Geodesic methods in Image Analysis.

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Tubular and tree structures appear very commonly in biomedical images like vessels, microtubules or neuron cells. Minimal paths have been used for long as an interactive tool to segment these structures as cost minimizing curves. The user usually provides start and end points on the image and gets the minimal path as output. These minimal paths correspond to minimal geodesics according to some adapted metric. They are a way to find a (set of) curve(s) globally minimizing the geodesic active contours energy. Finding a geodesic distance can be solved by the Eikonal equation using the fast and efficient Fast Marching method.

In this course we will present different methods based on geodesics from their basics to biomedical applications.

Here is an overview:

- Segmentation of tubular structures using a Minimal path between two points,
- Eikonal Equation, Fast Marching and front propagation
- Geodesics on a surface and geodesic remeshing of a surface
- Anisotropic Metric
- Finding a closed contour by iteratively adding keypoints
- 3D Extension to segment a surface linking two curves.
- Geodesic voting and tree structure segmentation
- Other Medical Applications: virtual endoscopy, visualization of vessels.