OPTICA | Formerly OSA

Imaging Through 100 Scattering Lengths

08 – 10 November 2023
Optica Headquarters
Washington, DC, USA

optica.org/incubator

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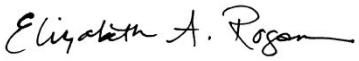
Welcome

Hello and welcome to Washington, DC, and the **Optica Incubator on Imaging Through 100 Scattering Lengths.** This program has been developed by Daniele Faccio, University of Glasgow; Andreas Velten, University of Wisconsin-Madison; and Florian Willomitzer, University of Arizona.

The incubator begins on the evening of 08 November with a welcome dinner at 18:00 at Bistrot du Coin, located at 1738 Connecticut Ave NW. The following morning, Thursday, 09 November, there will be breakfast at 8:30, with the program beginning at 9:00 at Optica Headquarters. We have enclosed a map for your reference.

Incubator Meetings are designed to provide a unique and focused experience, allowing colleagues working in a niche field to meet and engage in discussions of related advances, challenges and opportunities. If you have feedback on the format of the Incubator program or suggestions for future Incubators, please share your thoughts with Hannah Walter-Pilon, Optica Director of Technical Community Engagement at incubators@optica.org.

Sincerely,



Elizabeth A. Rogan

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Incubator on Imaging Through 100 Scattering Lengths

08 - 10 November 2023

Hosted by:

Daniele Faccio, University of Glasgow, United Kingdom
Andreas Velten, University of Wisconsin-Madison, United States
Florian Willomitzer, University of Arizona, United States

Wednesday, 08 November 2023

Afternoon **Attendees arrive in DC and check into the Royal Sonesta Hotel**

18:00 EDT **Welcome Dinner**
Bistrot du Coin, 1738 Connecticut Ave NW

Thursday, 09 November 2023

08:30 EDT **Breakfast at Optica Headquarters**
2010 Massachusetts Ave NW

09:00 EDT **Welcome**
Ryan Strowger, Chief Events and Corporate Engagement Officer, Optica

09:15 EDT **Program Overview & Goals**
Daniele Faccio, Andreas Velten and Florian Willomitzer

09:30 EDT **Attendee Introduction Session**
Attendees will have 5 minutes to introduce their current work

10:30 EDT **Coffee Break**

11:00 EDT **Attendee Introduction Session (continued)**

12:00 EDT **Lunch at Optica Headquarters**

13:30 EDT **Discussion Session I: Fundamentals**
Discussion led by Daniele Faccio

15:00 EDT **Coffee Break**

15:30 EDT **Discussion Session II: Applications - Fog and Water**
Discussion led by Andreas Velten

17:00 EDT **Networking Dinner**
La Tomate, 1701 Connecticut Ave NW

Friday, 10 November 2023

08:00 EDT **Breakfast at Optica Headquarters**
2010 Massachusetts Ave NW

08:30 EDT **Discussion Session III: Applications - Bio/Body**
Discussion led by Florian Willomitzer

10:00 EDT **Coffee Break**

10:30 EDT **Breakout Sessions**
Question: If you teamed up and had unlimited funds made available to you, what would you do with that money?

12:00 EDT **Lunch at Optica Headquarters**

13:00 EDT **Report Out from Breakout Sessions and Discuss Next Steps**

14:00 EDT **Adjourn**

Hosts

Daniele Faccio

Professor, University of Glasgow
daniele.faccio@glasgow.ac.uk

Daniele Faccio is a Royal Academy Chair in Emerging Technologies and professor in Quantum Technologies at the University of Glasgow where he leads the Extreme-Light group. He worked in the optical telecommunications industry for four years before obtaining his PhD in Physics in 2007 at the University of Nice-Sophia Antipolis (France). His research focuses on quantum and computational imaging with applications ranging from fundamental physics questions (e.g. generation of entanglement in curved space) to applications in bio-imaging and healthcare.

