Vanderbilt University Graduate Anchor Award for Mentorship."
- Dr. Sharon Weiss

VBC CONNECTIONS

Tiffany-Chau Le

By: Alex Cousart

While pursuing her undergraduate studies at Vanderbilt, Tiffany-Chau Le joined the BBOL due to her strong interest in using low-resource engineering to address health disparities. Her work on developing an affordable, home-based monitoring device for chronic kidney disease has solidified her desire to integrate patient care with scientific inquiry, and she is now planning to pursue an MD/PhD program. After completing her undergraduate degree, Tiffany decided to take a gap year to further her research at the VBC and search for a graduate program that aligns with her interests. She came across the work of Dr. Isaac Pence, a fellow VBC alum who worked under Dr. Mahadevan-Jansen, at the University of Texas Southwestern. Dr. Pence's expertise in developing label-free, noninvasive optical tools for surgery and disease analysis through Raman spectroscopy was a perfect fit for Tiffany. His dedication to creating translational biophotonics technologies to address clinical challenges resonated with her. Tiffany is excited to join Dr. Pence's lab in Dallas, where she hopes to continue her research under his mentorship. When asked to say a few words about Tiffany Dr. Bowden said, "I am so excited to see you realize your dream to begin an MD/PhD program, which shows you to be among the best of the best of students! BBOL has really enjoyed having you in our lab and we really benefited from your full-time presence in the past year. I wish you well in you career – please keep in touch!"

RECENT PUBLICATIONS, PRESENTATIONS, AWARDS, & FUNDED GRANTS

Publications

- *Fiberscopic pattern removal for optimal coverage in 3D bladder reconstructions of fiberscope cystoscopy videos*
  - Rachel Eimen, Audrey Bowden
- *Towards improved 3D reconstruction of cystoscopies through real-time feedback for frame reacquisition*
  - Rachel Eimen, Audrey Bowden
- *Characterization of lamina propria remodeling in pediatric eosinophilic esophagitis using second harmonic generation microscopy*
  - Ezekiel Haugen, Girish Hiremath
- *Recognising the importance and impact of Imaging Scientists: Global guidelines for establishing career paths within core facilities*
  - Bryan Millis
- *Ultrasound Modulates Calcium Activity in Cultured Neurons, Glial Cells, Endothelial Cells and Pericytes*
  - Malachy Newman, Charles Caskey
- *SpecReFlow: an algorithm for specular reflection restoration using flow-guided video completion*
  - Haoli Yin, Audrey Bowden

Presentations

ARVO Annual Meeting 2024

- "*Development of a Traumatic Optica Neuropathy Model Induced by Blunt Force Trauma*"
  - Pratheepa Kumari Rashia, Tonya Rex
- "*Automated hands-free focus tracking and z-tracking for point-of-care ophthalmic OCT and OCTA*"
  - Jake Watson, Kenny Tao
- "*Real-time iOCT visualization using DMD-based heads-up display integrated with surgical microscope oculars for ophthalmic surgery*"
  - Samantha Morganti, Kenny Tao
- "*Quantification of retinal distortion and subretinal injection volumes with intraoperative OCT using intraocular reference features*"
  - Rachel Hecht, Kenny Tao

International Conference on Clinical Spectroscopy

- *"Contact free Raman spectroscopy for clinical applications"*
  - Anita Mahadevan-Jansen
- *"Correlating in vivo and ex vivo Raman signatures of pediatric eosinophilic esophagitis"*
  - Ezekiel Haugen, Anita Mahadevan-Jansen

Awards

- Dr. Yuankai Huo (Computer Science) was awarded 100,000 Node hours on DOE Oak Ridge National Laboratory Summit HPC by the NAIRR.

Funded Grants

- "Artificial intelligence to estimate extent of cGVHD from patient photos", Awarded by the NHLBI to PI Dr. Eric Tkaczyk
- "Quantitative assessment of cutaneous systemic sclerosis", Awarded by the Department of Veterans Affairs to PI Dr. Eric Tkaczyk

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