Atherosclerotic Plaques Recognition in Intracoronary Optical Images using Neural Networks

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Aims: Coronary artery disease (CAD) is one of the leading causes of mortality world-wide. CAD is intrinsically related to atherosclerosis, which is a vessel wall inflammation forming an atherosclerotic plaque, composed by several types of tissues. The rupture of this plaques is responsible for most acute coronary events. The imaging modality called intracoronary optical coherence tomography (IOCT) enables a detailed high resolution visualization of microstructural changes of the arterial wall in vivo. In this paper, we introduce a new way of identifying atherosclerotic plaques using 1D Convolutional Neural Networks (CNN) analyzing only the lumen contour.

Methods: The input data for the proposed model is the lumen contour signature (array of distances from lumen centroid to each contour point), depicted in Fig. 1. To relate distance vectors and plaque presence, we propose an one dimensional CNN architecture, composed by a sequence of convolutional layers and a dense layer that delivers a final classification outcome. We experimentally tuned the architecture considering a range of 1 to 5 convolutional blocks, varying the number of filters in each block, and the number of nodes in the dense layer and present the results from the different models tested.

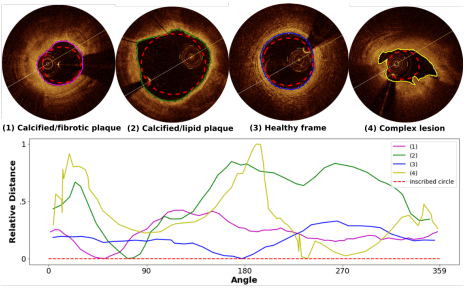

Fig. 1 - Signature of lumen contour.

Results: Training and test were performed with 1600 IOCT frames from in vivo patients. In our tests, we achieved f1-score of 95% for atherosclerotic plaque recognition.

Conclusion: The results allow us to report an interesting correlation between the lumen contour geometry and the presence of plaques in the vascular wall observed through IOCT exams. The use of lumen contour for plaque detection opens two new perspectives: assisting specialists in the task of detecting plaques visually by paying special attention to the lumen, and allowing methods to work in real time to detect plaques using efficient methods that use less information and deliver accurate results.