

Le prochain séminaire de l'équipe A3SI du LIGM (unité mixte de recherche de l'Université Paris Est) aura lieu le **Jeudi 16 juin de 13h30 à 14h30, salle 260** ([ESIEE PARIS](#)).

## Geodesic methods for Biomedical Image Segmentation

Laurent D. Cohen

CEREMADE, UMR CNRS 7534, Université Paris Dauphine

**Abstract:** 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 the past years we have introduced different extensions of these minimal paths that improve either the interactive aspects or the results. For example, the metric can take into account both scale and orientation of the path. This leads to solving an anisotropic minimal path in a 2D or 3D+radius space. On a different level, the user interaction can be minimized by adding iteratively what we called the keypoints, for example to obtain a closed curve from a single initial point. The result is then a set of minimal paths between pairs of keypoints. This can also be applied to branching structures in both 2D and 3D images. We also proposed different criteria to obtain automatically a set of end points of a tree structure by giving only one starting point. More recently, we introduced a new general idea that we called Geodesic Voting or Geodesic Density. The approach consists in computing geodesics between a given source point and a set of points scattered in the image. The geodesic density is defined at each pixel of the image as the number of geodesics that pass over this pixel. The target structure corresponds to image points with a high geodesic density. We will illustrate different possible applications of this approach. The work we will present involved as well F. Benmansour, Y. Rouchdy and J. Mille at CEREMADE.