

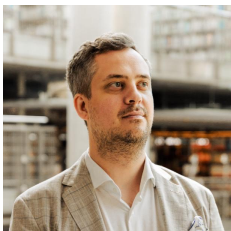
Less is more: Advancing Large-Scale 2D and 3D Quantitative Label-free Imaging with Lensless Digital Holographic Microscopy and Tomography

Warsaw University of Technology, Poland

Maciej Trusiak

Email: maciej.trusiak@pw.edu.pl

We present both numerical and experimental advances in high-throughput label-free lensless computational imaging for two- and three-dimensional technical and biomedical applications. Our focus is on novel lensless holographic techniques enabling large-volume, high-content, label-free imaging of both amplitude and quantitative phase of unimpaired bio-samples. These approaches are particularly well-suited for in-depth analysis of cells and tissues, offering scalable solutions for next-generation biomedical diagnostics. We demonstrate the capabilities of these methods through high-precision validation using static phantoms fabricated via two-photon polymerization and real-life challenging imaging of fixed biological tissue slices and cell cultures and time-lapse examination of dynamic live cells. Finally, we outline key challenges and opportunities ahead in pushing the frontiers of large-volume label-free 2D/3D quantitative imaging.



Short Bio:

Maciej Trusiak is an Associate Professor at the Institute of Micromechanics and Photonics, Faculty of Mechatronics, Warsaw University of Technology WUT. He earned his B.Sc., M.Sc., and Ph.D. degrees in Photonics Engineering from WUT in 2011, 2012, and 2017, respectively.

Following his doctoral studies, he completed a one-year postdoctoral fellowship in the Optoelectronic Image Processing Group led by Prof.

Javier García and Prof. Vicente Micó at the University of Valencia, Spain. In 2022, he obtained his habilitation degree and launched the Quantitative Computational Imaging Lab (qcilab.mchtr.pw.edu.pl), focusing on computational imaging, lensless microscopy, optical metrology, interferometry and holography, quantitative phase imaging, and fringe pattern analysis. In 2023, he was awarded the ERC Starting Grant for research on lensless, label-free nanoscopy. Prof. Trusiak is an active member of the optical science community. He is a Senior Member of SPIE and Optica, and served on the SPIE Award Committee, acting as Chair of the Maria Goeppert-Mayer Award in Photonics Sub-Committee and Member of the Chandra Vikram Award in Optical Metrology Sub-Committee. He has held various organizational roles, including Co-Chair and Committee Member of the SPIE Interferometry and Structured Light Conference at SPIE Optics + Photonics 2022 and 2025, and Chair of the Warsaw Summer School for Advanced Optical Imaging 2024. He is also a Scientific Committee Member of Computational Optical Sensing and Imaging (COSI) at the Optica Imaging Congress 2024 and 2025. He currently serves as Associate Editor for Applied Optics (Optica Publishing Group) and Optics and Lasers in Engineering (Elsevier), Executive Editorial Board Member for Journal of Physics: Photonics (IOP), and Editorial Board Member for Advanced Devices & Instrumentation (AAAS Science Partner Journal). He also reviews for numerous high-impact journals and agencies in the optics & photonics field.