Numerical Analysis and Scientific Computing Seminar

Bayesian Modeling and Computation for Structural and Functional Neuroimaging

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Abstract: Since its advent about 30 years ago, magnetic resonance imaging (MRI) has revolutionized medical imaging due to its ability to produce high-contrast images non-invasively without the use of radiation or injection. In neuroimaging in particular, MRI has become a very popular and useful tool both in clinical settings (e.g., in vivo measurements of anatomical structures) as well as psychology (e.g., studying neuronal activations over time in response to an external stimulus). Despite the applicability and history of MR-based neuroimaging, however, considerable challenges remain in the analysis of the associated data. In this talk, I will discuss two recent projects in which collaborators and I use fully Bayesian statistical modeling to draw inference about both brain structure and brain function. The former work illustrates how prior information can be used to improve our ability to delineate the hippocampus in patients with Alzheimer's disease. The latter work discusses an approach that makes use of the full complex-valued data produced by an MR scanner to improve our ability to not only identify task-related activation in functional MRI, but to differentiate between types of activation that might carry different biological meaning. Along the way, I will mention some computational techniques we employ to facilitate Markov chain Monte Carlo (MCMC) algorithms to approximate the posterior distributions of interest.

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