Assessing Cardiac Phase Retrieval in Intravascular Ultrasound

Aura Hernàndez-Sabaté*, Monica Mitiko Soares Matsumoto, Sergio Shiguemi Furuie and Debora Gil

Computer Science Dept, Computer Vision Center, Bellaterra, Barcelona, Spain

A good reliable approach to cardiac triggering is of utmost importance in obtaining accurate quantitative results of atherosclerotic plaque burden from the analysis of IntraVascular UltraSound. Although, in the last years, there has been an increase in research of methods for retrospective gating, there is no general consensus in a validation protocol. Many methods are based on quality assessment of longitudinal cuts appearance and those reporting quantitative numbers do not follow a standard protocol. Such heterogeneity in validation protocols makes faithful comparison across methods a difficult task.

We propose a validation protocol based on the variability of the retrieved cardiac phase and explore the capability of several quality measures for quantifying such variability. An ideal detector, suitable for its application in clinical practice, should produce stable phases. That is, it should always sample the same cardiac cycle fraction. In this context, one should measure the variability (variance) of a candidate sampling with respect a ground truth (reference) sampling, since the variance would indicate how spread we are aiming a target. In order to quantify the deviation between the sampling and the ground truth, we have considered two quality scores reported in the literature: signed distance to the closest reference sample and distance to the right of each reference sample. We have also considered the residuals of the regression line of reference against candidate sampling.

The performance of the measures has been explored on a set of synthetic samplings covering different cardiac cycle fractions and variabilities. From our simulations, we conclude that the metrics related to distances are sensitive to the shift considered while the residuals are robust against fraction and variabilities as far as one can establish a pair-wise correspondence between candidate and reference. We will further investigate the impact of false positive and negative detections in experimental data.