Master Project Mathematical Image Analysis
TRACTOMETRY for CONNECTOMICS

Project Description

In an ongoing project with the Neurosurgery Department of Elisabeth-TweeSteden Ziekenhuis in Tilburg we investigate the feasibility of so-called geodesic tractography to find major neural pathways (a.k.a. fiber tracts) in the brain. The premise is that one can find such pathways as shortest paths relative to a Riemannian (or, more generally, Finslerian) metric derived from diffusion magnetic resonance imaging. A feasibility study indicates that this is indeed the case, albeit at the expense of many ‘false positives’, i.e. spurious tracts that need to be pruned in order to retain only the biologically most plausible ones. In order to achieve this we want to investigate connectivity criteria based on a systematic study of (algebraic, differential, integral) invariants that can be defined for each tentative tract (this is what the term tractometry refers to).

Goal

The goal is to define operational criteria in terms of tractometric invariants that effectively remove false positive tracts while retaining true positive ones. Simulation data together with ground truth and experimentally obtained tracts are available.

Prerequisites

This project requires a strong affinity with differential geometry, and mathematics in general, as well as some programming skills in Mathematica. Highly recommended courses are Tensor Calculus & Differential Geometry and Differential Geometry for Image Processing.

Supervisor

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