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Editorial: Translational clinical intraluminal imaging and optical sensing

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Editorial on the Research Topic
Translational clinical intraluminal imaging and optical sensing

Intraluminal imaging systems and optical sensing enable the exploration of otherwise inaccessible organs such as the gastrointestinal tract, the respiratory system, or the cardiovascular system. A variety of imaging modalities and sensing approaches have been developed and are in use in clinics, alone or in combination, including fluorescence, reflectance spectroscopy, ultrasound, and optical coherence tomography.

Physicians have been interested in shining light inside the body for examination since ancient times. Advances in optics, detectors, and light sources enabled modern endoscopy, which is now part of everyday clinical practice. Advances in the miniaturization of optical instruments are enabling ever greater access to probing narrow and tortuous deep-tissue structures. These advances contributed to the growth in our understanding of human anatomy, as well as physiological and pathological processes occurring within the body. Ultimately, clinical translation of intraluminal imaging and optical sensing aim to support more accurate diagnosis and drive the growth of personalized medicine.

This Research Topic comprises four articles that provide insight into the state of the art of intraluminal imaging and sensing systems. Special emphasis is given to the use of Optical Coherence Tomography (OCT) to image the vascular system. While OCT was first adopted by the ophthalmologic field in the 1990s, it is now gaining traction as an alternative or complementary method to ultrasound to visualize luminal structures, such as the cardiovascular system. It provides high-resolution images with enough depth to visualize vessel morphology and wall pathology with fine detail. Furthermore, high-speed imaging enables the quantification of dynamic processes, such as vessel contractility, that could be of great clinical significance to track changes in the cardiac cycle.

Anagnostakou et al. present *New frontiers in intracranial imaging with HF-OCT: Ex vivo human cerebrovasculature evaluation and in vivo intracranial arteries dynamic visualization*, where they describe a novel high-frequency optical coherence tomography (HF-OCT) system that has successfully reached the most distal parts of the anterior and posterior cranial vasculature. This is an engineering challenge that requires navigation through

tortuous environments. The authors show examples of cadaveric human craniovasculature and quantify vascular dynamics in an *in vivo* canine model.

Ku et al. offer an overview of OCT-based applications to visualize cerebral aneurysms in their *Review of intraluminal optical coherence tomography imaging for cerebral aneurysms.* They cover a range of work on device description and image acquisition, specifics on imaging the vessel wall, and the use of OCT to assess aneurysm treatment and monitoring. Additionally, they dwell on prospects for integration with clinical practice.

Given the extent and richness of the datasets acquired during intraluminal imaging, the technique of deep learning has a natural complementarity with these approaches. In their paper *Calcified plaque detected on OCT with deep learning and cross-validated with optical and ultrasound signals: A complementary appraisal and preamble to combined IVUS-OCT catheter*, Huang et al., demonstrate how deep learning approaches can be used to automate the classification of intravascular OCT images of suspected atherosclerotic lesions.

Intraluminal imaging goes beyond OCT applied to the cardiovascular system. An example of integration with existing clinical instruments appears in the article from Slomka et al. *Design, fabrication, and preclinical testing of a miniaturized, multispectral, chip-on-tip, imaging probe for intraluminal fluorescence imaging of the gastrointestinal tract*. The authors describe the design of a miniature chip-on-tip probe to image the gastrointestinal tract of mice, using fluorescence contrast from multiple exogenous markers, which could find application in gastrointestinal cancer diagnostics.

Author contributions

AG: Draft and review the manuscript. BS: Draft and review the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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