Jewish General Hospital
Lady Davis Institute for Medical Research

"Dynamic Contrast-enhanced Ultrasound Modeling of an Analog to Pseudo-diffusivity in Intravoxel Incoherent Motion Magnetic Resonance Imaging"

Dimitre Hristov

Associate Professor, Department of Radiation Oncology
Stanford University, Stanford, California

Abstract

Tumor perfusion and vascular properties are important determinants of cancer response to therapy and thus various approaches for imaging perfusion are being explored. In particular, Intravoxel Incoherent Motion (IVIM) MRI has been actively researched as an alternative to Dynamic-Contrast-Enhanced (DCE) CT and DCE-MRI as it offers non-ionizing, non-contrast-based perfusion imaging. However, for repetitive treatment assessment in a short time period, high cost, limited access, and inability to scan at the bedside remain disadvantages of IVIM MRI. We propose an analysis framework that may enable 3D DCE Ultrasound (DCE-US) - low cost, bedside imaging with excellent safety record - as an alternative modality to IVIM MRI for the generation of DCE-US based pseudo-diffusivity maps in acoustically accessible anatomy and tumors. Modelling intravascular contrast propagation as a convective-diffusive process, we reconstruct parametric maps of pseudo-diffusivity by solving a large-scale fully coupled inverse problem without any assumptions regarding local constancy of the reconstructed parameters. In a mouse tumor model, we demonstrate that the 3D DCE-US pseudo-diffusivity is repeatable, sensitive to treatment with an antiangiogenic agent, and moderately correlated to histological measures of perfusion and angiogenesis.