Advanced Photoacoustic and Optical Imaging

Organizing Chair: Chulhong Kim, *Senior Member, IEEE* and Jinyang Liang

Abstract— **This mini-symposium in IEEE EMBC 2020, "Advanced Photoacoustic and Optical Imaging" aims at bringing together seasoned and new researchers in the field of photoacoustic (optoacoustic) and optical imaging, and providing a platform to foster sharing and collaboration in this vibrant research area. In particular, an in-depth panel discussion will be devoted to the potential clinical and industrial impacts of this imaging area.**

I. INTRODUCTION

High-resolution volumetric optical imaging modalities, such as confocal microscopy, two-photon microscopy, and optical coherence tomography, are growing in their importance for biological and medical imaging. However, due to strong light scattering, the penetration depth of optical imaging is limited to the transport mean free path of photons in biological tissues (~1 mm). Photoacoustic imaging, an emerging hybrid modality that can provide strong endogenous and exogenous optical absorption contrasts, has overcome the fundamental depth limitation of optical imaging by maintaining excellent spatio-temporal resolution representative of ultrasound imaging. The image resolution, as well as the maximum imaging depth, is scalable with ultrasonic frequency within the reach of diffuse photons. In biological tissues, the imaging depth can be up to a few centimeters. Furthermore, photoacoustic imaging can noninvasively deliver anatomical (i.e., vascular structures, solid tumors and angiogenesis, and internal organs), functional (i.e., total hemoglobin concentration, hemoglobin oxygen saturation, blood flow, pH, and metabolic rate of oxygen consumption), and molecular information from living tissues. For highly sensitive molecular photoacoustic imaging, a valuable tool for personalized medicine, exogenous contrast agents (e.g., organic dyes, metallic and nonmetallic nanoparticles, reporter genes, or fluorescence proteins) with biomarkers are commonly utilized. Thanks to sharing the same signal detection mechanism with conventional ultrasound imaging, photoacoustic imaging can be easily adapted with the existing ultrasound imaging systems. Thus, clinical translation and commercialization should be relatively easy.

In this mini-symposium, the following topics will be discussed; (1) recent progress on photoacoustic, ultrasound, and optical imaging, (2) potential and/or ongoing clinical translation, (3) industrial perspectives of photoacoustic/ultrasound imaging and challenges for commercialization, and (4) a panel discussion, "Prospects of clinical and industrial impacts of advanced photoacoustic, optical, and ultrasound imaging.

II. PROGRAM

This mini-symposium will consist of a combination of 4 invited talks and a panel discussion. This mini-symposium will be scheduled during the conference under the Biomedical Imaging and Image Processing theme with a 90 minutes time slot.

List of invited speakers: 20 mins per talk

1. Chulhong Kim, PhD., Mueunjae Chaired Professor of Creative IT Engineering, Pohang University of Science and Technology, Republic of Korea. Expert area: Photoacoustic contrast agents and clinical photoacoustic imaging systems. (Confirmed to participate, www.chulhongkim.com)

2. Jinyang Liang, PhD., Assistant Professor of Centre for Énergie Matériaux Télécommunications, Institut national de la recherche scientifique (INRS). Expert area: High speed optical and photoacoustic imaging. (Confirmed to participate, https://jinyangliang.com/)

3. Jun Xia, PhD., Assistant Professor of Biomedical Engieering, State University of New York at Buffalo. Expert area: 3D clinical photoacoustic clinical imaging. (Confirmed to participate, http://www.acsu.buffalo.edu/~junxia/)

4. Parsin Haji Reza, PhD., Assistant Professor of Systems Design Engineering, University of Waterloo. Expert area: Optical detection of photoacoustic/ultrasound waves and their applications. (Confirmed to participate, https://www.photomedicinelabs.com/)

Panel discussion: 15 mins

Title: What are the grand challenges for successful commercialization and clinical translation

Topics: Challenges in ultrasound and laser technologies for photoacoustic, ultrasound, and optical imaging, clinical and commercial translation.

J. Liang is with Centre for Énergie Matériaux Télécommunications, Institut national de la recherche scientifique (INRS), Varennes, Canada (phone: 514-228-6812; e-mail: jinyang.liang@emt.inrs.ca).

C. Kim is with the Creative IT Engineering Department, Pohang University of Science Technology, Pohang, Republic of Korea (phone: 82-54-278-8805; fax: 82-54-279-8899; e-mail: chulhong@postech.edu).