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Dynamics and Fluctuations in Biomedical Photonics XIV

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Introduction

Dynamics and Fluctuations in Biomedical Photonics XIV was held 29–30 January 2017, at the SPIE Photonics West Conference in San Francisco, California. The goal of the conference was to gather essentially different groups of leading researchers such as biophysicists, medical doctors and physicians, mathematicians, and optical and laser engineers, together with students to report the current state of the art and to facilitate future progress in the development of optical and laser technologies based on dynamics and fluctuations approaches towards biomedical science and clinical applications (such as laser-speckle, speckle-based coherence imaging, microcirculation analysis using various optical techniques and methods, dynamics of molecular diffusion, including nanoparticles, etc.). These approaches should be useful for diagnosis and therapy of devastating life-threatening diseases such as those of the heart, cancer, vascular, mental illness, and many others that manifest as a breach of the living organism's immune systems at the level of molecule, cell, organ, or organism as a whole. We hope that proceedings of this conference will contribute to the development of such interdisciplinary fields of science and applications as dynamics and structures of living systems, biomedical optics and laser medicine, and that it will be useful to scientists, medical doctors, engineers and students.

Martin J. Leahy also moderated "*Panel Discussion on Biophotonic Methods for detection, monitoring and imaging of Lymph Circulation*". The panel discussion was on the lymph transport network and the recently discovered glymph network within the brain. The 2012 discovery of a lymph-like system in the brain has intensified the need to image and measure lymph and the brain's glymph (so-called because of the important role of glial channels) structure and function. Malfunction of lymph is associated with diseases including cancer and in glymph is associated with neurodegenerative disease. Biophotonics is well placed to fill this need and many of our colleagues have already demonstrated techniques for this purpose. These include: Microscopy, Imaging, Photoacoustics, Raman, OCT, MRI, PET, Speckle, Optical Clearing and Optogenetics. The study of (g)lymph pulsations; (g)lymphatic, endothelial, pericytes and smooth muscle cell function, (g)lymphangiogenesis, lymph chemistry; circulating tumor, immune cells and other materials all require more advanced techniques for discovery, diagnosis and therapy. This panel discussion reviewed the state of the art and discussed what has and should be done by our community to provide the necessary tools.

The panel discussion followed several related talks in the Dynamics and Fluctuations Conference, including an excellent keynote lecture by Ekaterina Galanzha on "Nanobiophotonics breaks lymphatic theranostic challenges." Galanzha illustrated the discovery of lymph in the seventeenth century, its neglect for two centuries, and its subsequent rise in the mid-twentieth century. There have been over 12,000 publications in the past half century. She outlined the main

methods used to image and measure lymph flow as well as an innovative technique for the ablation of circulating tumour cells. Together with Valery Tuchin, N.G. Chernyshevsky Saratov National Research State University (Russian Federation), she illustrated the importance of lymph in more than a dozen common diseases. Tuchin further described optical clearing for better visualization and animal models aimed at better understanding the lymph role in cancer. Gross lymph transport in adults and children was illustrated in videos provided by Eva Sevick, where the lymph was loaded with indocyanine green and its fluorescence detected.

Stanislav Emelianov described the use of ultrasound and photoacoustics along nanodroplets, microbubbles and molecular probes or endogenous contrast (~haemoglobins) as appropriate to for example, elucidate the production of micrometastatic foci are formed in sentinel lymph node within a few weeks of primary tumour formation. The developments in ultrasound and photoacoustics for anatomical, functional and cellular/molecular imaging, represent a powerful array of tools to understand, track and treat cancer.

However, (g)lymph imaging in the brain is among the great challenges for biophotonics imaging. Lihong Wang previously demonstrated the possibility to image blood vessels inside the intact human skull using photoacoustics and together with his imaging of vasculature and lymphatics in the whole mouse, this would appear to be a good candidate for glymphatic imaging in the brain.

Teema Myllylä described the blood brain barrier and relationship to the glymphatic system. He further showed the opening of the BBB through intra-arterial mannitol infusion. Oxana Semyachkina-Glushkovskaya discussed drugs.

Additionally, most of the sessions featured invited presentations. These presentations drew significant attention from the audience and resulted in wide coffee break discussions. The oral sessions and corresponding poster session featured many presentations that described different methods and techniques developed and applied to study complex problems of dynamics and fluctuations in biological systems on the scale ranging from cell to the whole body. The reader is encouraged to browse the table of contents for this issue to learn the full scope of the conference.

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