Automatic rodent brain MRI lesion segmentation with convolutional neural networks

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INTRODUCTION

- Problem

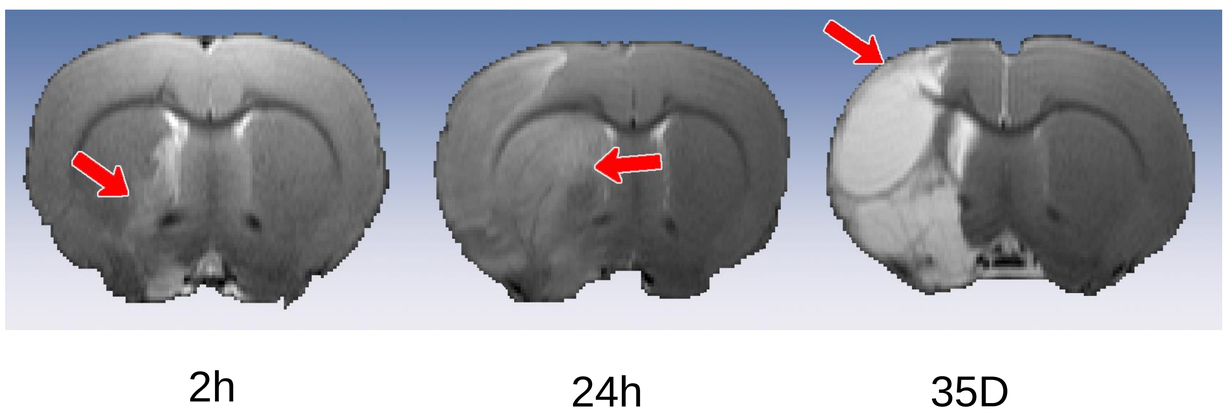
Lesion segmentation is **time-consuming** and **subjective**.
The quality of the segmentation depends on the annotator's experience, criteria and fatigue.

- Goals

- **Saving time**. 131 scans ≈ 100 hours.
- **Ensuring the reproducibility** of the segmentations.

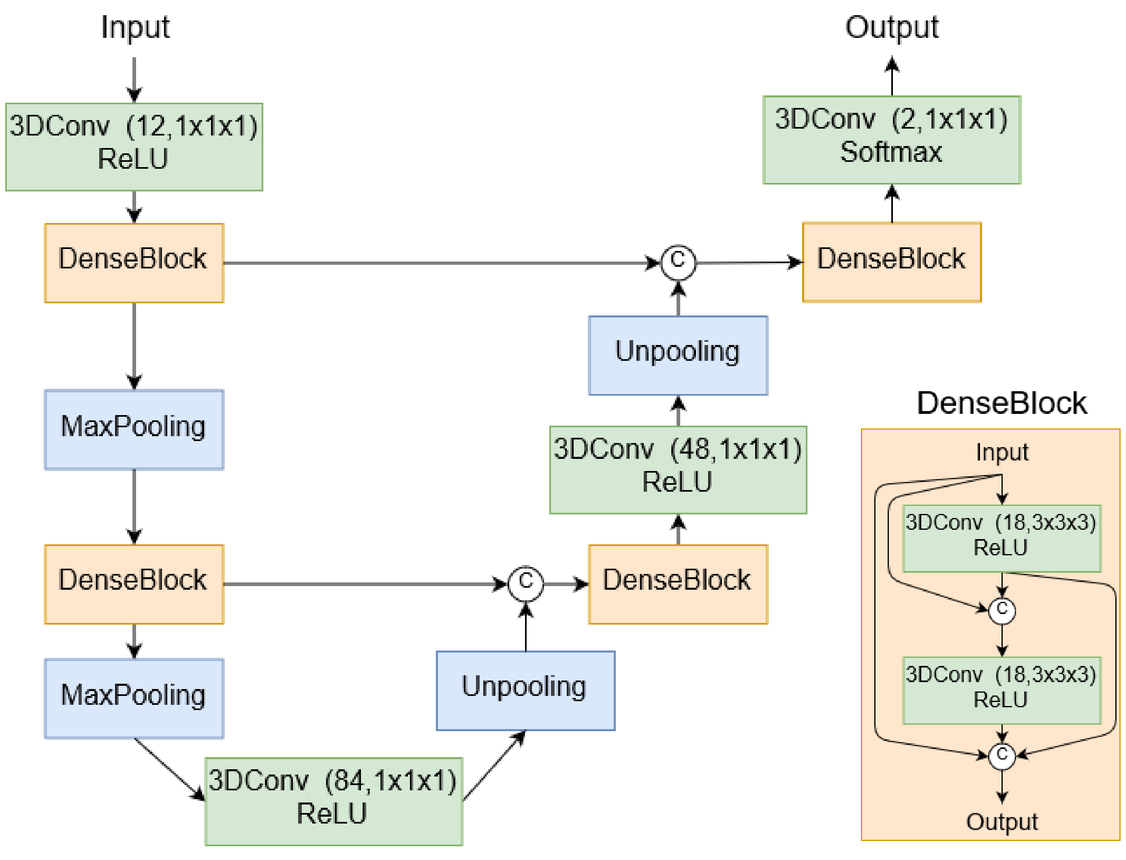
- Data set

131 T2-weighted rat brain scans.
Ischemic stroke lesion caused by tMCAO.
Scans obtained 2h, 24h and 35 days after causing the lesion.