Florian Willomitzer

Associate Professor, University of Arizona
fwillomitzer@arizona.edu

Florian Willomitzer is an Associate Professor at the Wyant College of Optical Sciences – University of Arizona and directs the Computational 3D Imaging and Measurement (3DIM) Lab. Prof. Willomitzer graduated from the University of Erlangen-Nuremberg, Germany, where he received his Ph.D. degree with honors ('summa cum laude') in 2017. During his doctoral studies, he investigated physical and information-theoretical limits of optical 3D-sensing and implemented sensors that operate close to these limits. Florian joined Northwestern University as Postdoc in Fall 2017, where he further shaped his current research profile. He became Research Assistant Professor in 2019. In Fall 2022, Florian joined the Wyant College of Optical Sciences at the University of Arizona as Associate Professor. In the 3DIM Lab, Prof. Willomitzer and his students work on novel methods to image hidden objects through scattering media or around corners, unconventional methods for precise VR eye-tracking, and the implementation of high-precision metrology methods in low-cost mobile handheld devices. Moreover, the group develops novel time-of-flight and structured light imaging techniques working at depth resolutions in the 100µm-range. Prof. Willomitzer serves/served as Chair and Committee Member of several Optica COSI conferences, Optics Chair of the 2022 IEEE ICCP conference, Committee member of Optica FiO and ODF conferences, and as reviewer for Nature, Optica (OSA), SPIE, IEEE, and CVPR. He is recipient of the NSF CRII grant, winner of the Optica 20th Anniversary Challenge, and his Ph.D. thesis was awarded with the Springer Theses Award for Outstanding Ph.D. Research.

Andreas Velten

Associate Scientist, University of Wisconsin-Madison
velten@gmail.com

Andreas Velten is Associate Professor at the Department of Biostatistics and Medical Informatics and the department of Electrical and Computer Engineering at the University of Wisconsin-Madison and directs the Computational Optics Group. He obtained his PhD in Physics at the University of New Mexico in Albuquerque and was a postdoctoral associate of the Camera Culture Group at the MIT Media Lab. He has included in the MIT TR35 list of the world's top innovators under the age of 35 and is a senior member of NAI, OSA, and SPIE as well as a member of Sigma Xi. He is co-Founder of Onlume, a company that develops surgical imaging systems, and Ubicept, a company developing single photon imaging solutions. His research focuses on computational imaging with ultra-fast light sources and detectors. This includes imaging through scattering, non-line-of-sight imaging, fluorescence lifetime-imaging, and fast, low light, and high dynamic range video capture.

Attendees

Andrei Ardelean

CTO, NovoViz
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Andrei received his BSc degree in Applied Electronics from The Polytechnic University of Timişoara (UPT), Timişoara, Romania, in 2015, the MSc degree in Microelectronics from Delft University of Technology (TUDelft), Delft, The Netherlands in 2017 and the PhD from The École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland in 2023. In 2016 during his Master's studies, he was an intern at the Advanced Detector Arrays, Systems and Nanoscience group with NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, USA. He is currently finishing his postdoctoral studies at EPFL in the Advanced Quantum Architecture Laboratory (AQUA). During his research, he has contributed to the design and testing of the first megapixel SPAD camera and has developed the first fully-reconfigurable SPAD processing array. He now serves as the founder and CTO of NovoViz, a fabless semiconductor company focused on the development of computational imaging SPAD sensors.

Amit Ashok

Professor, University of Arizona
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Dr. Amit Ashok is a Professor in the College of Optical Sciences and the Department of Electrical and Computer Engineering at the University of Arizona. He received his Ph.D. and M.S. degrees in Electrical and Computer Engineering from the University of Arizona and the University of Cape Town respectively. His research interests include computational/compressive imaging and sensing,

quantum-inspired imaging, Bayesian inference, statistical optics, and information theory. He has made several key contributions in task-based joint-design framework for computational imaging and information-theoretic system performance measures across several imaging modalities spanning RF to visible/IR and X-ray domains. He currently serves as the congress chair of Optica's Imaging congress and a general co-chair of SPIE's Anomaly Detection and Imaging with X-ray conference. His current research focuses on quantum-inspired imaging and X-ray transmission/diffraction imaging and sensing.

Randy Bartels

Investigator/Professor, Morgridge Institute, University of Wisconsin-Madison
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Randy A Bartels earned a BS in 1997 from Oklahoma State University, and an MS 1999 and PhD in 2002 from University of Michigan. During his graduate career, Bartles was supported by a National Defense Science and Engineering Graduate Fellowship and received numerous awards, including OSA's New Focus Student Research Award, a JILA scientific achievement award, and selection as a finalist for the DAMOP Thesis Award. He joined Colorado State University as an assistant professor in January of 2003. Prof. Bartels received the 2004 Adolph Lomb Medal and a 2004 CAREER Award from the National Science Foundation. His current research involves the control of molecular coherences for novel nonlinear optics and manipulation of ultrafast optical pulses, as well as development of EUV laser sources and optical systems. He is a Fellow of Optica and APS.

