Editorial

Celebrating 10th anniversary of Photoacoustics

A R T I C L E I N F O

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Ten years ago, Vasilis Ntziachristos and Daniel Razansky, colleagues at the Technische Universität München (Munich, Germany) had a vision that rapidly growing research community of optoacoustic imaging needs its own journal. It is with their endless efforts the journal of Photoacoustics was created under auspices of Elsevier, a leader in information and analytics for customers across the global research and health ecosystems. The journal was dedicated to all technologies and applications that utilize acoustic waves generated by photons in the wide range of wavelengths of the electromagnetic spectra, including biomedical optoacoustic imaging, sensing and microscopy and classical photoacoustic spectroscopy and ultrasound. The driving force of the journal for all 10 years has been the community of biomedical researchers developing technologies and applications of optoacoustic tomography and photoacoustic microscopy, while industrial applications are gaining momentum in the recent years. Professor Vasilis Ntziachristos, the founding Editor-in-Chief of Photoacoustics, assembled a strong initial editorial board. In addition to Daniel Razansky, an expert in technological advances, he invited internationally recognized leaders in biomedical applications of photoacoustics, such as Sanjiv Gambhir, a world-wide authority in molecular imaging and Stanislav Emelianov, an expert in combined ultrasound and optoacoustic imaging enhanced with nanoparticle-based contrast agents. Three years ago, we created 5 Sections of the Editorial Board dedicated to the five major research areas in the scope of Photoacoustics: (i) technological advances, techniques and algorithms of signal and image processing, (ii) medical systems and clinical applications, (iii) preclinical research in functional and molecular imaging including contrast agents for diagnostics and therapy, (iv) high-resolution imaging and sensing (microscopy, mesoscopy, nanoscopy), (v) industrial applications and advances in system components.

It is rewarding to see that at the end of the first decade of its development, Photoacoustics is growing with even faster pace. With the recent cite score of 12.2 and impact factor of 9.656, Photoacoustics has become the journal of choice for the most prominent authors in the field of science and applications of technologies based on acoustic waves generated by optical pulses.

One parameter of excellence of any publication is the number of citations by peers. Therefore, in the year of the 10th anniversary of Photoacoustics, we would like to recognize the top 10 most influential research papers published in our journal based on their average annual number of citations. Below is the list of these papers.

1. Yao J., Wang L.V. Sensitivity of photoacoustic microscopy, 2014, vol. 2 10.1016/j.pacs.2014.04.002
2. Jansen K., Wu M., Van der Steen A.F.W., Van Soest G. Photo-acoustic imaging of human coronary atherosclerosis in two spectral bands, 2014, vol. 2; 10.1016/j.pacs.2013.11.003
3. Strohm E.M., Berndl E.S.L., Kolios M.C. High frequency label-free photoacoustic microscopy of single cells, 2013, vol. 1; 10.1016/j.pacs.2013.08.003
4. Hariri A., Lemaster J., Wang J., Jeevarathinam A.S., Chao D.L., Jokser J.V. The characterization of an economic and portable LED-based photoacoustic imaging system to facilitate molecular imaging; 2018, vol. 9 10.1016/j.pacs.2017.11.001
5. Oraevsky A.A., Clingman B., Zalev J., Stavros A.T., Yang W.T., Parikh J.R. Clinical optoacoustic imaging combined with ultrasound for coregistered functional and anatomical mapping of breast tumors, 2018, vol. 12 10.1016/j.pacs.2018.08.003
6. Jeon S., Park E.-Y., Choi W., Managuli R., Lee K.J., Kim C. Real-time delay-multiply-and-sum beamforming with coherence factor for in vivo clinical photoacoustic imaging of humans 2019, vol. 15 10.1016/j.pacs.2019.100136
7. Cho S., Baik J., Managuli R., Kim C. 3D PHOVIS: 3D photoacoustic visualization studio, 2020, vol. 18. 10.1016/j.pacs.2020.100168.
8. Zhou H.-C., Chen N., Zhao H., Yin T., Zhang J., Zheng W., Song L., Liu C., Zheng R. Optical-resolution photoacoustic microscopy for monitoring vascular normalization during anti-angiogenic therapy, 2019, vol. 15. 10.1016/j.pacs.2019.100143
9. Lang Z., Qiao S., He Y., Ma Y. Quartz tuning fork-based demodulation of an acoustic signal induced by photo-thermo-elastic energy conversion; 2021, vol. 22, 10.1016/j.pacs.2021.100272
Analysis of the 10 most cited papers shows that we have three exciting fields and trends to celebrate on the 10th Anniversary of our journal: (i) Clinical applications of optoacoustic tomography, (ii) Advanced methods of photoacoustic microscopy and (iii) photoacoustic sensing and spectroscopy of rare atmospheric gases, enhanced with quartz tuning fork.

