Automatic segmentation using deep learning for the hippocampus

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Hippocampal volume is used as a biomarker to track the development of Alzheimer's disease (AD). Therefore, accurate hippocampal segmentation is of utmost clinical importance.

Emerging deep-learning technologies can perform at state of the art for many computer vision problems and in this vein we present a fully automated approach that is able to accurately delineate the hippocampus.

Method

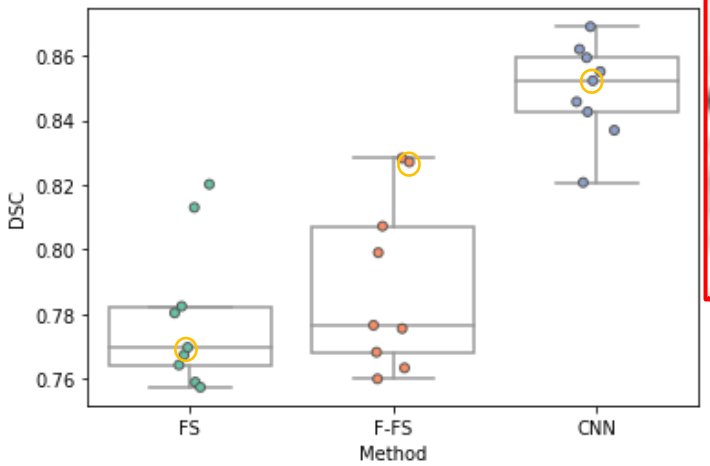
Manually edited hippocampi segmentations from 80 subjects from an AD cohort (ADNI[1,*]) are used to develop our neural network (CNN)[2]. The pre-processing pipeline is summarised:

On the right, we compare our model to FreeSurfer[3] and FastSurfer[4] (another AI based approach) using a separate validation set.

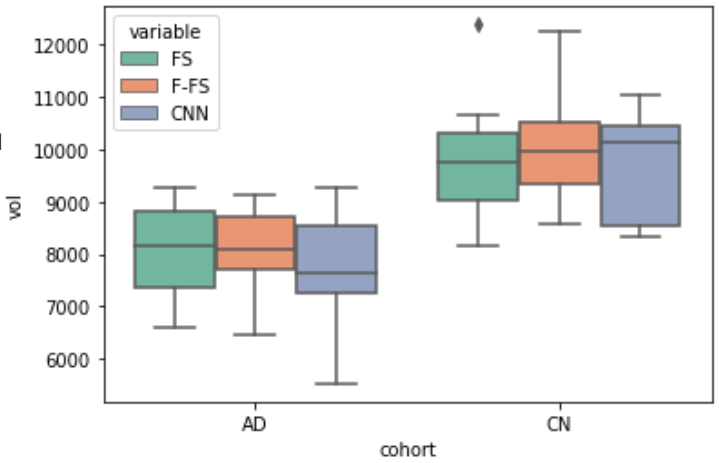
Conclusion

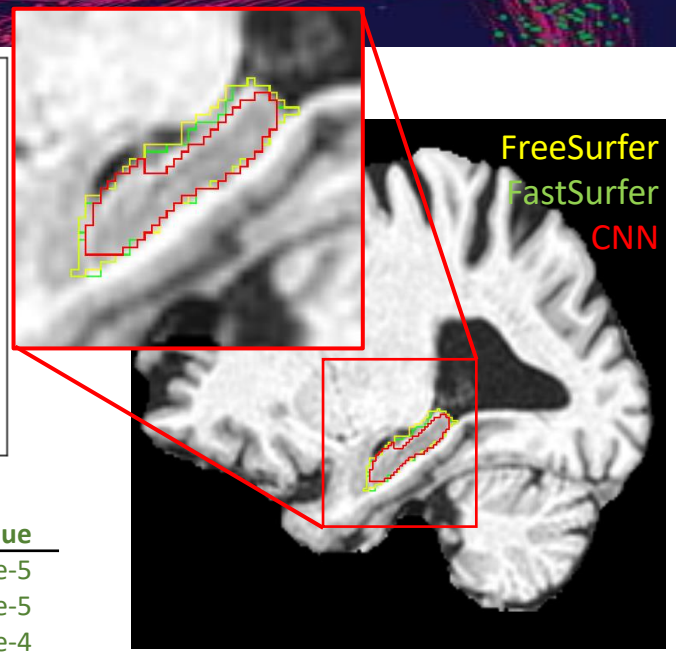
We present a deep learning as a credible segmentation tool, applied to the hippocampus. Given that the AI tools are an order of magnitude faster to run than FreeSurfer, they are surfacing as alternatives over classical approaches for scalable data processing. For an application of this cross-sectional pipeline for longitudinal data analysis, we invite you to the talk: **#257 - A deep-learning based framework for brain-atrophy measurement.**

1. Jack Jr, Clifford R., et al. *Journal of Magnetic Resonance Imaging* 27.4 (2008): 685-691.
2. Çiçek, Özgün, et al. *International conference on medical image computing and computer-assisted intervention*. Springer, Cham, 2016.
3. Fischl, B., 2012. *Neuroimage*, 62(2), pp.774-781.
4. Henschel, Leonie, et al. *NeuroImage* 219 (2020): 117012.



Method	Dice Overlap (mean, std)	T-test	P-value
CNN	0.849, 0.0147	-5.048	2.05e-5
F-FS	0.790, 0.0267	-5.644	1.08e-5
FS	0.779, 0.0228	-4.437	1.37e-4





Results

Dice overlap and group separation for unseen subjects is presented left. Our CNN shows superior mean dice overlap, with a lower standard deviation. An example subject is shown above (highlighted in the dice plot). Group separation shows larger median separation for the CNN; all methods show a statistically significant cohort separation.

*Data used in preparation of this poster were obtained from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database (adni.loni.usc.edu). As such, the investigators within the ADNI contributed to the design and implementation of ADNI and/or provided data but did not participate in analysis or writing of this report. A complete listing of ADNI investigators can be found at: http://adni.loni.usc.edu/wp-content/uploads/how_to_apply/ADNI_Acknowledgement_List.pdf