CTA image segmentation of pulmonary embolism based on RAUNet

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Abstract:

The traditional UNet model has the drawbacks of blurred boundaries and feature loss in the segmentation of small emboli and low-contrast lesions in pulmonary embolism (PE). To address this, this study proposes an improved RAUNet model that integrates residual learning and dynamic attention mechanisms, aiming to enhance the segmentation accuracy of CTA images. The model is based on the UNet architecture and is improved as follows: in the encoding stage, multiple residual modules are adopted, and cross-layer connections are used to alleviate the vanishing gradient problem and retain shallow texture features to enhance the recognition ability of small emboli; in the decoding stage, an attention gating module is integrated to strengthen the feature response in the lesion area. A hybrid loss function (BCE + Dice Loss) is used to balance the class imbalance problem and improve the convergence speed of the model. The experiments are based on the public dataset FUMPE, and the training/validation set is split using the hold-out method. The results show that the average Dice coefficient of the RAUNet on the test set reaches 79.1%, significantly outperforming the traditional UNet (71.3%) and ResUNet (75.6%), especially demonstrating more accurate segmentation performance in low-contrast regions. This study provides a high-precision solution for the intelligent auxiliary diagnosis of PE, laying a technical foundation for clinical translation and having significant application value in optimizing the diagnosis and treatment process of acute and severe pulmonary vascular diseases.

Keywords:

PE, Image segmentation, RAUNet, Residual Attention Mechanism, Dice Coefficient