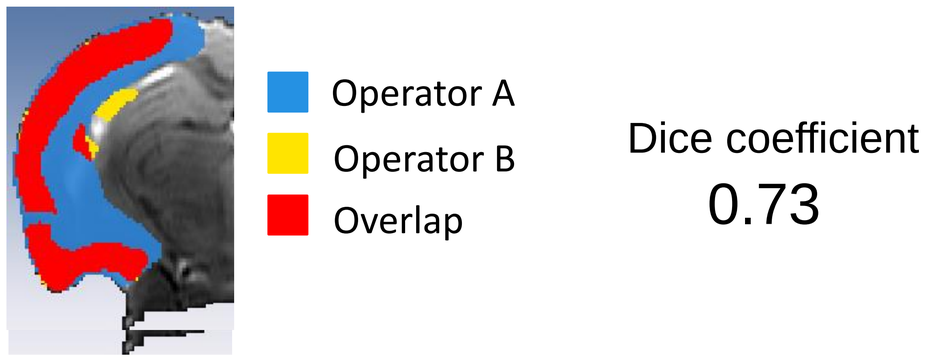
APPROACH

RatLesNet: 3D Fully Convolutional Network



EXPERIMENTS

1. Approximation of the inter-rater variability



Dice coefficient
0.73

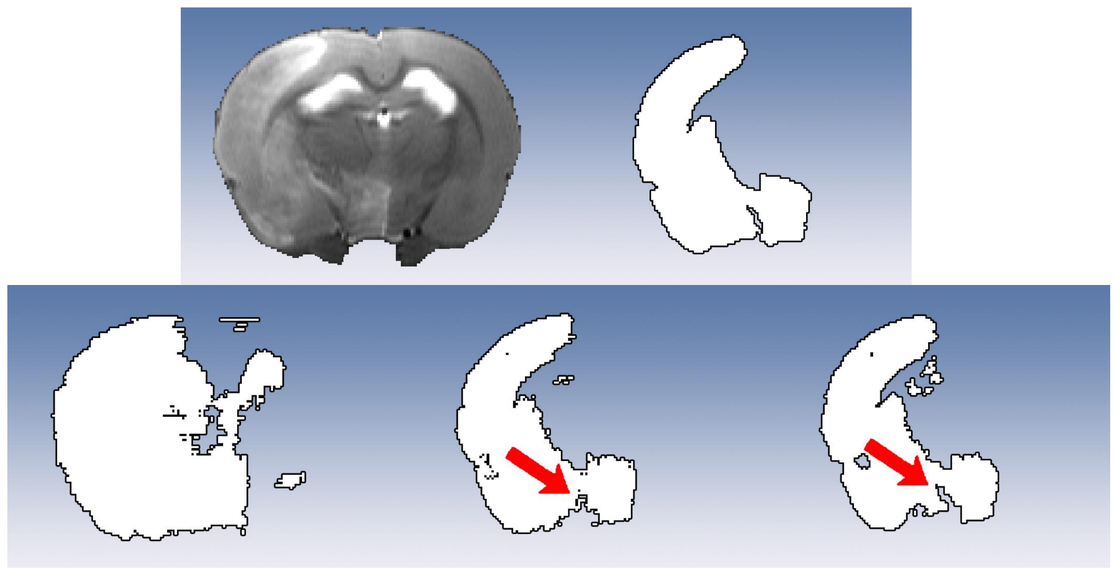
2. Five-fold cross validation

Data set:

48 scans → 2h lesion (12) and shams (12)
48 scans → 24h lesion (12) and shams (12)

Time-Point	3D U-Net[1]	VoxResNet[2]	RatLesNet
2h	0.171	0.603	**0.672**
24h	0.429	0.787	**0.845**
Average	0.3	0.695	**0.759**

Average Dice coefficients on non-sham animals.



3. Generalization test

Training set: 36 scans, 2h and 24h (including shams)
Validation set: 12 scans, 2h and 24h (including shams)
Test set: 83 scans, 24h and 35D

Time-Point	3D U-Net[1]	VoxResNet[2]	RatLesNet
Study A (D35)	0.64	**0.706**	0.682
Study B (24h)	0.622	0.769	**0.818**
Study C (24h)	0.6	0.782	**0.833**
Average	0.622	0.756	**0.788**

Average Dice coefficients.

Acknowledgements

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References

1. Çiçek, Ö. et al. "3D U-Net: Learning Dense Volumetric Segmentation from Sparse Annotation". MICCAI (2016) 424-432.
2. Chen, H. et al. "VoxResNet: Deep voxelwise residual networks for brain segmentation from 3D MR images". NeuroImage (2017), 170, 446-455.

arXiv:1908.08746