IMPROVED U-NET DEEP NETWORK FOR RECTAL CANCER TUMOUR SEGMENTATION ALGORITHM

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Introduction

Colorectal cancer is one of the most common cancers in the world [1]. Colorectoscopy is the best method to prevent and detect colorectal cancer. However, it has been difficult to accurately detect and cut polyp images due to the diversity of sizes and shapes of polyp images during the examination.

Keywords: Medical image segmentation, U-Net, colorectal cancer, residual module.

Research methods

The U-Net network is mainly used for the segmentation of medical images. When it was proposed, it was mainly used for the detection of pulmonary nodules and the extraction of blood vessels on the fundus retina after the segmentation of the cell wall. The method is based on the U-Net model and uses the deep residual module to replace the original convolutional blocks in the encoding and decoding parts of the U-Net structure, which simplifies the training of the network and solves the problem of gradient degradation. The improved D-UNet network structure is mainly composed of a convolutional layer, a maximum pooling layer (downsampling), an inverse convolutional layer (upsampling), a deep residual module, and a ReLU nonlinear activation function. Its specific network structure is shown in Fig. 1.

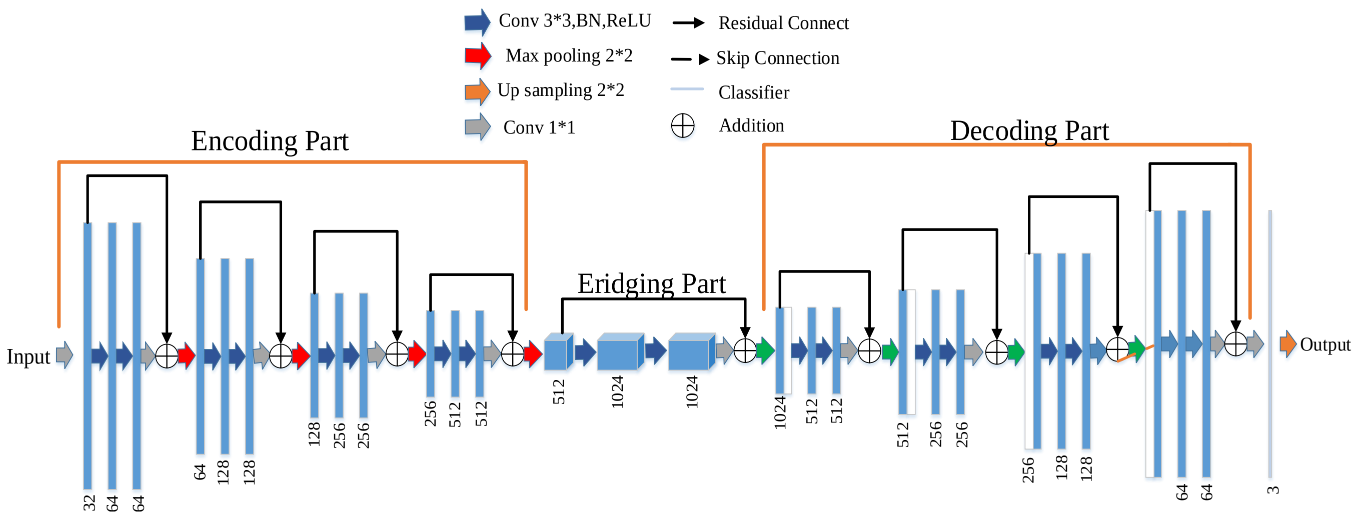

Fig. 1. D-UNet structure construction

Results

Read training files and test files. In this study, there were a total of 107 patient data files [2]. According to the «28 theorem», the data of 86 patients is used as the training set, and the data of 21 patients is used as the test set [3]. The CT images and annotated masks of rectal tumor regions were used as data training samples for training, as shown in Fig. 2. Because CT images are serial tomographic images, some images contain rectal tumor areas and some do not. All training and testing images are uniformly sized to 256 × 256 and normalized [4]. Using the control variable method, choose one of them to not use or change, carry out iterative training, get the Dice coefficient and analyze.

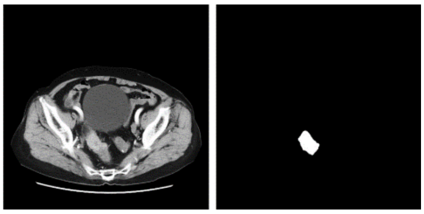

Fig. 2. CT Image and Label

Dice distance is used to measure the similarity of two sets, and a very well-known use of Dice coefficient is the F1 value of experimental performance evaluation. The Dice coefficients are defined as follows:

$$Dice = \frac{|A \cap B|}{|A| + |B|}$$

At the same time, in order to preserve the integrity of the tumor region during training, only thresholding is performed during testing, which has the best effect. After the final 150 iterations of training, the similarity of the training set reaches 89.62 %, and the test set reaches 88.48 %. Similarity, that is, the accuracy of segmentation reaches 88.94 %, as shown in Fig. 3.

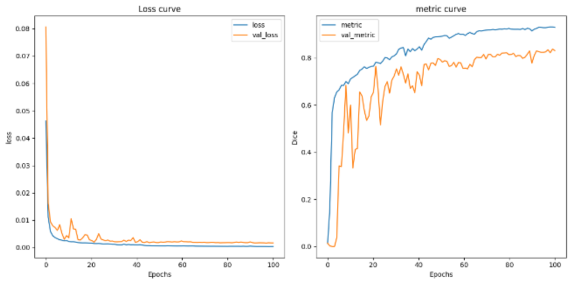

Fig. 3. During the training process, the D-UNet framework is computed for training loss and Dice for rectal cancer dataset

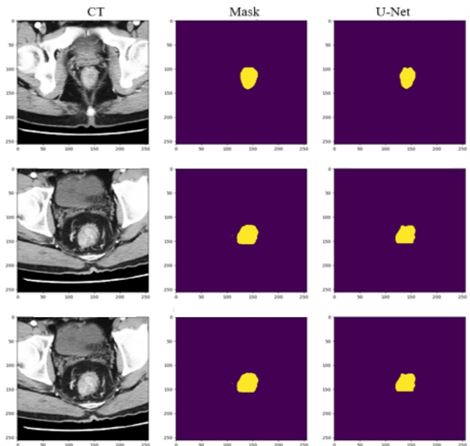

Fig. 4. Segmentation result

In order to observe the visualization effect, three CT images in the test set were randomly selected for display. The results are shown in Fig. 4. The yellow part in the figure is the segmented tumor location, and the purple part represents the non-tumor location. It can be seen from the visualization results that D-UNet network can segment the tumor location well, indicating that the model has good segmentation performance.

Conclusion

In this paper, an improved automatic tumour segmentation model based on U-Net neural network model is proposed for the problem of tumour segmentation in rectal cancer patients, and the similarity of segmentation (Dice coefficient) is verified and analysed. In this study, the segmentation of rectal cancer tumours using the

D-UNet network achieved the desired state: 88.94 %. This effectively solves a series of problems caused by doctors segmenting tumour locks with the naked eye and achieves automated and efficient segmentation.

Reference

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