Automated Three-Dimensional Detection of Intracoronary Stent Struts in Optical Coherence Tomography Images

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Optical coherence tomography (OCT) is a new intracoronary imaging tool that has been recently introduced and has become the method of choice to investigate new treatment methods for coronary artery disease. Due to the OCTs high image resolution, hundreds of stent struts are visualized per patient and therefore a computer-assisted stent strut detection method could help to improve accuracy by reducing analysis time.

OCT images are converted to rows from which feature vectors are extracted. The mean, maximum and the sum of values above the mean of each row were evaluated by a K-nearest neighbor algorithm (mKNN) with help of a-priori information (detected in 3 frames per patient) and tested in two populations: 1) Stents acquired directly after implantation and 2) patients returning for a follow-up including tissue coverage on top of the stents. A user-interface was available for easy adjustments to the results as generated by the algorithm.

A total of 29 OCT datasets were analyzed containing a total 4024 frames. In the post-implant group (n=15), a total of 23608 struts were detected of which 3626 had to be removed, 115 moved and 1155 had to be added, resulting in a success rate of 77% for the algorithm. In the follow-up group (n=14), a total of 21077 struts were detected of which 5749 struts had to be removed, 1008 moved and 1915 added, resulting in a success rate of 50%. The average analysis time (automated plus correction), was on average 4.1 sec/frame for the post-implant and 6.3 sec/frame for the follow-up population.

Computer-assisted stent strut detection in OCT images is well feasible in patients directly after implantation. In patients who showed considerable tissue growth inside their stents at follow-up it is more challenging. However, the current proposed method can save considerable analysis time and helps to improve the accuracy.