**Biomedical Optoacoustic Imaging:**

**Exponential Growth from the First Ideas to Clinical Trials**

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**Abstract:**

Optoacoustic imaging established its place in the main stream medicine due to its capability to provide physician not only with anatomical, but also functional and molecular information. This lecture will discuss development of the field of optoacoustic imaging from pioneering works that set the basic principles of the technology to the first *in vivo* images, to the most recent validation of clinically viable systems, and finally our vision of the future medical imaging modalities and their applications in the main stream medicine and surgery. Since clinically viable applications require visualization of tissues at the depth of at least 1 cm, we are most interested in the optoacoustic technologies that enable high resolution imaging in the depth of tissue.

Discoveries that made optoacoustic imaging the most rapidly developing biomedical imaging technology in the 21st century are that (1) laser pulses may be effectively used to produce ultrawide-band acoustic pressure (ultrasonic waves) in biological tissues, which carry its main energy in the lower frequency range and, thus, propagate in tissues with minimal attenuation, (3) 2D and 3D images of the absorbed optical energy can be reconstructed with high resolution under the illumination condition of pressure confinement in the course of the optical energy deposition in a voxel to be resolved.

2D and 3D system designs will be discussed along with their advantages and limitations for specific biomedical applications. The most important results obtained by our group in the past 25 years will be presented, including *in vivo* preclinical and clinical functional-anatomical maps of vasculature and tumors. Diagnostic imaging of breast cancer motivated development of the first optoacoustic imaging systems in the early years, and today it has become the first commercially available clinical application. Many more clinical applications of the optoacoustic imaging will be commercialized in the near future. The technological developments that will transform optoacoustic imaging systems into compact and robust clinical modalities are the high power diode lasers and the supersensitive ultrawide-band ultrasonic detectors.

**Biography:**   
Alexander obtained a doctorate in laser spectroscopy and laser biophysics from the USSR Academy of Sciences in 1986. In 1992, as Whitaker Fellow, he joined the faculty at Rice University, where he invented and performed pioneering research in optoacoustic imaging. Prior to his leadership position at TomoWave Laboratories, he was a Chief Scientific Officer at Seno Medical Instruments, Vice President of R&D at Fairway Medical Technologies, Director of the Optoacoustic Imaging and Spectroscopy Laboratory at the University of Texas Medical Branch in Galveston and an Assistant Professor at the Department of Ophthalmology and Visual Sciences. Presently he holds a Santander Chair of Excellence in Physics at the University Carlos III of Madrid, Distinguished Professor of Medical Imaging at Guangzhou Medical University, an adjunct Professor of Biomedical Engineering at the University of Houston. Alexander is the holder of 21 patents, has published ten book chapters and over 200 scientific papers dealing with novel laser technologies applicable in biology and medicine. Dr. Oraevsky is the recipient of multiple research awards advancing biomedical applications of the optoacoustic imaging sensing and monitoring. Dr. Oraevsky is the founder and Chair of the largest conference in the field of laser optoacoustic ultrasonic imaging under the auspices of SPIE.