Carotid Artery Tracking in Atherosclerotic US Images

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

Ultrasound (US) imaging technology is the most commonly used medical imaging tool for carotid artery screening. Measuring the carotid plaque area and Intima-media thickness (IMT) through US images is an essential way of identifying patients at increased risk of stroke, myocardial infarction, and vascular death. Several deep learning-based approaches have been proposed to automatically segment the carotid plaque in either longitudinal or transverse view. However, the generalization ability of the existing plaque segmentation method is limited due to the irregular shapes of plaques. Instead of segment the plaque directly from the original US images, utilizing the prior knowledge to pre-identify the plaque possible locations could potentially stimulate the generalizability. The segmentation framework is thus divided into two stages: one coarse localization stage, where the vessel is tracked and one fine segmentation stage, where the plaque is segmented.

Background and Motivation

A tracking network could be implemented to tackle the coarse localization task. Unlike plaques, vessel possesses a regular statistical shape model, which makes it possible to provide a stable searching template. However, because of the existence of plaques, the shape of vessel may vary throughout the carotid US sweep. In order to have a stable tracking performance, both spatial and temporal information should be exploited. Recent achievements in computer vision field [1,2] could be adopted to the US image analysis area to address such challenges.

Student's Tasks Description

In this project, the student should try to implement the proposed method of [1] and [2] to a new scenario, namely carotid artery tracking in atherosclerotic case and compare their performances. If there is time left, we can also try out other network structures or other techniques to increase the robustness of the network.

Technical Prerequisites

Python (pytorch)

Medical imaging processing

References

[1] Bhat G, Danelljan M, Gool LV, Timofte R. Learning discriminative model prediction for tracking. InProceedings of the IEEE/CVF international conference on computer vision 2019 (pp. 6182-6191).

[2] Wang N, Zhou W, Wang J, Li H. Transformer meets tracker: Exploiting temporal context for robust visual tracking. InProceedings of the IEEE/CVF conference on computer vision and pattern recognition 2021 (pp. 1571-1580).

Please send the completed proposal to ardit.ramadani@tum.de, zl.jiang@tum.de, lennart.bastian@tum.de and tianyu.song@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.