Improved Automated Hippocampus Segmentation using Deep Neural Networks

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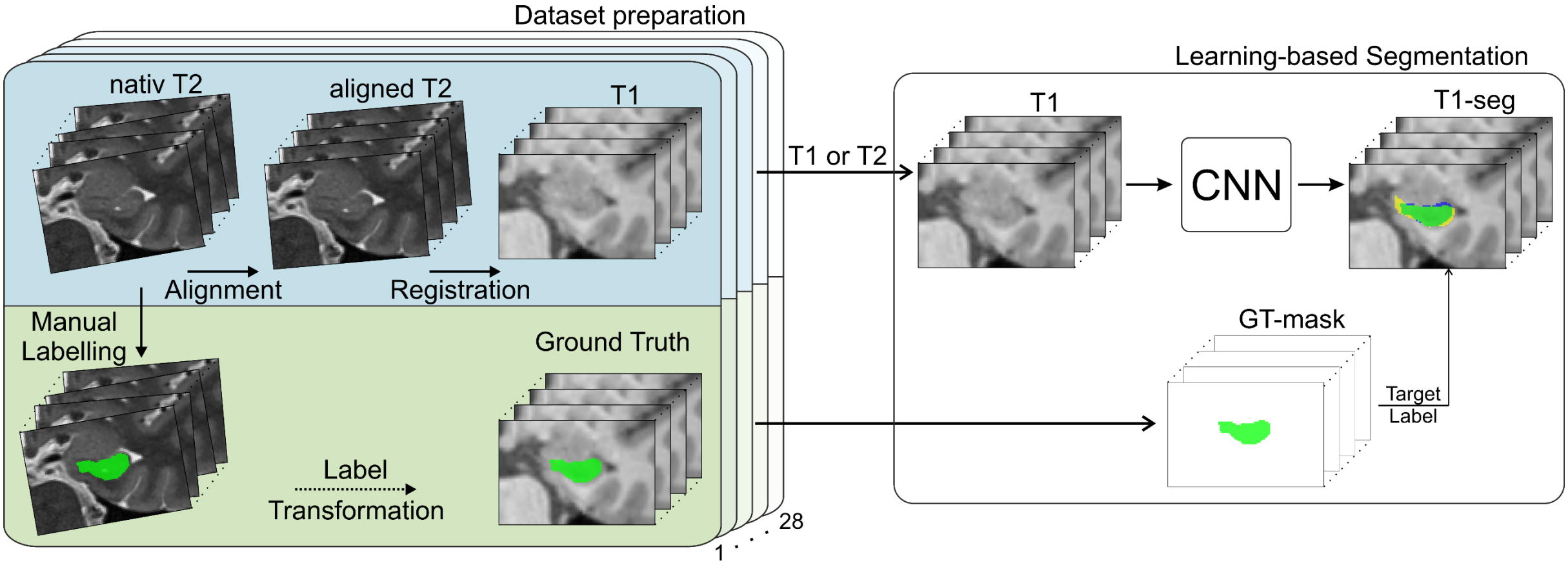
Synopsis

Most imaging studies in Alzheimer's disease require the segmentation of the hippocampal formation on T1-weighted structural MR scans. However, manual annotation is an exhaustive task, while current clinically used automated software (mostly FreeSurfer) is computationally expensive and often inaccurate.

In this work, we implement and evaluate a deep learning-based hippocampus segmentation with manual ground truth (GT) data that originates from high resolution T2-weighted MR images. Results were evaluated against our GT-labels and compared to segmentation results obtained with FreeSurfer.

All learning approaches outperformed FreeSurfer in terms of accuracy and speed, where experiments utilizing the T2-weighted data yielded the best results. Thus, using T2-weighted images and T2-based labels for training a deep learning model can improve automated HC segmentation.

