DeepMedic for automated lesion segmentation in chronic stroke

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Introduction

- ✓ Accurate segmentation of lesions is key to the use of the lesion method to localize the neural basis of cognitive functions (Ito, Kim, & Liew et al., 2019).
- ✓ Comparative evaluation of existing automated segmentation algorithms has recognized Lesion Identification with Neighborhood Data Analysis (LINDA) as the best automated alternative to the "gold standard of manual segmentation" (Ito et al., 2019)
- ✓ We compare DeepMedic – a convolution neural network, originally trained and tested on sub-acute ischemic stroke lesions – to LINDA .

LINDA Vs DM

Methods

a. LINDA

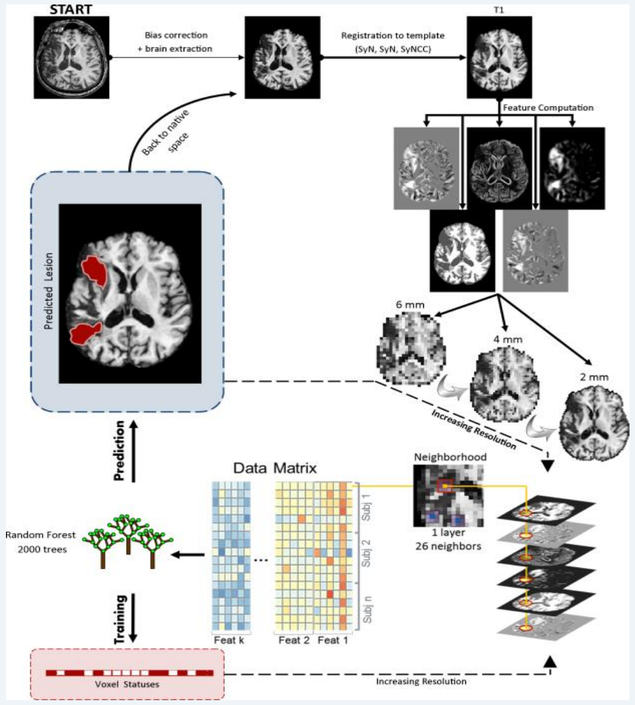


Figure 1.

b. DeepMedic

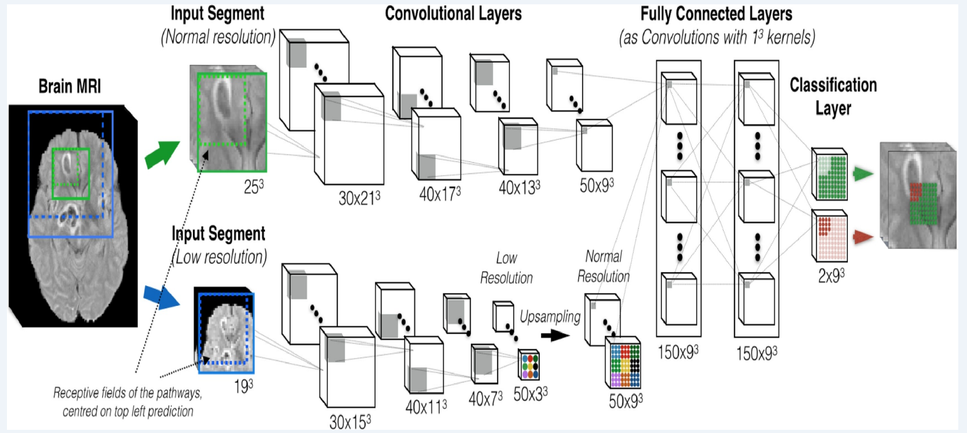
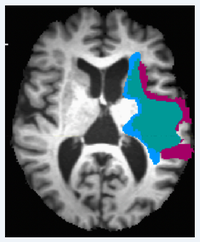


Figure 2.

