Department Seminars

Mathematics of higher-order SPD tensors and their estimation from DW-MRI

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Abstract:

In Diffusion Weighted Magnetic Resonance Image (DW-MRI) processing, a 2nd order tensor has been commonly used to approximate the diffusivity function at each lattice point of the DW-MRI data. From this tensor approximation, one can compute useful scalar quantities (e.g. anisotropy, mean diffusivity) which have been clinically used for monitoring encephalopathy, sclerosis, ischemia and other brain disorders. It is now well known that this 2nd-order tensor approximation fails to capture complex local tissue structures, e.g. crossing fibers, and as a result the scalar quantities derived from these tensors are grossly inaccurate at such locations. In this talk, I will present a 4th order symmetric positive-definite (SPD) tensor approximation to represent the diffusivity function and present a novel technique to estimate these tensors from the DW-MRI data guaranteeing the SPD property. Several articles have been reported in literature on higher order tensor approximations of the diffusivity function but none of them guarantee the positivity of the estimates, a fundamental constraint since negative values of the diffusivity are not meaningful. In this talk, I will show an application of Hilbert's theorem on ternary quartics –- when the 4^{th} order tensors are represented by ternary quartics -- in conjunction with the Iwasawa parameterization, which will guarantee an SPD 4th-order tensor approximation to the DW-MRI data at each lattice point. I will then present the performance of this model on several synthetic and real DWMRI data sets from excised rat and cat spinal cords.

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Note location change

12:00-1:00 p.m.

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