Paul Yushkevich

Title:
Statistical Analysis of Shape and Appearance in 3D Medical Images Using Medial Models

Abstract:

Since the advent of in vivo medical imaging, our understanding of how the human brain works has increased dramatically. However, we still don't know precisely how various neurological disorders affect the anatomy and function of brain structures. Statistical comparisons of groups of subjects can often implicate brain structures in a disease and explain the pathology in terms of size, shape or change in inherent tissue properties. When structures are represented in terms of their medial axes (also known as skeletons), we are able to make statistical inferences in terms of intuitive features such as bending and thickness, relating these features to image intensities in a meaningful way.

In my talk, I will summarize the key ideas of medial geometry, defining the medial axis as a continuous locus of centers and radii of maximal inscribed balls in an object and deriving the relationship between the medial axis and the boundary using envelope equations. I will then discuss the challenges of building generative models that represent medial axes explicitly using parametric curves and surfaces and then define the boundaries of objects implicitly as a function of the medial axis. I will present a promising new approach in which the problem of medial modeling is formulated as solving a Poisson PDE on a curved manifold with non-linear boundary conditions.