



Artificial Intelligence Meets OCT: From Signal Features to Deep Learning Trends

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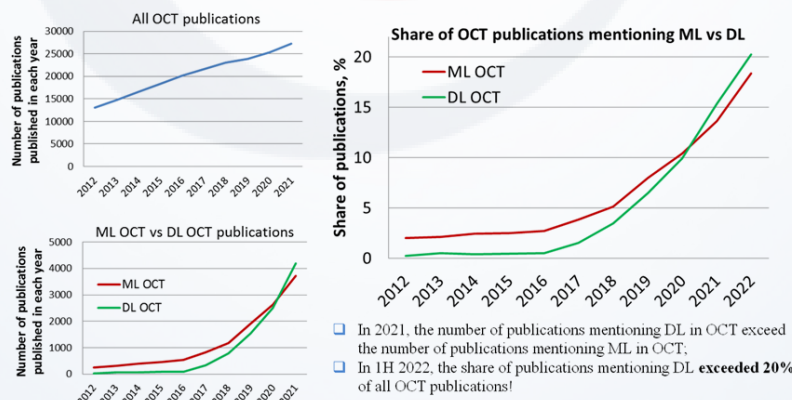
Abstract

Optical coherence tomography (OCT) is the medical imaging technique that fills the gap between ultrasound and microscopy. It is already standard diagnostic tool in ophthalmology and emerging diagnostic tool for other tissues and pathologies (in oncology, skin diagnostics, mucosa diagnostics etc.). Due to OCT interferometric nature the OCT signals contain a lot of features related as to optical properties (optical amplitude and phase and polarization) as well as speckle structure (spatial distribution functions, speckle contrast, temporal evolution etc.). OCT technique is rich in novel modalities for structural and functional imaging such as angiography, elastography, optical attenuation coefficient imaging, polarization-sensitive imaging and speckle contrast imaging. In the last decade the OCT implementation for non-ophthalmological applications are based on utilizing the signal features via machine learning approaches often called «radiomix». Currently, we are in the phase of the rise of deep learning methods in OCT. This presentation will review 1) how the OCT signal features are related to the tissue microstructure and processes (such as flows, deformations etc.); 2) what new new modalities based on these features were developed; 3) how these modalities and features were used for machine learning; 4) in what fields OCT deep learning is currently developing; 5) what tasks and applications of deep learning in OCT are most promising.

How deep is Deep Learning in Optical Coherence Tomography?

Evolution of “Machine learning” and “Deep learning” in OCT field

Data: Google Scholar, the number of publications from 2012 to 2021



OCT imaging modality development (devices, signal processing, modalities such as angiography, elastography...)

The rise of Machine Learning in OCT sometimes called “radiomix” (based on e.g. PCA, LDA, SVM...)

The rise of Deep Learning in OCT (e.g. based on neural networks).
In 2021 DL exceed ML in OCT.
In 2022 more than 20% of OCT publications mentioning DL.

AI and Data Science

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Biography

Dr. Lev A. Matveev is a signal & image processing and statistical machine learning professional. He obtained his MSc at the University of Nizhny Novgorod (Radiophysics Dept., 2007) and PhD at Institute of Applied Physics of the Russian Academy of Sciences (IAP RAS, 2010) in nonlinear acoustics diagnostic of heterogeneous materials. Currently his research interests are focused on Optical Coherence Tomography (OCT) and its applications. Dr. Matveev authors 50+ peer-reviewed scientific papers and is a Senior Research Scientist at the Russian Academy of Sciences.

