# CONVOLUTIONAL NEURAL NETWORKS FOR BRAIN LESION SEGMENTATION IN MRI IMAGES

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Brain tumours are a disease with a very high morbidity and mortality rate, accounting for 2.4 % of all human tumour morbidity. Surgery is the only way to radically cure brain cancer patients, and accurate delineation of the tumour site in the brain is a prerequisite for surgery. In this paper, based on U-Net segmentation, the brain tumour region is accurately delineated, Dice coefficients are calculated and similarity analysis is performed to guide the diagnosis and surgical intervention of doctors.

U-Net is mainly used for medical image segmentation and has been proposed mainly for cell wall segmentation and then for lung nodule detection and blood vessel extraction on retina [1]. U-Net provides end-to-end imaging and is well suited for tasks such as segmentation, reconstruction, enhancement and super-resolution of images. The structure of U-Net network mainly consists of convolutional layer, maximum pooling layer (down-sampling), anti-convolutional layer (up-sampling) and nonlinear activation function ReLU, the specific structure of the network is shown in рис. 1.

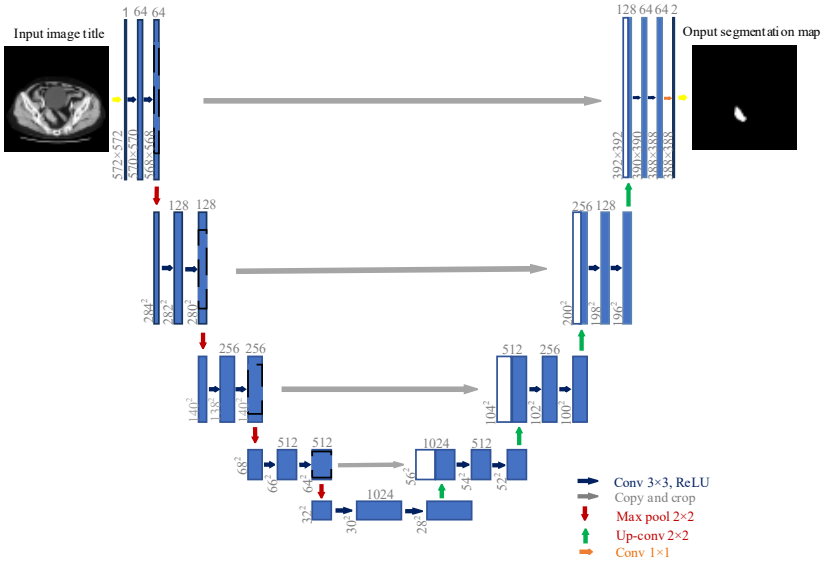


*Рис. 1. Построение структуры U-Net*[1]

Read the training and test files. In this study, there were 110 patient data files [2]. According to the two-eight theorem, 88 patients' data were used as training set and 22 patients' data were used as test set. MRI image mask and labelled brain tumour regions are used as training data samples for training, as shown in рис. 2. All training and test images have a uniform size of 256 × 256 and are normalized [3]. Using the control variable method, one of them was chosen to be unused or variable and iterative training was performed to obtain the Dice coefficient and analyse it.

The Dice distance is used to measure the similarity of two sets and the Dice coefficient is determined as follows:

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

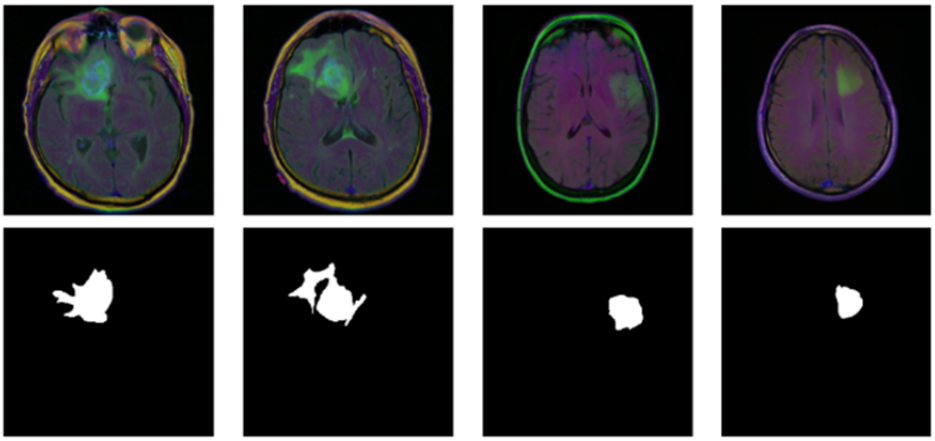

*Рис. 2. Изображение и этикетка CT*[2]

