JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH

Department of Biostatistics

BIOSTATISTICS SEMINAR

Inference for Eigenvalues and Eigenvectors of Diffusion Tensors

Dr. Armin Schwartzman
Department of Biostatistics
Harvard School of Public Health

Abstract

Diffusion tensor images (DTI) differ from most medical images in that values at each voxel are not scalars, but 3×3 symmetric positive definite matrices called diffusion tensors (DTs). In this talk, I present a series of papers concerning the problem of testing whether two groups of DTIs are equal at each voxel in terms of the mean DT's eigenvalues or eigenvectors. Following a matrix log transformation that eliminates the positive definite constraints, I present corresponding maximum likelihood estimators (MLEs) and log-likelihood ratio (LLR) tests for the eigenvalues and eigenvectors of Gaussian symmetric matrices. The parameter sets involved are either affine subspaces, embedded submanifolds or polyhedral convex cones of Euclidean space. I show that for a class of sets that includes the ones considered here, the MLEs of the mean parameter do not depend on the covariance parameters if and only if the covariance structure between the matrix entries is orthogonally invariant. Closed-form expressions for the associated LLRs are derived for this covariance structure, and then their distributions approximated asymptotically by scaled chi-squared distributions when the covariance structure is arbitrary. Voxelwise application of the test statistics over the entire brain leads to a large-scale multiple testing problem involving about 100,000 tests. The above methods show regions of differences in neural fiber directions in the white matter between boys and girls, significant at a false discovery rate level of 0.05.

The Johns Hopkins Bloomberg School of Public Health
Department of Biostatistics, Wednesday, November 3, 2010
Room W2030 School of Public Health, 4:00-5:00pm (Refreshments: 3:30)