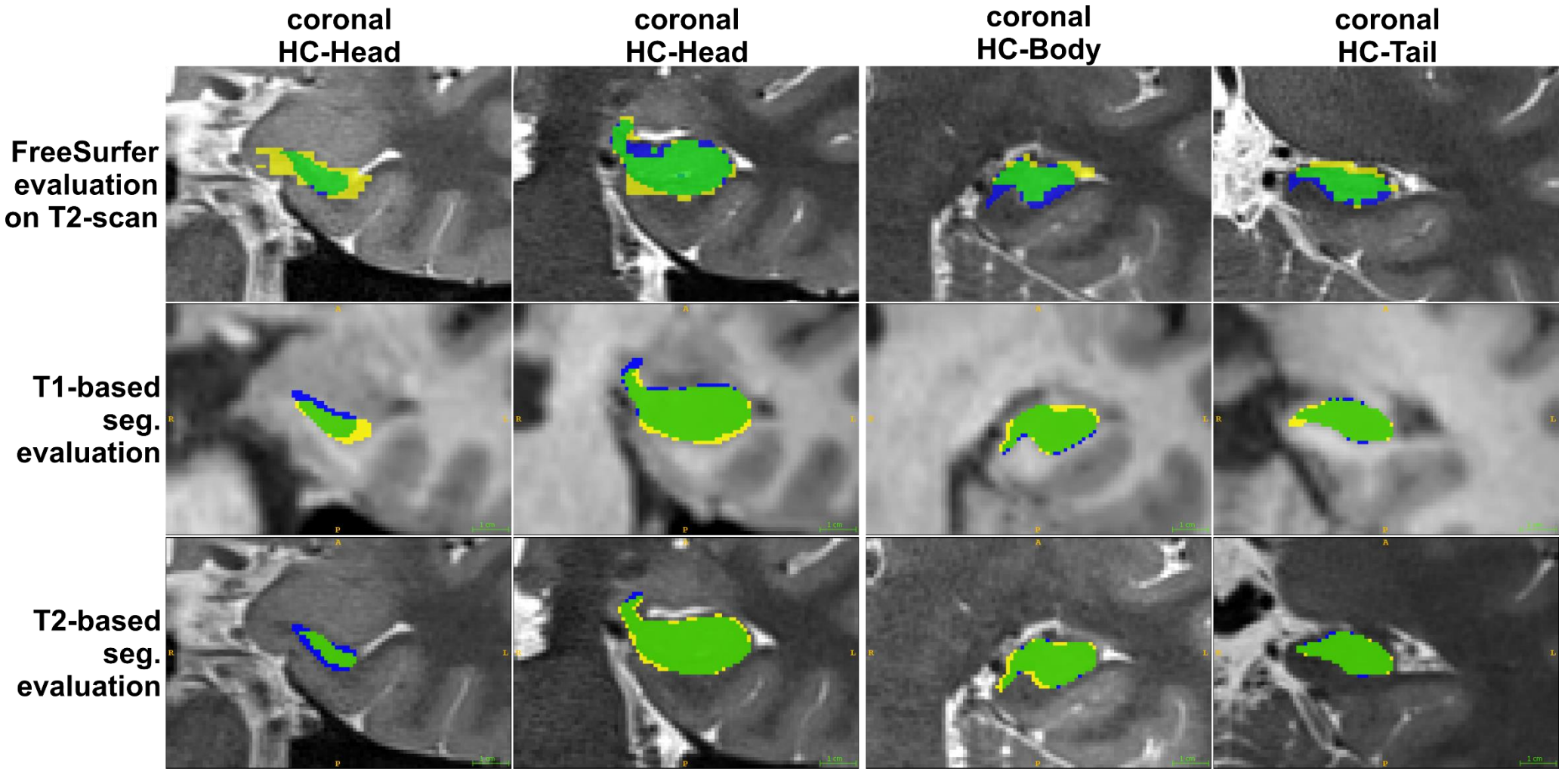
Preprocessing & Segmentation Scheme



- 3D T1 MP-RAGE @ 1x1x1mm³
- 2D T2 TSE @ 0.47x0.47x1mm³

- cropped T1/T2 images + GT-labels
- intensive data augmentation
- U-net based CNN

Results & Conclusion

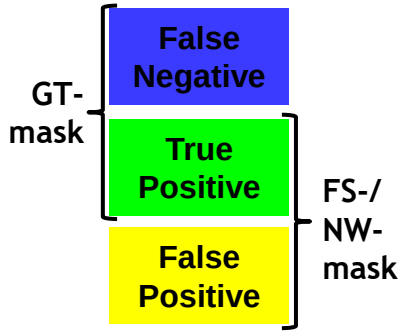


avg. Dice Scores:

FS: 78.06 ± 3.99%

T1: 85.62 ± 3.86%

T2: 91.91 ± 0.87%



- learning-based T1/T2 HC segmentation outperforms FreeSurfer in accuracy & speed.
- HC segmentation benefits from more accurate T2-based ground truth (GT) data.