David Brady

Professor, University of Arizona
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David Brady works on array camera imaging systems, including systems with active illumination and aperture synthesis for wavefront sensing. He has also recently worked on analysis of coherent and partially coherent scatter for super resolution through bandlimited and distorted channels.

Shawn Divitt

Doctor, U.S. Naval Research Laboratory
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Dr. Shawn Divitt (Naval Research Laboratory, DC) is an expert in physical and statistical optics, computation, and mathematical methods. Since joining the Naval Research Laboratory in 2018 he has worked in non-line of sight imaging, imaging through obscurants in air and water, super-resolution imaging at a distance, and fundamental studies in optical scattering.

Ioannis Gkioulekas

Associate Professor, Carnegie Mellon University
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Ioannis Gkioulekas is an Associate Professor at the Robotics Institute, Carnegie Mellon University (CMU). He is a Sloan Research Fellow, and a recipient of the NSF CAREER Award and the Best Paper Award at CVPR 2019. He has PhD and MS degrees from Harvard University, where he was advised by Todd Zickler, and a Diploma from the National Technical University of Athens, where he was advised by Petros Maragos. He works broadly in computer vision and computer graphics, but focuses on computational imaging: this is the joint design of optics, electronics, and computation to create imaging systems with unprecedented capabilities. Some examples include:

imaging systems that can see around corners or through skin; passive 3D sensing systems with extreme resolution; ultrafast programmable lenses; imaging systems that adapt to their environments. Technical keywords that often show up in his research include: non-line-of-sight imaging, single-photon imaging, LiDAR, SONAR, interferometry, speckle, acousto-optics, physics-based rendering, differentiable rendering, Monte Carlo simulation, probabilistic modeling.

Roarke Horstmeyer

Assistant Professor, Duke University
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Roarke Horstmeyer is an assistant professor of Biomedical Engineering, Electrical and Computer Engineering, and Physics at Duke University. He develops microscopes, cameras and computer algorithms for a wide range of applications, from forming large-area, high-resolution 3D videos of freely moving organisms to detecting blood flow and brain activity deep within tissue. Before joining Duke in 2018, Dr. Horstmeyer was a visiting professor at the University of Erlangen in Germany and an Einstein International Postdoctoral Fellow at Charité Medical School in Berlin. Prior to his time in Germany, Dr. Horstmeyer earned a PhD from Caltech's EE department (2016), an MS from the MIT Media Lab (2011), and bachelor's degrees in Physics and Japanese from Duke in 2006.

Jinyang Liang

Associate Professor, National Institute of Scientific Research (INRS) - Université du Québec
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Dr. Jinyang Liang is an Associate Professor at the Institut National de la Recherche Scientifique (INRS) – Université du Québec. He holds the Canada Research Chair in Ultrafast Computational Imaging (Tier II). He directs the Laboratory of Applied Computational Imaging (LACI). His research focuses on the development of new ultrafast computational optical imaging systems for applications in biomedicine, materials science, and advanced manufacturing. He has published >100 journal papers and conference proceedings. He has applied for >20 patents on ultrafast optical imaging technologies. He is a Senior Member of Optica and SPIE and serves as an Associate Editor of Optica's Photonics Research and a Senior Editor of Springer's PhotoniX. He received many awards, including the 2019 Young Scientist Prize from the International Union of Pure and Applied Physics (IUPAP) and the 2017 Educational Award–Gold from Edmund Optics. He received his Ph.D. degree in Electrical Engineering from the University of Texas at Austin in 2012. From 2012 to 2017, he was a postdoctoral trainee at Washington University in St. Louis and the California Institute of Technology.

Di Lin

Electrical Engineer, U.S. Naval Research Laboratory
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Dr. Di Lin received his Ph.D in electrical engineering from the University of Minnesota, with a focus in computational imaging and inverse problems. He led the development of a novel, passive non-line-of-sight imaging system based on plenoptic information conveyed by indirect photons as a post-doc at the University of Minnesota under the DARPA REVEAL program. After joining NRL, he developed software algorithms for the plenoptic wavefront sensor for tackling long-range, deep turbulence and is now

leading the development of a gated single-pixel system for imaging through turbid environments. His work primarily focuses on theoretical analyses for facilitating hardware design, algorithmic development for image processing and phase retrieval, and numerical validation of optical systems using mathematical modeling.