Image metrics

1. Dice Score (DS)
2. Precision
3. Recall



Results

a. Qualitative Analysis

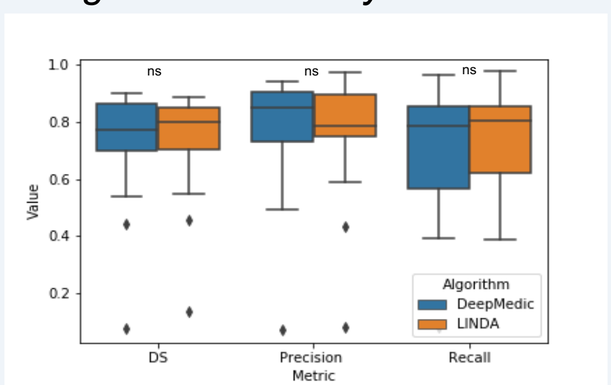
Lesions	Identified	Unidentified	Misclassified
DM	25(89.3%)	1(3.57%)	2(7.14%)
LINDA	25(89.3%)	0	3(10.71%)

b. Quantitative Analysis

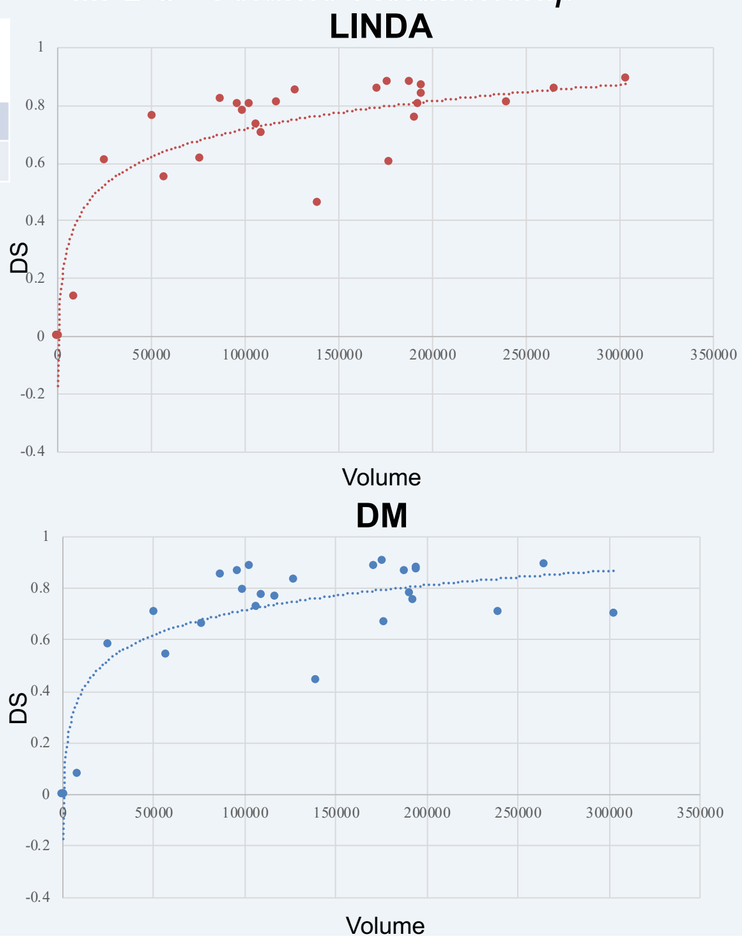
i. Descriptive Statistics

Median (IQR)	LINDA	DM
DS	0.80 (0.15)	0.77 (0.17)
Precision	0.79 (0.15	0.85 (0.18)
Recall	0.80 (0.24)	0.78 (0.28)

ii. Image Metrics Analysis



iii. DS- Volume Relationship



Conclusion

- DeepMedic is a worthwhile alternative to LINDA
- It is more adaptable to a range of settings and applications:
  - Bilateral lesions
  - Trainable
  - Multimodal

Future directions:

- Train and test DeepMedic on a larger, more diverse dataset.
- Develop a more diverse training set.

References

Ito, K. L., Kim, H., & Liew, S. L. (2019). A comparison of automated lesion segmentation approaches for chronic stroke T1-weighted MRI data. *Human Brain Mapping*, *40*(16), 4669–4685. doi: 10.1002/hbm.24729

Figure 1. Pustina, D., Coslett, H. B., Turkeltaub, P. E., Tustison, N., Schwartz, M. F., & Avants, B. (2016). Automated segmentation of chronic stroke lesions using LINDA: Lesion identification with neighborhood data analysis. *Human Brain Mapping*, *37*(4), 1405–1421. doi: 10.1002/hbm.23110

Figure 2. Kamnitsas, K., Ledig, C., Newcombe, V. F., Simpson, J. P., Kane, A. D., Menon, D. K., … Glocker, B. (2017). Efficient multi-scale 3D CNN with fully connected CRF for accurate brain lesion segmentation. *Medical Image Analysis*, *36*, 61–78. doi: 10.1016/j.media.2016.10.004