Geometric Approach to Tractography in Brain Imaging (specialization Geometry, Topology, and Geometric Analysis)

by Temesgen Tsegaye Bihonegn (guarantor of the specialization Jan Slovák)

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Abstract:

Magnetic resonance imaging (MRI) is the non-invasive way of examining the micro-structure of biological tissue. Understanding the mechanisms of brain function is essential to better diagnose neurological disorders. However, data complexity makes this imaging method mathematically and computationally difficult. We use Riemannian geometric tools to tackle Tractography and Segmentation problems. This work discussed geometric analysis for fiber tracking and segmentation in medical tensor imaging. A systematic approach is proposed to improve fiber tracking algorithms and identify scalar quantities that could be used as biomarkers. On the basis of numerical solutions to the geodesic equations, a Riemannian geometry approach was applied to improve fiber tracking using appropriate activation functions and anisotropy data from the voxels. We present a method to choose the appropriate conformal class of metrics where the metric gets scaled according to tensor anisotropy. We use the idea that rotational information is related to the anisotropy of the tensor, and logistic functions can be exploited to capture it. In particular, the rotational information is misleading in nearly isotropic regions in the presence of noise, and the metric tensor is rescaled appropriately. In addition, we provide a framework for exploiting higher-order tensors (HOTs) appearing in high-angular resolution diffusion imaging (HARDI). These can potentially serve as biomarkers. It involves flattening of HOTs and extraction of the diagonal components.

See https://is.muni.cz/auth/th/l9ko0/?fakulta=1431;obdobi=8903 for the full text as well as the reports.