Muralidhar Madabhushi Balaji

Ph.D. Candidate, Southern Methodist University
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Muralidhar is pursuing a Ph.D. in the Photonics Architecture Lab at Southern Methodist University under the guidance of Prof. Prasanna Rangarajan. His research is centered on harnessing the distinct properties of coherent light to address complex imaging challenges such as non-line-of-sight imaging and imaging through scattering media. His dissertation leverages the latest advancements in tunable diode lasers, neuro-morphic focal plane arrays, and computational processing techniques to image through strongly scattering media.

Richard Paxman

Chief Scientist, Maxar
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I have been active for over 40 years in the problem of imaging through turbulent media. In the last decade I have also been interested in imaging through turbid (scattering) media. Here are some of those publications: “One-sided imaging of non-fluorescing objects through scattering media,” R.G. Paxman and D.A. Carrara, to be presented in SPIE conference on Unconventional Imaging, Sens[1]ing, and Adaptive Optics 2023, San Diego CA, August 21-24, 2023. “Focusing through dynamic scattering media,” C. Stockbridge, Y. Lu, J. Moore, S. Hoffman, R.G. Paxman, K.C. Toussaint, and T.G. Bifano, Optics Express 20, 15086-15092 (2012). “A vector transmission matrix for

the polarization behavior of light propagation in highly scattering media," S. Tripathi, R.G. Paxman, T.G. Bifano, and K.C. Toussaint Jr., Optics Express 20, 16067-16076 (2012).

Jack Radford

Research Associate, University of Glasgow
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I have recently completed my PhD under the supervision of Prof. Daniele Faccio, exploring the limits of imaging in the highly diffusive regime. My research interests include numerical and experimental exploration of diffuse optical imaging using ultrafast lasers and single-photon sensitive detectors. During my PhD, I published a numerical study using information theory to establish potential practical limits of imaging through highly diffusive materials and a separate study that analyses the contribution of diffuse photons to enhance image reconstruction. My ongoing work includes utilizing a machine learning framework featuring variational autoencoding to tackle the highly ill-posed inverse problem of imaging beyond 100 transport meanfree paths, numerical and experimental analysis of photon propagation through anentire adult human head, and exploring computational imaging paradigms using functional near-infrared spectroscopy measurements of brain activity from the visual cortex.

Prasanna Rangarajan

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Prasanna Rangarajan currently serves as an Assistant Professor in the Lyle School of Engineering at Southern Methodist University in Dallas, USA. He directs the activities of the Photonics Architecture Lab (PAL), which specializes in manipulating light and harnessing its power using machine intelligence to build EO/IR systems with unique capabilities.

Prasanna's current research interests focus on the interplay between Physical Optics, Signal Processing and Neuromorphic Sensing, and the unique insights afforded by synergistic activities spanning these disciplines.

Stefan Rotter

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Stefan Rotter is professor at the Institute for Theoretical Physics of TU Wien in Vienna, Austria. After studies in Vienna and Lausanne, he obtained his Ph.D. in 2004, followed by a postdoctoral position at Yale University. His group was established in 2011 and focuses on non-Hermitian physics, theoretical quantum optics and on the propagation of classical or quantum waves through complex media. In the domain of imaging, the Rotter group has recently proposed new strategies for deep imaging based on the concept of "Fisher Information" [1,2]. In particular, it has been shown, how to design the optimal input light field that extracts the maximum amount of Fisher Information from an object embedded inside or behind a disordered medium [1]. This information can then be used to optimally estimate the object's constituent parameters (like its position, size, orientation etc.). In striking analogy to the Poynting theorem, also the flow of Fisher Information from the object to an observer satisfies a continuity equation, that encapsulates the conservation of information even in complex scattering processes [2]. Another promising concept for deep imaging is that of "Scattering-Invariant Modes", which are light fields that are transmitted through a disordered media as through free space [3]. Preliminary results demonstrate that these special modes enable reflection matrix imaging and target detection even in the regime of strong multiple scattering, where conventional approaches fail.[1] D. Bouchet, S. Rotter, and A. P. Mosk, Nature Physics 17, 564 (2021)[2] J. Hüpfl, F. Russo, L. M. Rachbauer, D. Bouchet, J. Lu, U. Kuhl, and S. Rotter, arXiv:2309.00010[3] P. Pai, J. Bosch,

M. Kühmayer, S. Rotter, and A. P. Mosk, Nature Photonics 15, 431 (2021)

Abbie Watnik

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Abbie T. Watnik—the head of the Optical Techniques Section at the U.S. Naval Research Laboratory, USA. Watnik leads programs in electro-optics, laser propagation, orbital angular momentum, lidar, speckle imaging, imaging through scattering and adaptive optics. She received her B.S. in Electrical Engineering from Colorado State University, USA, and her M.S. and Ph.D. in Optics from the University of Rochester, USA.

