Classification and identification for medical images by integrated deep learning with CNN and FCN models

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Abstract

Parkinson's disease (PD) is a degenerative disease. In clinical, single-photon computed tomography is often used to diagnosis with a high detection rate. However, PD staging through SPECT images requires subjective judgment. Therefore, this study used deep neural network approach to establish multi-stage PD classification model and the location of the active area of the striatum.

The study was a retrospective experiment. The ^{99m}Tc-TRODAT-1 nuclear medicine was collected for brain SPECT imaging. There were collected 202 cases, and the PD stage according to the clinical diagnosis report. It was used as the gold standard. The deep learning algorithm compares five convolutional neural networks (CNN) simultaneously, including AlexNet, GoogLeNet, Residual Neural Network, VGG, and DenseNet. Each subject captures 5 images of the maximum active striatum slice for establishment. The image data set uses 70% and 30% for training and verification, and then use fully convolutional networks (FCN) model to segment striatum location and active area. The efficiency evaluation method uses indicators such as accuracy, recall, precision, F-score, Kappa consistency, and intersection over union (IoU).

The research results show that AlexNet and DenseNet have better classification results in PD stage classification. The accuracy, recall, precision, F-score and Kappa were 0.83, 0.75, 0.87, 0.80, 0.73 and 0.85, 0.82, 0.90, 0.86, 0.72 with respectively.

The average accuracy and IoU of using FCN to cut the active area of the striatum were 0.79 and 0.75, respectively.
This study uses CNN and FCN model to classify PD images in multiple stages and segment the active area of the striatum. In the future, it will continue to explore the combination of machine learning models and parameter modification and hope to provide clinical assistance and teaching application.

Keywords: Parkinson's disease, convolutional neural networks, fully convolutional networks.