Light is absorbed by molecules in the human body. Those molecules slightly warmed up by the optical energy generate optoacoustic signals. This phenomenon provides a unique opportunity to generate images that represent tissue functions with molecular specificity and, thus, enable much deeper understanding of diseases especially when combined with pictures of tissue anatomical structures. To further emphasize the importance of clinical applications of optoacoustic tomography for the readers of *Photoacoustics*, I would like to mention two reviews:

(i) Attia A.B.E., Balasundaram G., Moothanchery M., Dinish U.S., Bi R., Ntziachristos V., Olivo M. A review of clinical photoacoustic imaging: Current and future trends; 2019, vol. 16. 10.1016/j.pacs.2019.100144

(ii) Steinberg I., Huland D.M., Vermesh O., Frostig H.E., Tummers W. S., Gambhir S.S. Photoacoustic clinical imaging, 2019, vol. 14. 10.1016/j.pacs.2019.05.001

Each of these reviews has been cited about 200 times. While it is obvious that reviews generate more citations than regular articles, these excellent reviews reflect important new research fields paved by original research articles.

Photoacoustic microscopy is also of a great interest to the readers of *Photoacoustics*, not only because high resolution images of microvasculature are so beautiful, but also because microscopy in combination with artificial intelligence methods is being translated into indispensable tools for clinical pathology.

Photoacoustic spectroscopy for detection of rare gases at ppb level of concentrations once again proves that photoacoustic methods possess unmatched sensitivity. With growing concerns about global pollution and also demonstrated possibility of early detection of notorious diseases in the clinics, photoacoustic sensing using the quartz tuning fork detectors continues to gain interest in photoacoustics as one of the most important research fields in the 21st century.

When talking about new trends and emerging technological directions that have been pioneered in the past 10 years, I would like to mention the following:

(1) all-optical optoacoustic systems, pioneered by Paul Beard (University College London), and their recent enhancement through non-contact detection of acoustic waves pioneered by Roger Zemp (University of Alberta), represented in the list of the most cited papers by Chen S.-L., Guo L.J., Wang X. All-optical photoacoustic microscopy, 2015, vol.3. 10.1016/j.pacs.2015.11.001 and Hosseiniae Z., Le M., Bell K., Reza P.H. Towards non-contact photoacoustic imaging 2020, Vol. 20. 10.1016/j.pacs.2020.100207.

(2) laser ultrasound imaging with applications in nondestructive evaluation and medical imaging, represented in the list of the most cited papers by Pelivanov I., Ambrozinski L., Khomenko A., Koricho E.G., Cloud G. L., Haq M., O’Donnell M. High resolution imaging of impacted CFRP composites with a fiber-optic laser-ultrasound scanner, 2016, vol. 4. 10.1016/j.pacs.2016.05.002

and (3) advanced methods of computational photoacoustics, including iterative methods of image reconstruction with significantly improved speed and image analysis based on (AI) deep learning, represented in the list of the most cited papers by Grohl J., Schellenberg M., Dreher K., Maier-Hein L. Deep learning for biomedical photoacoustic imaging: A review; 2021, vol. 22. 10.1016/j.pacs.2021.100241 and Yang C., Lan H., Gao F., Gao F. Review of deep learning for photoacoustic imaging; 2021, vol. 21. 10.1016/j.pacs.2020.100215.

In summary, I would like to thank all authors who contributed outstanding research papers to *Photoacoustics* in the past 10 years. These papers represent new trends and advanced research directions, making our journal so interesting to read. I also would like to thank the Section Editors: Chulhong Kim, Stanislav Emelianov, Ferdinand Knieling, Benjamin Cox and Ivan Pelivanov, my partners, who dedicate their time and talent to publish exciting works making manuscripts even better through the peer review process.

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