RECTAL CANCER IMAGE SEGMENTATION METHOD BASED ON U-NET NETWORK

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Introduction

Rectal cancer is one of the common digestive tract malignant tumors, and its incidence is increasing year by year. Surgery is the only way to cure rectal cancer patients, and accurate extraction of rectal cancer tumor area is an indispensable prerequisite for surgery. In order to solve the problem that the massive data of rectal cancer CT images is difficult to process and the doctor's misdiagnosis rate and missed diagnosis rate, this paper proposes a U-Net segmentation based on U-Net segmentation to accurately extract the rectal cancer tumor area, obtain the mask image, and calculate the Dice coefficient and similarity analysis to provide reference for doctors' diagnosis and surgery.

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 [1]. The network has excellent segmentation performance in these aspects. U-Net network is a network that can achieve end-to-end mapping, which is very suitable for image segmentation, restoration, enhancement and super-resolution. The U-Net network structure is mainly composed of convolution layer, maximum pooling layer (downsampling), deconvolution layer (upsampling) and ReLU nonlinear activation function. Its specific network structure is shown in Fig. 1.

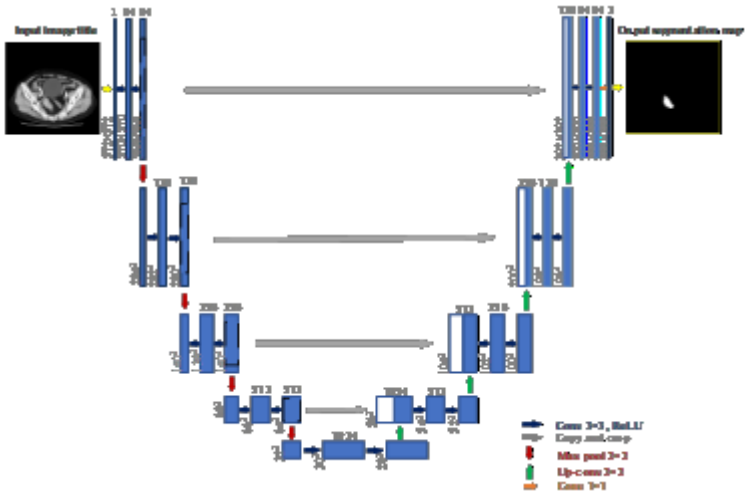

Fig. 1. U-Net structure construction.

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 [3,4]. The imaging data of patients with rectal tumors can be divided into two types: arterial phase and portal venous phase. The arterial phase is taken 25-30 s after the angiography injection, and the portal venous phase is taken 60 s after the angiography injection. There are differences in the strength of the area and surrounding tissue. In the actual tumor segmentation task, only the rectal tumor region needs to be segmented, so the two kinds of data are put together for training. 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 [5]. Using the control variable method, choose one of them to not use or change, carry out iterative training, get the Dice coefficient and analyze.

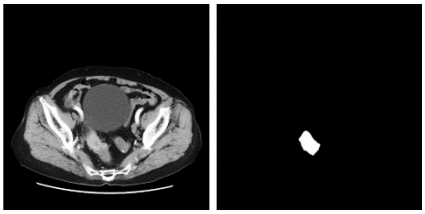

Fig. 2. CT Image and Label.

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 200 iterations of training, the similarity of the training set reaches 85.98%, and the test set reaches 85.76%. Similarity, that is, the accuracy of segmentation reaches 85.76%, as shown in Fig. 3.

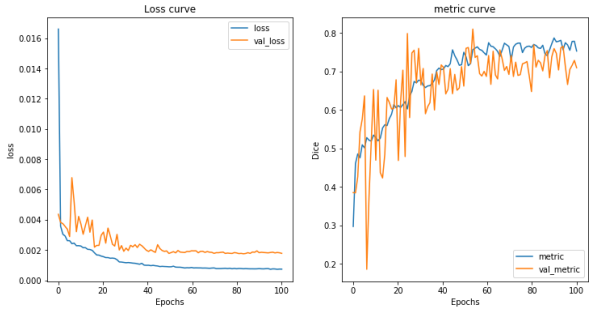

Fig. 3. During the training process, the U-Net framework is computed for training loss and Dice for rectal cancer dataset.

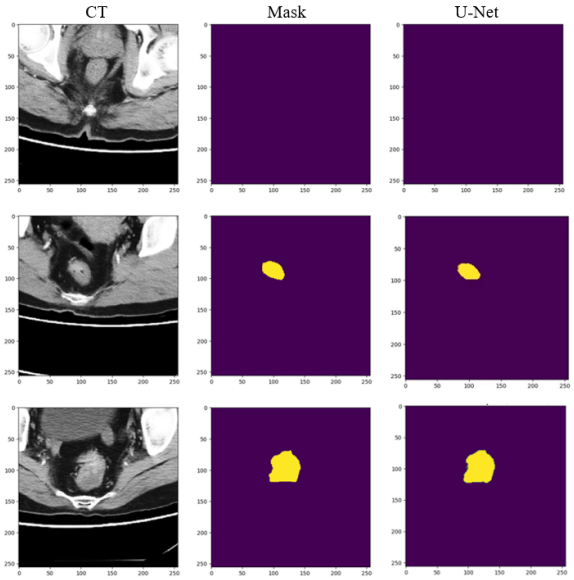

Fig. 4. Segmentation result.

In order to observe the visualization effect, three CT images in the test set were randomly selected for display. The results are shown in Figure 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 the U-Net network can segment the tumor location well, indicating that the model has good segmentation performance.

Conclusion

In this paper, an automatic tumor segmentation model based on U-Net neural network model is proposed for the tumor segmentation problem of rectal cancer patients, and the similarity of segmentation (Dice coefficient) is verified and analyzed. In this study, the segmentation of rectal cancer tumors using the U-Net network achieved an ideal state: 85.76%. This effectively solves a series of problems caused by doctors' segmentation of tumor locks with the naked eye, and realizes automatic and efficient segmentation.

Reference

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