Elitenetzwerk Bayern

Einblicke in die Forschungsarbeit

MASTERARBEIT

„Augmentation Strategies for Biomedical Image Segmentation“

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Augmentation Strategies for Biomedical Image Segmentation

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Outperforming humans in several fields

Due to the steady increase in computational power and the evolution of neural net- work architectures, deep learning for computer vision has continuously gained mo- mentum and has even outperformed humans in several fields. Yet, the full potential of supervised deep learning remains unreached in the field of biomedical imaging, due to the difficulty to acquire large labeled data sets.

A successful approach to mitigate this problem is data augmentation. Although previous studies demonstrated the effectiveness of this approach, the effects of the augmentations vary depending on the original data set and the task of the network. In addition, the parametrization of the augmentations remains a challenge, as developers often rely on visual inspection and guesswork to set the parameters of the transformations, which may lead to sub-optimal results. In this work, we focus on the task of automatic liver tumor segmentation in two-dimensional CT slices from the LiTS data set using a residual U-Net. We propose the use of oblique slices obtained from the three-dimensional CT volumes and study the effect of training the network using oblique slices in addition to the axial slices. In addition, we study the effect of elastic distortion as an augmentation method for liver tumor images. Different parameters for both augmentation methods are tested to derive the best settings for the studied data set.

Finally, the effect of combining these two augmentation methods is tested to evaluate their compatibility.

The best segmentation result

This study shows that the use of oblique slices significantly improves the segmentation results. Rotating the slicing plane by 10° about the y-axis delivers the best segmentation results, yet decreases the network’s specificity. Similar results are obtained for the light distortions. However, heavy distortions deliver a higher specificity and perform as well as the light distortions only when segmenting slices with many or large tumors. Combining oblique slicing and light distortion further improved the segmentation accuracy. However, the combination of oblique slicing with heavy distortion did not show a significant advantage over the use of the best individual method.