Semantic segmentation of Prostate in MRI using CNN

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1 Introduction

Identification and segmentation of the prostate in MRI is useful for diagnosis of diseases, research, evaluation of treatment responds and monitoring of pathological changes. Manual segmentaion of the prostate is a challenging and time consuming task especially because MR images are usually acquired as multi-slices yielding a 3D volume. In practice there is inter observer variance between different manually segmented images from different observers, since observers tend to over-segment or under-segment the images. Furthermore, there is intra observer variance since annotators tends to have difficult reproducing the same segmented images. Ground truth medical image segmentation is thus special hard to obtain and expensive. Therefore, there is a need for fast and accurate methods for segmenting the prostae in MRI.

2 Methods

Deep learning approaches for semantic segmenation has shown great potential. However, segmenting 3D structures is a challenging task due the computational complexity compared to segmentation of 2D structures. We propose a 3D convolutional neural network for segmentation of the prostate. We employ the U-Net architecture [1] with skip connections by concatenation. After each convolution the output is concatenated with the input. A binary cross entropy was used for training. We use the Adam optimizer with learning rate equal to 0.001 and learning rate decay equal to 0.0001 for 1500 iterations.

The data was split into 40 for training 5 for validation. The input consist of subvolumes of size 64x64x16 uniform sampled from the prostate and the background. The batch size was 4. For inference, the overlapping sliding tile strategy was employed with subvolumes of size 64x64x16 and stride equal 32x32x8. The probability for the overlapping subvolumes was averaged. The mean validation dice coefficient for the whole subvolumes was 0.9209.

References

[1] Olaf Ronneberger, Philipp Fischer, and Thomas Brox. U-net: Convolutional networks for biomedical image segmentation. In *International Conference on Medical image computing and computer-assisted intervention*, pages 234–241. Springer, 2015.