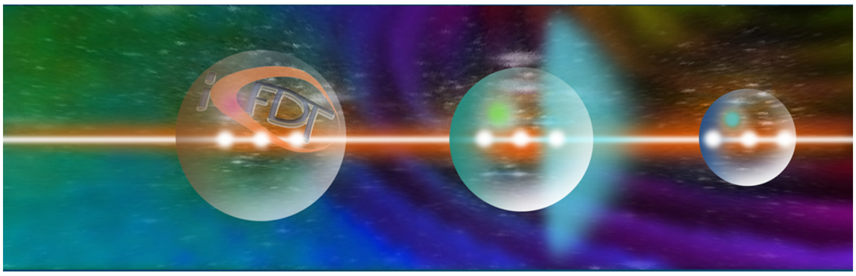

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Novel contrasts and technologies in diagnostic neuroimaging

Wednesday, October 3, 2018 12:00 PM (30 minutes)

Single modality neuroimaging has been a cornerstone of clinical as well as research applications in Neurology and Psychiatry (e.g. Alzheimer's Disease, Parkinson's Disease, Ataxias, Progressive Supranuclear Palsy just to name a few) as well as in a wide range of other diseases with neurological implications like Primary open angle Glaucoma, Obesity, Diabetes, Acquired Immunodeficiency Syndrome (AIDS) and Cancer just to name a few. The insights gained by standard modalities like e.g. structural (T1-weighted) Magnetic Resonance Imaging (MRI), Fluid-attenuated Inversion Recovery (FLAIR) (MRI), Electroencephalography (EEG), Computed Tomography (CT), fludeoxyglucose (FDG) positron emission tomography (PET) are by now crucial in correct diagnosis, disease staging, and tailoring of therapeutic strategies in clinical practice as well as in facilitating clinical trial. Still, more recent technological developments have the potential to empower diagnosis as well as clinical trials with 1) a number of novel imaging modalities which provide access to metabolic, functional, and microstructural information within clinically reasonable scanner times and 2) novel processing strategies and data integration algorithms which allow the formulation of multi-mechanisms hypotheses about the genesis, current stage and future evolution of brain disease. In this context, we will discuss recent developments in Magnetoencephalography (MEG)-based brain connectivity estimation, the advent and impact of combined PET-MRI machines on diagnostic accuracy and feasibility of multimodal imaging, the possibility of employed ultra-fast, ultra-high field MRI to estimate potentially novel biomarkers like the elasticity of the brain parenchyma and brain vascular tissue, and the use of advanced models for the diffusion weighted MRI signal in the brain in order to obtain both sensitive and specific white matter microstructural information. In addition, during the last three years a particular class of machine learning methods one particular class of methods known as deep neural networks (DNN) has provided disruptive innovation in a number of fields, including medical applications in general and decision support in complex problems based on multimodal data in particular. We will show how deep learning can be successfully applied to diagnostic problems in medical application with success rates which equal (and often exceed) those achieved by medical experts, as well as to related problems like radiation oncology treatment planning.

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