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Commemorating 25 Years of Optical Coherence Tomography: a Perspective on Biomedical Applications

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Optical coherence tomography (OCT) has become a major medical imaging technology in the time since its inception now more than 25 years ago. During this time, OCT has become very well established in ophthalmology, and this application area largely dominates the field. Next in importance and stage of development is cardiovascular medicine, also a strongly commercial technology, but at an earlier stage and a slower pace of uptake than ophthalmology. Other application areas are generally less well developed, but continue to grow, and new opportunities continue to emerge across a wide range of topics, including beyond medicine and biology.

In parallel with these developments, research activity into the underlying devices, subsystems, methods, and techniques has also continued to grow. As the underlying technology has either matured or reduced in cost, old paradigms have continued to be revisited and fresh opportunities have been revealed, paving the way for a new generation of OCT technology translators.

The focus of this special section commemorating the 25th anniversary of OCT is on applications in medicine and biology, particularly focusing on applications outside of ophthalmology, and complementing other feature issues elsewhere. The special section has resulted in the collation of contributed and invited papers spanning a wide range of applications. Papers in this special section treat the main emerging application areas of gastroenterology, dermatology, and oncology, as well as more speculative earlier stage clinical applications in gynecology. Ophthalmology is represented by papers on visible light OCT and ocular biomechanics probed with

OCT. An enabling technology for a raft of applications is the capacity to hold the imaging instrument in the hand, and a review paper describes the technology and applications of such devices.

A challenge for emerging areas is the absence of a critical mass of researchers to drive the field forward, and this is apparent in some of the potential emerging areas, such as dentistry. At the same time, each new application involves different challenges and varying degrees of difficulty, which also determines the rate of progress. A re-emerging technology of note is polarization-sensitive OCT, which features in applications in osteoarthritis, burn scars, and oral tissues. Angiography is another prominent area currently, and three papers relate to new developments in the retina and brain.

Of final note is a historical account of the life and works of one of the pioneers of OCT, Adolf Fercher, who sadly passed away recently, written by his close colleague Christoph Hitzenberger. It is important to capture such perspectives before they are lost with the passage of time.

Across the microcosm of this special section, from whichever perspective you look, OCT remains true to the spirit of the broader field of biophotonics itself — with the focus on practical engineering to tackle practical challenges. 25 years on, despite the maturity of some areas, others remain relatively unexplored, and new doors are being opened by technical advances. This special section reinforces the perspective that OCT, as a research topic, is vibrant and strong, with many new opportunities in the wings waiting for clinical and commercial prime time.

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Engineering, The University of Western Australia, and is director of the Centre for Microscopy, Characterisation & Analysis, which is The University of Western Australia's microimaging core facility, and a node of the Australian Microscopy & Microanalysis Research Facility and the (Australian) National Imaging Facility. He is an SPIE Fellow, OSA Fellow, and IEEE Fellow. His personal research interests are in optics and photonics applied to medicine and biology.

Peter Andersen received his MSc and PhD degrees from the Technical University of Denmark, Denmark, 1991 and 1994, respectively. His current research interests include laser systems, optical coherence tomography, nonlinear microscopy, and multimodal imaging for biomedical applications.

Ton van Leeuwen is a full professor in biomedical physics and was appointed head of the Biomedical Engineering and Physics

Department at the Academic Medical Center of the University of Amsterdam in 2008. His current research focuses on the physics of the interaction of light with tissue. He uses that knowledge for the development, introduction, and clinical evaluation of emerging optical imaging techniques for gathering quantitative functional and molecular information on tissues.

Ruikang Wang has worked at Keele University, Cranfield University, Oregon Health & Science University, and the University of Washington (UW). He is now professor of bioengineering and professor of ophthalmology at UW. His research interests include optical coherence tomography, optical microangiography, and biophotonics. He is a fellow of the AIMBE, the OSA, and SPIE.