

Medical image segmentation using machine learning techniques

Program: Ph.D. in Engineering

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Project Description:

The automatic segmentation and annotation of structures in medical images is essential to several key applications like assisted diagnosis, monitoring pathologies, and clinical research. While important, this process is also very challenging due to the low contrast, region overlaps and noise, typically found in medical images. Moreover, although several efficient segmentation approaches have been proposed over the years, such approaches usually require the intervention of a human to manually label regions of interest in the image or volume, a complex and time consuming task.

The goal of this project is to develop novel segmentation methods, based on machine learning techniques, which require no human intervention and are robust to the low quality of medical images. To achieve this goal, two machine learning techniques will be investigated: transductive learning and statistical shape priors. Transductive learning will first be used to transfer information from pre-labeled images, called atlases, to the target image. More specifically, techniques based on manifold embedding and random walks will be tested. Furthermore, a priori knowledge on the structures of interest, called shape priors, will also be used to improve the segmentation accuracy and robustness. The usefulness and efficiency of the proposed methods will be evaluated on various modalities, such as 3D MRI and 2D ultrasound.

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