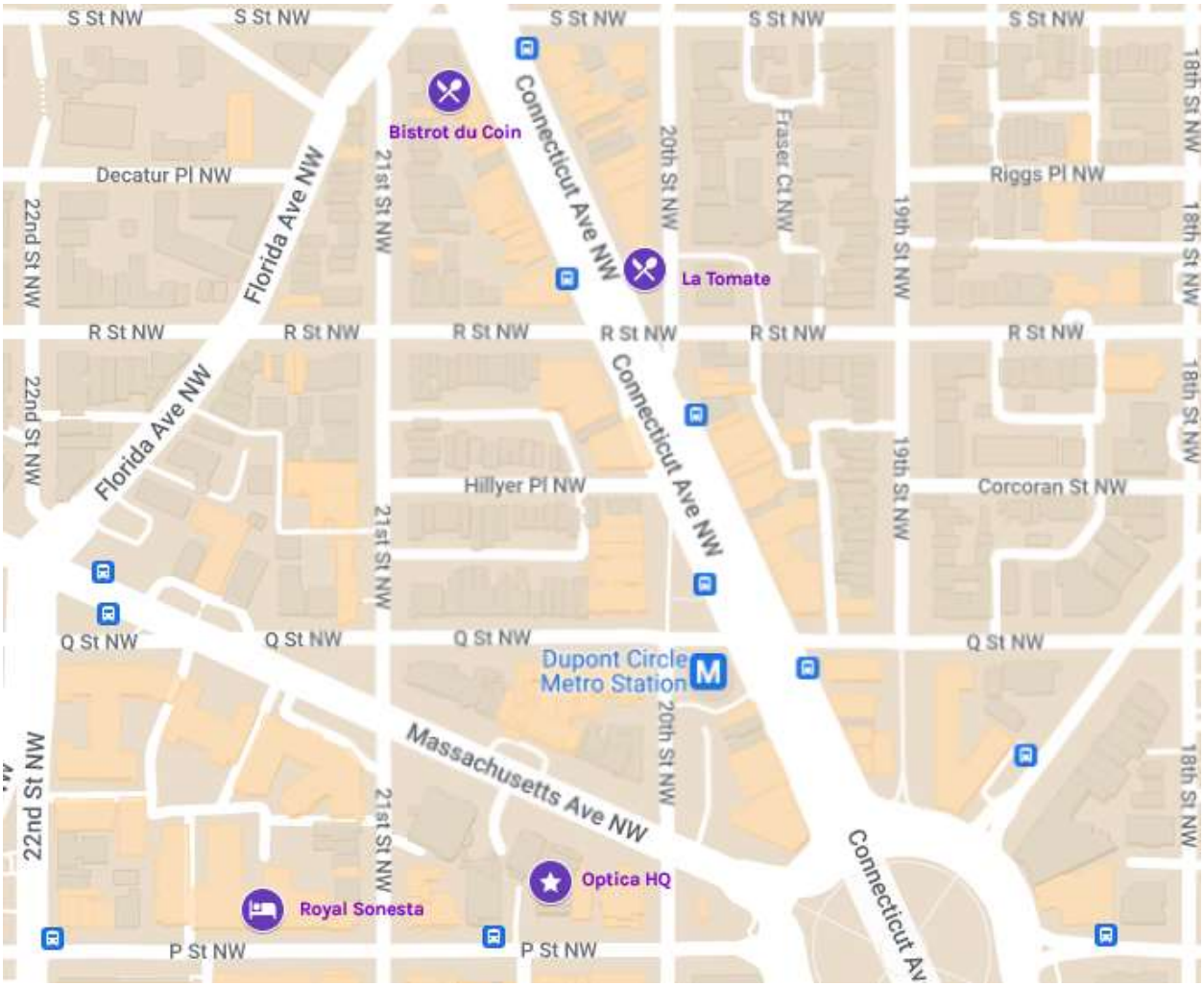
Map

Optica Headquarters: 2010 Massachusetts Ave NW

Royal Sonesta Hotel: 2121 P St NW

Welcome Dinner: Bistrot du Coin, 1738 Connecticut Ave NW

Networking Dinner: La Tomate, 1701 Connecticut Ave NW



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- Email codeofconduct@optica.org