ANALYSIS OF VESSELNESS FILTERS IN 3D MEDICAL IMAGES

Jonas LAMY

Univ Lyon, Univ Lyon 2, CNRS, INSA Lyon, UCBL, LIRIS, UMR5205, F-69676 Bron, France

Hepatic vessels segmentation in medical images remains an open problem. Yet, such segmentation is useful for praticians in several contexts including surgical planning. The difficulties of hepatic vessels segmentation are numerous. Compared to the volume of the liver, the vessels cover a sparser area. They exhibit a weaker contrast compared to neighbouring tissues, a variable morphology and for the smallest vessels, a size nearing the images resolution. The imaging context of computed tomography (CT) and magnetic resonance imaging (MRI) adds an extra layer of difficulties induced by specific artifacts (noise, contrast inhomogeneity, movement, etc.). To ease the segmentation process, one can use vesselness filters. These filters can improve the contrast of vessels by enhancing tubular structures. A number of such filters have been proposed in the literature, however the use of the same filters with default parameters has been observed in the majority of cases. In this context, our objectives are to understand this trend, by comparing the performance of several filters and to study their efficiency in the context of liver vessel imaging. We propose to build a reproducible and scalable benchmark able to evaluate the filters over areas of interest defined by the user. We then put this benchmark into practice by analysing seven vesselness filters over tree datasets (CT scans, MRI, and synthetic MRI). An exhaustive analysis of the filters is performed over six areas of interest : the organ, the vessels neighbourhood depending on the vessels size and the bifurcations. We also discuss the effect of the parameters settings of the filters and give usage recommendations depending on the segmentation context. This work regroups a comprehensive set of knowledge and public reproductible tools for anyone looking to use vesselness filters in their work.