Automated stenosis Detection and Grading System

(Below is limited to 1-page only; be careful not to disclose vital technology content. Please delete these words when the document is finished)

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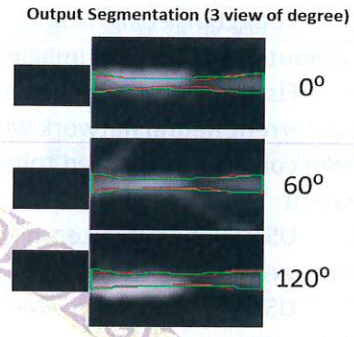
Experience:

https://med.ntuh.gov.tw/doctors/doc_profile.asp?section=cv&doctor=%A4%FD%A9v%B9D&employee=005307



Market Needs:

In the field of CT imaging, the limited spatial resolution of CT imaging, the intensity of high-density calcified plaque voxels will contaminate to neighboring voxels, resulting in blooming artifacts. Blooming artifacts make calcified plaques appear to be much larger on coronary computed tomography angiography (CCTA) than they actually are, resulting in an overestimation of the degree of coronary artery stenosis and increasing the chance of false positive(FP) diagnosis. Therefore, it is necessary to cooperate with downstream tests, such as invasive coronary angiography (ICA). However, this solution will increase the cost of treatment and is not cost-effective.

Our Technology:

Compared with the convolutional layer architecture used in the traditional U-net network, this study combines the convolutional long and short-term memory unit (ConvLSTM), which considering the relevance of space and time dimensions. The Mnet+ConvLSTM deep learning network architecture is proposed. The proposed model can refer to the information before and after the calcified plaque blood vessel boundary, effectively reducing the influence of Blooming Artifact on CT image and outputing the precise blood vessel inner wall segmentation. At present, the result of vessel inner wall segmentation can reach Dice Similarity Score = 0.8913.

Strength:

1. Consider the influence of Blooming Artifact on CT images, and label the training set data more accurately.
2. Refer to the clinical extension of the vessel at both ends of the plaque as a reference to interpret the position of the blooming artifact plaque. Consider the continuity of the slice and the slice before and after the 2D cross-sectional stacking of the 3D plaque image.
3. Propose the Mnet+ConvLSTM deep learning model architecture, which considering the. spatial–temporal correlation.

Competing Products:

Research

1. Hong, Youngtaek, et al. "Deep learning-based stenosis quantification from coronary CT angiography." Medical Imaging 2019: Image Processing. Vol. 10949. International Society for Optics and Photonics, 2019.
2. Zreik, Majd, et al. "A recurrent CNN for automatic detection and classification of coronary artery plaque and stenosis in coronary CT angiography." IEEE transactions on medical imaging 38.7 (2018): 1588-1598.

3. Zreik, Majd, et al. "Deep learning analysis of cardiac CT angiography for detection of coronary arteries with functionally significant stenosis." CoRR (2019).
4. Wolterink, Jelmer M., Tim Leiner, and Ivana Išgum. "Graph convolutional networks for coronary artery segmentation in cardiac CT angiography." International Workshop on Graph Learning in Medical Imaging. Springer, Cham, 2019.
5. Kong, Bin, et al. "Learning tree-structured representation for 3D coronary artery segmentation." Computerized Medical Imaging and Graphics 80 (2020): 101688.
6. Fischer, Andreas M., et al. "Accuracy of an artificial intelligence deep learning algorithm implementing a recurrent neural network with long short-term memory for the automated detection of calcified plaques from coronary computed tomography angiography." Journal of Thoracic Imaging 35 (2020): S49-S57.

Patent

1. US10483006B2 - Learning Based Methods For Personalized Assessment, Long-term Prediction And Management Of Atherosclerosis
2. US20170372475A1 - Method and System for Vascular Disease Detection Using Recurrent Neural Networks
3. US01069940720200630 - Method and system for assessing vessel obstruction based on machine learning
4. EP3654281A1 - Deep Learning for arterial analysis and assessment

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