

Research on Multimodal Medical Images Synthesis Based on GAN

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Abstract

The collection and annotation of medical images data have always been a challenge in many data-driven medical images processing tasks, especially for those based on registered multimodal medical image data. This problem can be largely alleviated by utilizing the image synthesis technology. However, medical images contain complex physiological structure information, and the directly-synthesized medical images generated by current methods usually have unreasonable structures or contours and uncontrollable lesions. The registration of different modalities when synthesizing multimodal medical images remains difficult. How to control the synthesis of the most critical lesion information in medical images is also a major problem. In addition, a more comprehensive way is needed to evaluate the performance of synthetic images and lesions.

To solve these problems, this study proposed a multimodal medical image synthesis method based on Generative Adversarial Networks, which can synthesize registration multimodal medical images with specified lesions. Experiments on multiple datasets have verified the availability of the synthesized images, the effectiveness of the synthesized lesions and the registration of the synthesized multimodal. The main contributions are as follows:

1. This study proposed a structural map extraction and synthesis method based on the Sobel operator, which does not require additional structural information labels or label extraction training. The method can extract structural map directly from the real images and then feed it to Variational Auto-Encoder for training. Finally, the trained model can achieve any number of structural maps synthesis from the random normal distribution matrixes.

2.This study proposed a multimodal registration medical images synthesis scheme that can control lesion synthesis. The randomly generated structural maps are used to fuse with the selected lesion labels and then synthesize multimodal medical images. The modal translator constrains the consistency of the translations between the multimodal synthesis and ensures the registration between the multimodal synthesis. The lesion processor constrains the restoration of the lesion label in the synthetic image to ensure that the synthetic image generates a corresponding lesion according to the input label.

3.This study directly evaluated the similarity of the synthesized data and the real data by the general evaluation method in the first step. Next, the synthesized images were further used to train the intelligent medical image processing model, and the performance of the synthesized images were indirectly evaluated by evaluating the trained model. The results showed that the synthesized image can be used for pre-training and data augmentation in a variety of tasks to improve model performance.

Keywords: Medical Images, Image Synthesis, Multimodal Registration, Lesions, Generative Adversarial Networks