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Automatic segmentation of stroke lesions in non-contrast computed tomography with convolutional neural networks


Anup Tuladhar [1*]


Serena Schimert [1*]


Deepthi Rajashekar [1]


Helge C. Kniep [2]


Jens Fiehler [2]


Nils D. Forkert [1]

Full Paper

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Trained Model

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* Co-first authors

1 UNIVERSITY OF CALGARY MIPLAB

2 Universitätsklinikum Hamburg-Eppendorf

University Medical Center Hamburg-Eppendorf

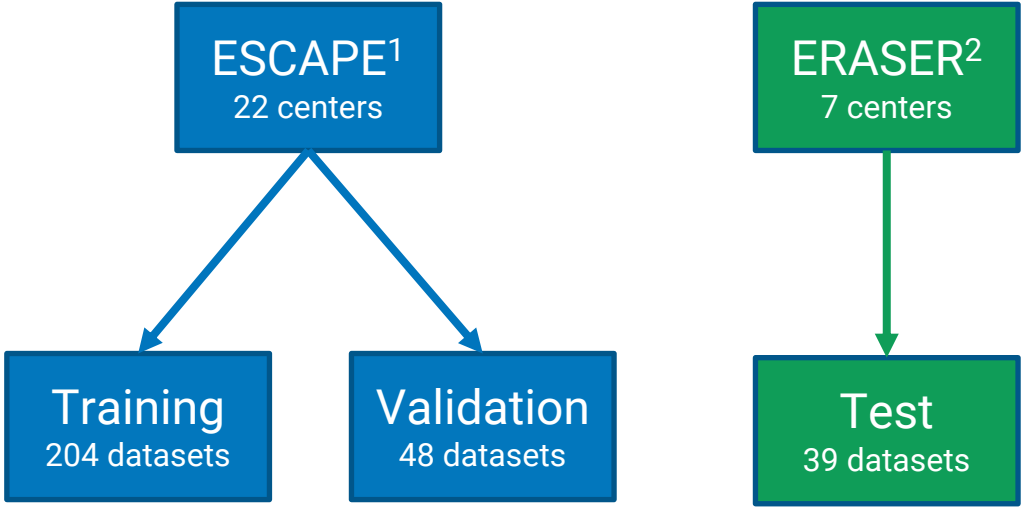
CNN for segmenting Non-contrast Computed Tomography (NCCT) datasets

Trained CNN based on DeepMedic[3] framework[4]

- 3D CNN kernels
- 3 parallel convolutional pathways for multi-scale processing (1×, 3× and 5×)
- Trained model available:

doi: 10.21227/jps9-0b57

291 multi-center datasets of follow-up NCCT stroke imaging from ESCAPE[1] and ERASER[2] trials

