Special Section Guest Editorial: Microendoscopy

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The field of microendoscopy is growing rapidly, with the goal of improving the accuracy of white light endoscopy and enabling new capabilities that are not possible with traditional endoscopy. Combined with flexible endoscopes, it is primarily focused on tissue characterization in the cardiovascular, digestive, and respiratory systems. In addition, rigid designs compatible with laparoscopes or needles are being developed for applications in the urinary and reproductive systems among others. Microendoscopes use a variety of optical technologies, such as confocal microscopy, multi-photon microscopy, photoacoustic, fluorescence imaging, spectroscopy, and optical coherence tomography. However, each technology faces specific challenges, such as efficient light delivery using optical fibers, miniaturization of the focusing optics, implementation of scanning mechanisms, and achieving a wide field of view while being compatible with standard care devices and procedures. State-of-the-art optical technologies are constantly emerging to improve all aspects of micro-optic solutions for endoscopy.

This special section consists of four original papers and one review paper. Li et al. developed a multispectral fluorescence line-scan confocal endomicroscope that can accurately assess lung nodules at the time of biopsy. The confocal endomicroscope uses multiple FDA-approved dyes to distinguish lung cancer from benign disease and has been successfully tested on both normal rat lungs and *ex vivo* human core biopsy lung tissue. Galvez et al. compared the performance of three custom distal optic systems, including a custom-pitch GRIN singlet, 3D-printed monolithic doublet, and 3D-printed monolithic triplet. They found that 3D printing allows for flexible design of monolithic multielement systems with short working distances, making them suitable for microendoscopy in collapsed or flushed lumens such as pancreatic duct or fallopian tube. González-Cerdas et al. presented a compact and sterilizable forward-viewing endomicroscope that enables imaging of tissue pathology inside the bladder through the working channel of a conventional cystoscope. The device uses microstructuring of fused silica and a fiber scanner driven by a tubular piezoelectric actuator for beam scanning, allowing for optical coherence tomograph (OCT) and optical coherence angiography (OCA). Caravaca-Mora et al. proposed an automatic scanning method for OCT using a steerable catheter integrated with a robotic endoscope to expand the field of view and improve scanning accuracy during minimally invasive treatment of colorectal lesions. The results show that the presented method provided high accuracy and smooth motion with improved control over the user-defined scanning patterns. Oh et al. provided a review of recent research on endomicroscopy, which uses small, tubular instruments to visualize microscopic structures in internal tissues. The article highlights recent developments in using coherent optical fiber manipulation to improve the resolution and miniaturization of endoscopic instruments, potentially enabling real-time histopathologic diagnosis through submillimeter thick probes. We hope that this special section will inspire new research directions and novel concepts in the microendoscopy field. We would like to thank Editor-in-Chief Hans Zappe for his unwavering support of this special section.

Hongki Yoo has been an associate professor in the Department of Mechanical Engineering at Korea Advanced Institute of Science and Technology (KAIST), Republic of Korea, since 2019. He obtained his PhD in mechanical engineering from KAIST in 2007 and later worked as a

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Michalina Gora is a manager in neurophotonics in the Wyss Center for Bio and Neuro-engineering. She obtained her PhD in physics and biomedical engineering in 2010 from Nicolaus Copernicus University in Poland. Subsequently, she was a postdoctoral researcher in the team of Prof. Guillermo Tearney at the Wellman Center for Photomedicine, Massachusetts General Hospital, and later a junior faculty at Harvard Medical School in Boston. In 2015 she joined the ICube Laboratory at the French National Center for Scientific Research (CNRS), where she led a research group focused on combining catheter-based optical imaging methods with robotics for comprehensive diagnosis and improved minimally invasive treatment of diseases. Her current research topics are focused on investigation of the connection between the gut and the brain using light to improve management of neuro and digestive disorders.

Xingde Li is a professor of biomedical engineering, electrical and computer engineering, and oncology at the Johns Hopkins University (biophotonics.jhu.edu). He received his PhD degree in physics from the University of Pennsylvania, followed by postdoctoral training at MIT. His research centers on biophotonics imaging technologies and their translational and basic research applications. He has published about 140 peer-reviewed journal papers, with a total citation ~21,000 and an H-index ~62 (Google Scholar). He has served on many committees of various societies and has chaired many international conferences including the Optica Biomed Congress. He is serving (or served) as a topical editor or associate editor for *Optics Letters*, *Biomedical Optics Express*, *Journal of Biomedical Optics*, *IEEE Trans on BME*, *Light: Science and Applications* etc. He is also the lead founding EiC for the recently launched AAAS Science Partner Journal – *BMEF (Biomedical Engineering Frontiers)*. He is fellow of Optica (formerly OSA), SPIE, and AIMBE.