Bioengineering
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

SEMINAR

Non-Gaussian diffusion MRI for assessing tumor tissue microstructures

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Tuesday, March 13, 2018
11:00 a.m. - 12:00 p.m.
2240 DCL, 1304 W. Springfield Ave., Urbana

Tumor tissues exhibit a high degree of structural heterogeneity and complexity, which reflect the underlying biology. Encoding the diffusion-driven displacements of water molecules, diffusion-weighted MRI (DWI) has the potential to provide quantitative information related to the structural changes due to the physiologic and/or pathologic transformations in tissue. The assumptions made to characterize the distribution of diffusion displacements, however, have a direct impact on the tissue-characteristic information extracted from the DWI data. Given the heterogeneous nature of biological tissues, particularly the tumors, water diffusion does not follow the classical Gaussian distribution. Recognizing this complexity, several non-Gaussian diffusion models have been suggested to probe the underlying tissue microstructures and environment. Among these, the continuous-time random walk model, its predecessor fractional-order calculus model, and the fractional motion model were developed to examine the spatiotemporal and/or stochastic characteristics of biological tissue through non-Gaussian diffusion dynamics. This talk will present theory, implementation, and validation of these new non-Gaussian DWI models; and discuss their clinical applications in diagnosis and prognosis of different types of cancer, such as brain tumor, gastric cancer, and breast cancer.

Muge Karaman received her Ph.D. in Computational Sciences from Marquette University. She is a post-doctoral research associate in the Center for Magnetic Resonance Research at the University of Illinois College of Medicine at Chicago. Her current research interests include development of non-Gaussian diffusion MRI methods and their application for characterizing tissue complexity and heterogeneity, particularly for cancer diagnosis and treatment evaluation. She has published 11 peer-reviewed papers and 28 conference abstracts.