מכון ויצמן למדע

THE WEIZMANN INSTITUTE OF SCIENCE

FACULTY OF MATHEMATICS AND COMPUTER SCIENCE

Vision and Robotics Seminar

Room 1 ,Ziskind Building
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Big data - small training sets: biomedical image analysis bottlenecks, some strategies and applications

Abstract:

Recent progress in imaging technologies leads to a continuous growth in biomedical data, which can provide better insight into important clinical and biological questions. Advanced machine learning techniques, such as artificial neural networks are brought to bear on addressing fundamental medical image computing challenges such as segmentation, classification and reconstruction, required for meaningful analysis of the data. Nevertheless, the main bottleneck, which is the lack of annotated examples or 'ground truth' to be used for training, still remains.

In my talk, I will give a brief overview on some biomedical image analysis problems we aim to address, and suggest how prior information about the problem at hand can be utilized to compensate for insufficient or even the absence of ground-truth data. I will then present a framework based on deep neural networks for the denoising of Dynamic contrast-enhanced MRI (DCE-MRI) sequences of the brain. DCE-MRI is an imaging protocol where MRI scans are acquired repetitively throughout the injection of a contrast agent, that is mainly used for quantitative assessment of blood-brain barrier (BBB) permeability. BBB dysfunctionality is associated with numerous brain pathologies including stroke, tumor, traumatic brain injury, epilepsy. Existing techniques for DCE-MRI analysis are error-prone as the dynamic scans are subject to non-white, spatially-dependent and anisotropic noise. To address DCE-MRI denoising challenges we use an ensemble of expert DNNs constructed as deep autoencoders, where each is trained on a specific subset of the input space to accommodate different noise characteristics and dynamic patterns. Since clean DCE-MRI sequences (ground truth) for training are not available, we present a sampling scheme, for generating realistic training sets with nonlinear dynamics that faithfully model clean DCE-MRI data and accounts for spatial similarities. The proposed approach has been successfully applied to full and even temporally down-sampled DCE-MRI sequences, from two different databases, of stroke and brain tumor patients, and is shown to favorably compare to state-of-the-art denoising methods.