A Computational Tool for Coronary Atherosclerotic Plaque Analysis of Virtual Histology Images

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Histopathological studies have shown an association between sudden death from acute coronary syndromes and the presence of ruptured plaques. This way, several efforts have been made for identifying profiles of rupture-prone atherosclerotic lesions. Diagnosis tools for in-vivo assessment of arterial wall composition have been playing a major role in this context. Virtual Histology (IVUS-VH) is an image modality, derived from intravascular ultrasound (IVUS), which allows the identification of atheromatous components, providing a frame-by-frame tissue classification into four classes: Fibrotic (FT), Fibro-Fatty (FF), Necrotic-Core (NC) and Dense Calcium (DC). According to current pathology consensus, intra-plaque spatial distribution of tissue elements has become an important issue for lesion classification. However, there is not an available environment to realize previously described analysis. To attend this demand, a computational tool has been developed in this work. ImageJ has been used as development framework, due to be an open-source platform for image processing built in Java language. Morphological operations and labeling algorithms of binary images were used to determine neighborhood relations between confluent sets of pixels, such as to measure distance to the arterial lumen. In order to attend the current classification scheme, automatic plaque type identification has been implemented as a new functionality. Automatic segmentation of grayscale IVUS images have also been implemented using active contours techniques. A sample test of 495 IVUS frames have been used to evaluate the accuracy of segmentation algorithms. For luminal contour, an average true positive rate (TPR) of 72.3% has been achieved. For adventitia contour, the average TPR was 80.9%. These are encouraging results, once we visualize some possible modifications in order to improve our methods. In the next months, we intend to distribute this tool for download under request.