Meanwhile, in order to maintain the integrity of the tumour region during training, threshold selection is performed only during testing, which gives the best results. With 130 iterations of training, the segmentation accuracy reached 89.56 %, as shown in рис. 3.

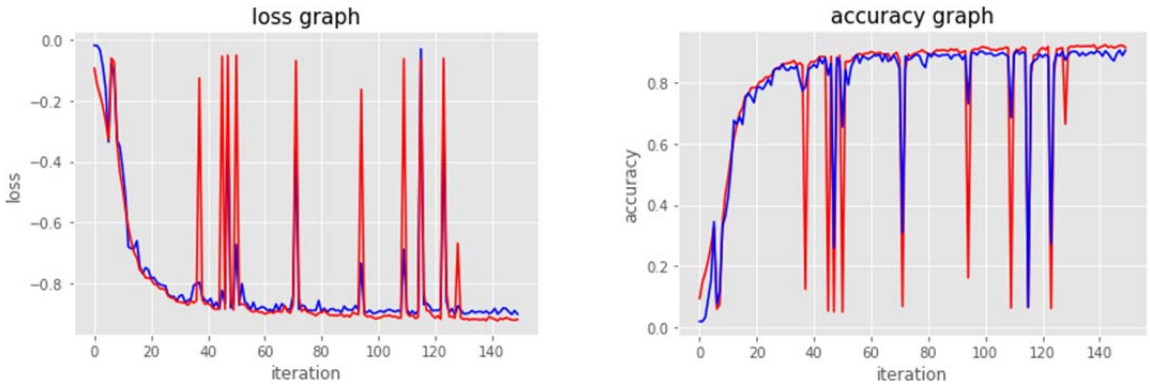


*Рис. 3. During the training process, the U-Net framework is computed for training loss and accuracy graph for brain cancer dataset*

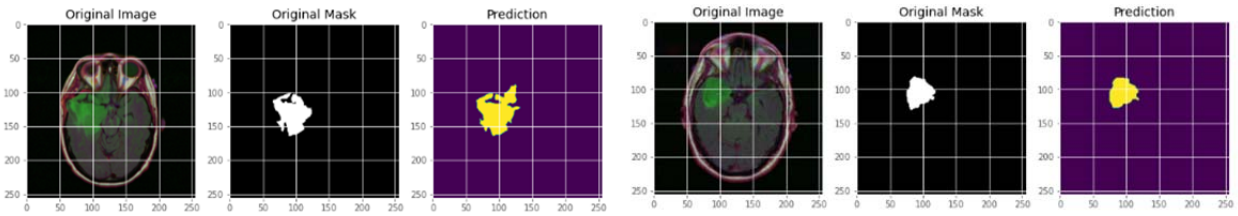


*Рис. 4. Результат сегментации*

In order to visualise the effect, two MRI images from the test set were randomly selected and the results are displayed in рис. 4, where the yellow part is the segmented tumour location and the purple part is the non-tumour location. From the imaging results, it can be seen that the U-Net network segments the tumour locations well, indicating that the model performs well in segmentation.

**Список литературы**

1. Ronneberger O., Fischer P., Brox T., «U-Net: convolutional networks for biomedical image segmentation,» International Conference on Medical Image Computing and Computer-Assisted Intervention, 2015, pp. 234–241.

2. Brain MRI segmentation: https://www.kaggle.com/mateuszbuda/lgg-mri-segmentation.

3. Aksenov S.V. Identification of bronchopulmonary segment containing COVID abrasions using EG-CNN and Segnet // XVIII Международной научно-практической конференции студентов, аспирантов и молодых учёных, Изд-во ТПУ, 2021. – С. 96–98.