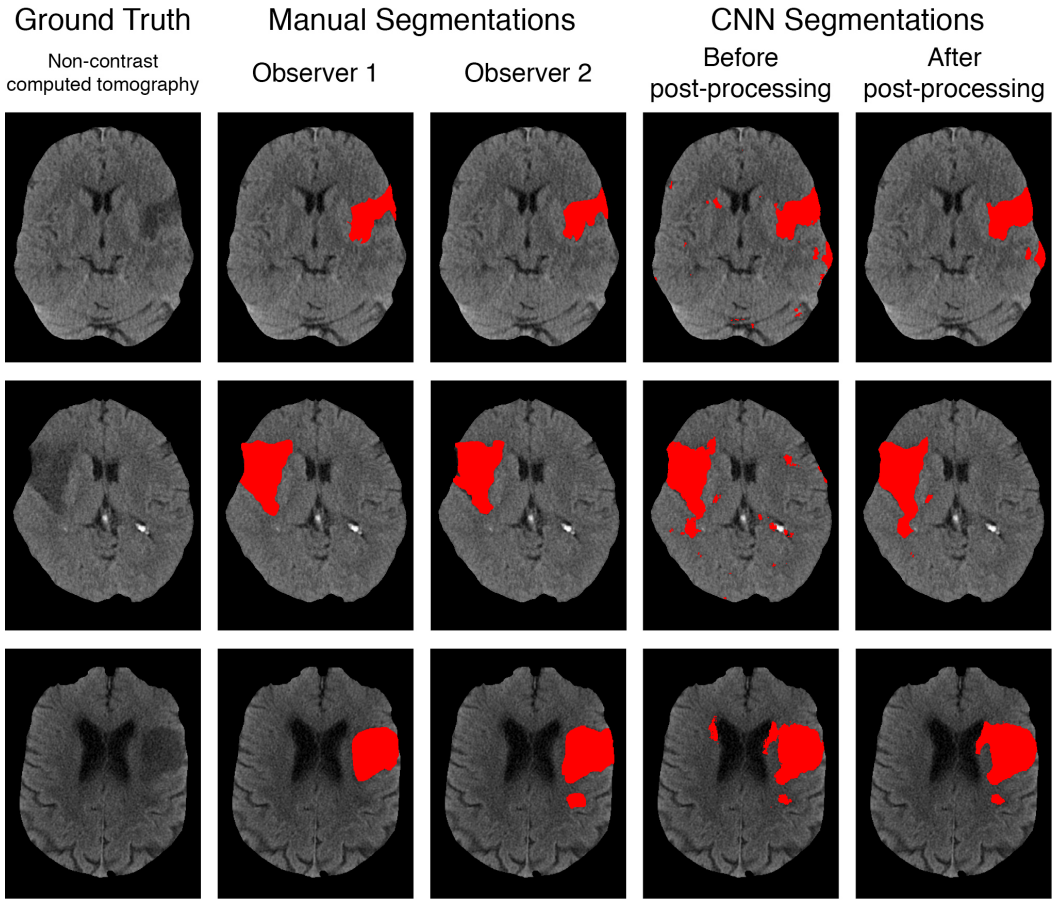


Out-of-distribution

Multiple raters

[1] Demchuk et al, *Int. J. Stroke* (2015)
[2] Fiehler et al, *Stroke* (2019)
[3] Kamnitsas et al, *Medical Image Analysis* (2017)
[4] DeepMedic: https://github.com/deepmedic/deepmedic

Improving CNN segmentations with post-processing



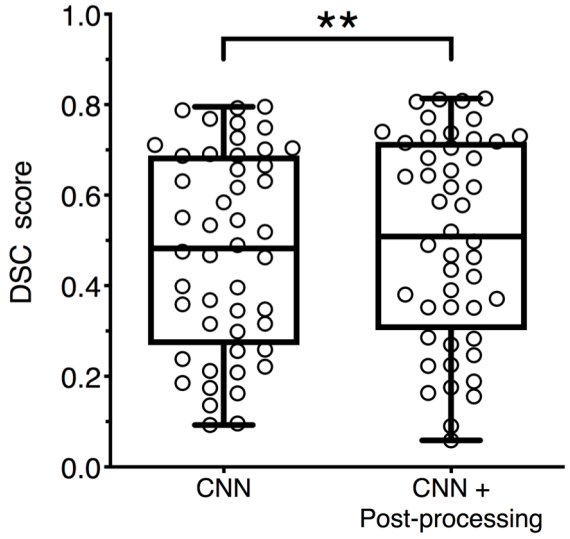
Used post-processing to improve segmentation accuracy

- Connected-component analysis to exclude small lesions fragments < 1.5 mL
- Hole-filling kernel of 3 voxels
- Used validation dataset to optimize parameters

Tuladhar et al., *IEEE Access* (2020), doi: 10.1109/ACCESS.2020.2995632

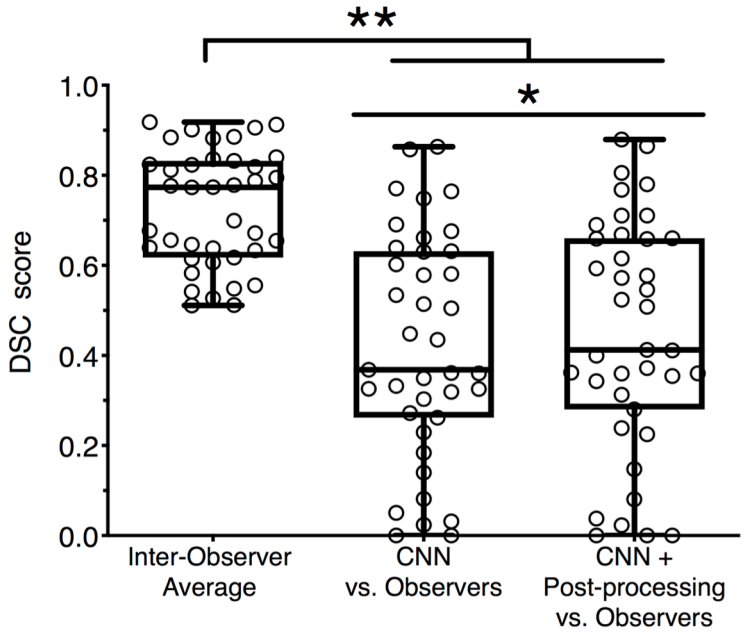
Post-processing improves segmentations of trained CNN

