Abstract: Liver Tumor Segmentation in Late-phase MRI using Multi-model Training and an Anisotropic U-Net

Annika Gerken[1], Grzegorz Chlebus[1], Hans Meine[1,2], Felix Thielke[1], Farina Kock[1], Tobias Paulus[3], Nasreddin Abolmaali[3], Andrea Schenk[1,4]

[1]Fraunhofer-Institut für Digitale Medizin MEVIS, Bremen
[2]Universität Bremen, Medical Image Computing Group, Bremen
[3]Katholisches Klinikum Bochum, Universitätsklinikum der Ruhr Universität Bochum, Institut für Diagnostische und Interventionelle Radiologie und Nuklearmedizin, Bochum
[4]Medizinische Hochschule Hannover, Institut für Diagnostische und Interventionelle Radiologie, Hannover
andrea.schenk@mevis.fraunhofer.de

Automatic liver tumor segmentation can support the planning of liver interventions, such as selective internal radiation therapy (SIRT). Most studies on deep learning-based liver tumor segmentation have focused on contrast-enhanced CT, however dynamic contrast-enhanced MRI (DCE-MRI) can yield a higher sensitivity. In this work , we demonstrate the deep learning-based segmentation of liver tumors in the late hepatocellular phase of DCE-MRI. In particular, we employ an anisotropic 3D u-net architecture (aU-Net) and a multi-model training strategy: the training is started 16 times using different random weight initializations. After 5k, 10k, 20k and 40k iterations, the number of neural networks is reduced to the best performing half, based on validation data. This approach significantly improves the segmentation performance compared to a standard single-model training (mean Dice score 0.74 vs. 0.70), and is close to the inter-rater-agreement of three clinical experts (mean Dice score 0.78). Moreover, the aU-Net architecture alone improves the segmentation performance compared to our previous study using three 2D U-Nets working on orthogonal view directions (mean Dice score 0.65). In a qualitative rating, 66 % of automatic segmentations from multi-model training are rated as good or very good, compared to 43 % for the single-model training. However, the detection performance (F1-score 0.59) is still inferior to the inter-observer-agreement of the clinical experts (0.76). In summary, this study demonstrates that correctly detected liver tumors can be automatically segmented with high accuracy in late-phase DCE-MRI data, but the detection can still be improved, in particular of smaller lesions [1, 2].

References

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