Graph-based Segmentation of Optimal IVUS Media-Adventitia Border using Shape Prior

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Abstract

We present a shape prior based graph cut method which does not require user initialisation. The shape prior is generalised from multiple training shapes, rather than using singular templates as priors. Weighted directed graph construction is used to impose geometrical and smooth constraints learned from priors. The proposed cost function is built upon combining selective feature extractors. A SVM classifier is used to determine an optimal combination of features in the presence of various IVUS tissues and artefacts. Comparative analysis on manually labelled ground-truth shows superior performance of the proposed method compared to conventional graph cut methods.

1 Introduction

Intra-vascular Ultrasound (IVUS) imaging is a catheter-based technology, which assesses the severity and morphology of the coronary artery stenosis. The media-adventitia border represents the outer coronary arterial wall located between the media and adventitia. The media layer exhibits as a thin dark layer in ultrasound and has no distinctive feature. It is surrounded by fibrous connective tissues called adventitia. The media-adventitia border in IVUS is disrupted by various forms of artefacts such as acoustic shadow or reverberation which can be caused by catheter guide-wire or fatty and cholesterol materials deposit and fibrosis formed inside the artery. Fig. 1 gives an example of IVUS image.

Common approaches to IVUS segmentation include graph cut and deformable modelling, and usually requires user initialisations [3, 7, 12]. The use of shape prior has shown to be a promising approach to tackle the ambiguities in identifying media-adventitia border. For example, Unal *et al.* [13] used principal component analysis (PCA) to generalise the shape variation. The initialisation of the media-adventitia border is based on the maximum