Validation Set



DSC: 0.47 → 0.50

Out-of-distribution Test Set



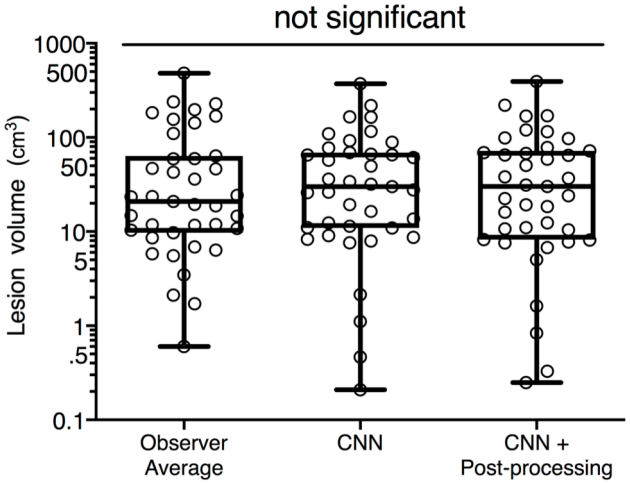
DSC: 0.42 → 0.45

Tuladhar et al., *IEEE Access* (2020), doi: 10.1109/ACCESS.2020.2995632

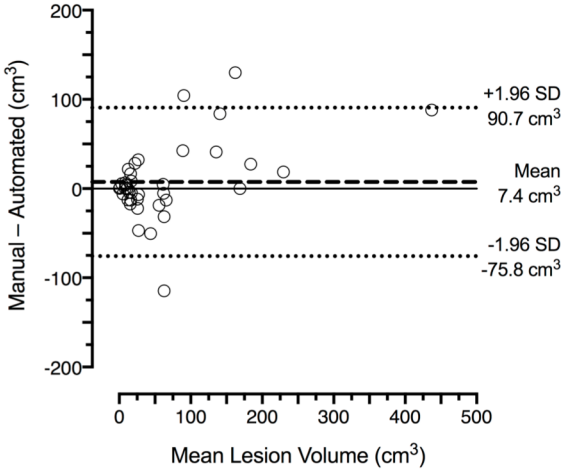
* : P < 0.05 ** : P < 0.01

CNN lesion volume estimates are consistent with manual segmentations

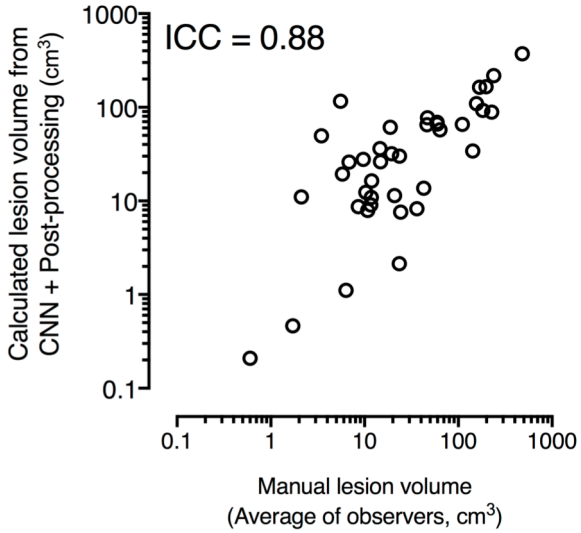
Calculated Lesion Volumes



Bland-Altman



Inter-rater Reliability



ICC: Intra-class correlation coefficient between manual observers and automated segmentation

ICC of observers-only: 0.80

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