Distinguished Lecture 4
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Associate Professor Wibool Piyawattanametha
National Electronics and Computer Technology Center (NECTEC)
& Faculty of Medicine Chulalongkorn University (MED CU)
Email: wibool.piyawattanametha@nectec.or.th

Dr. Piyawattanametha received a PhD degree in electrical engineering from the University of California, Los Angeles, in 2004. From 1994 to 1997, he was with Schlumberger, Ltd.

He is currently with the National Electronics and Computer Technology Center, Pathumthani, Thailand, as a director of Advanced Light Microscopy; the Faculty of Medicine, Chulalongkorn University, Pathumwan, Thailand, as a director of Advanced Imaging Research Center; and the Bio-X Program, Stanford University, Stanford, CA, as a research scientist and adjunct professor. He has authored or co-authored over 80 conference and journal papers, and has contributed 7 book chapters in the field of Microelectromechanical Systems (MEMS), Photonics, and Bio-medical Imaging. He serves as the technical program chairs for the Optical MEMS and Miniaturized Systems of the Society of Photo-Optical Instrumentation Engineers (SPIE) Photonics West Conference, USA; the International Conference on Bioinformatics and Biomedical Engineering (iCBBE), USA; and the IEEE Optical MEMS and Nanophotonics, USA.
Biomedical research truly needs new advances in imaging. Existing modalities of in vivo imaging, such as magnetic resonance imaging or ultrasound, lack the spatiotemporal resolution required to image the fundamental building block of living tissue. By contrast, existing high-resolution techniques for imaging cells and their sub-cellular features are technologies that are best suited for in vitro experiments in tissue slices. Yet, the ability to make direct connections between human pathological symptoms/behavior and the underlying cells and molecules responsible for such behavior requires in vivo techniques that can image cellular constituents. Our group research aim is to develop novel high-resolution optical endoscopes to satisfy unmet needs in the clinical environment. These differ from medical endoscopes, which are generally larger and designed to image macroscopic abnormalities. Most importantly, this novel optical endoscopic imaging might suggest new approaches to disease diagnosis and treatment. This talk will be focused on the development a novel and portable confocal imaging modality integrated with microelectromechanical systems (MEMS) technology and their clinical imaging applications (translational research). Confocal microscopy is an attractive tool for three-dimensional (3-D) imaging due to its optical sectioning property. Conventional single-axis confocal (SAC) microscopes have a tradeoff between resolution, field of view, and objective lens size, since a high numerical aperture (NA) lens is needed for sufficient resolution, and a long focal length is needed for a large FOV and working distance. A dual-axes confocal (DAC) microscope architecture has been proposed utilizing two overlapping low NA beams, which effectively decouples these tradeoffs. The other important advantage is the ability to achieve a much superior optical sectioning compared to the SAC design. The microscopes are miniaturized into two form factors (5-mm and 10-mm diameter). The imaging demonstrations of the probes were on both ex vivo and in vivo from mice and human for cancer oncology and genetic research.

Figure 1. Ex vivo fluorescence images of normal human colon tissue (a and b). Rings of colonocytes and crypt lumens are clearly resolved. Freshly excised colon tissues are soaked in the Li-Cor IRDye 800 CW solution for 1 min before being irrigated with water to remove excess dye. All scale bars are 100 μm.