Brain Tumor Segmentation with Random Forest and U-Net

Shuhan Xiao and Alexander Kugele

Heidelberg University

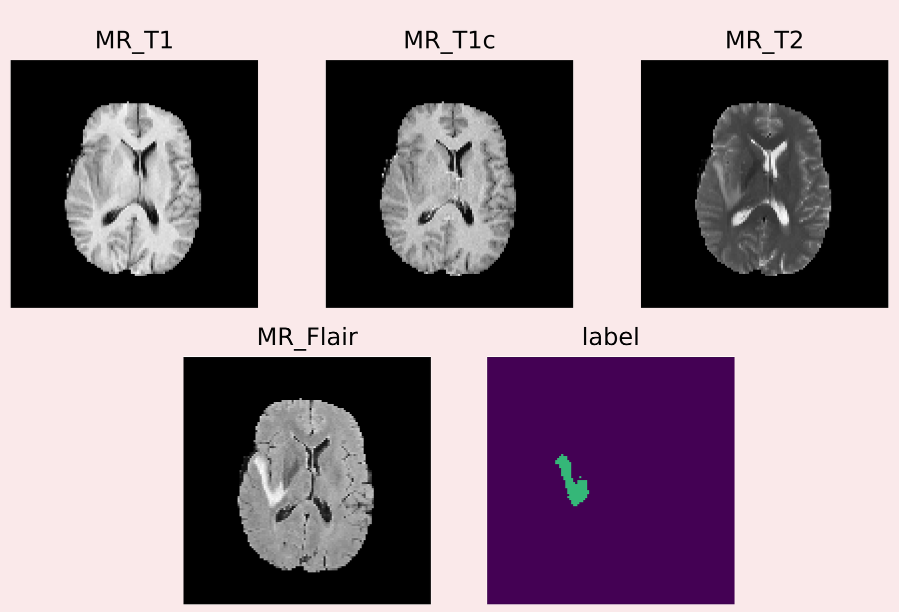
Motivation

- Brain tumors need immediate treatment
- Even experts can not segment perfectly
- Takes time to go through a complete MR scan

Efficiently segmenting tumors automatically improves treatment planing

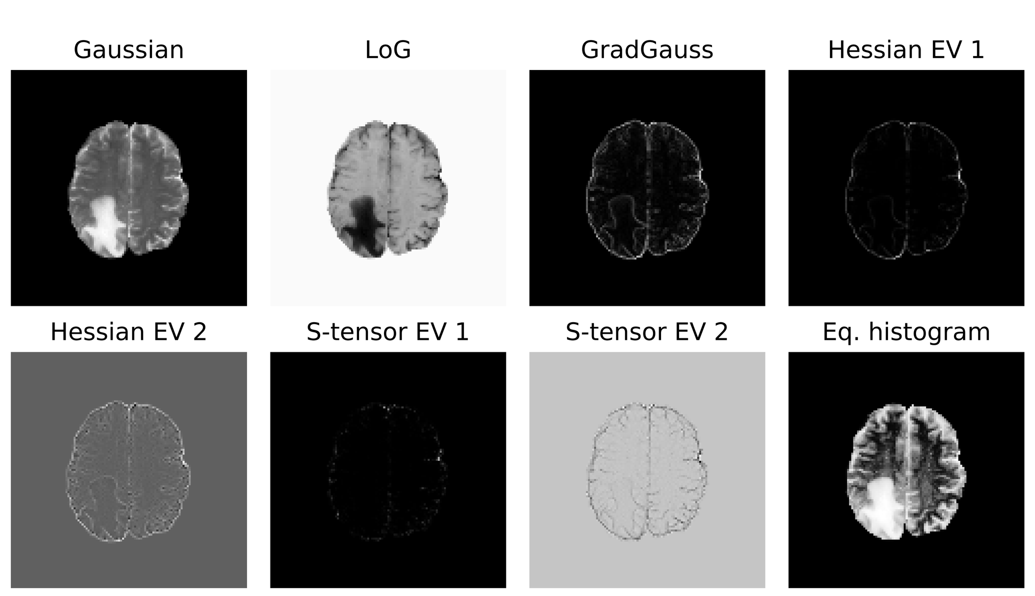
Dataset

- 3D MR scans of 275 human brains
- 4 scan types, T1, T1c, T2 and Flair
- depth = 155, height = 240, width = 240
- $\Rightarrow$ 170500 images
- 5 classes (we only use 2)
- center-cropped to 80% of their size



Features

- Gaussian, LoG, Gaussian gradient
- Hessian and structure tensor eigenvalues
- equalized histogram
- 29 features in total
- 1k images + features ≈ 30 GB of memory



Random Forest

- trained in batch-mode [1]
- 100 estimators per batch, 3 batches of 1k images

Advantages and disadvantages

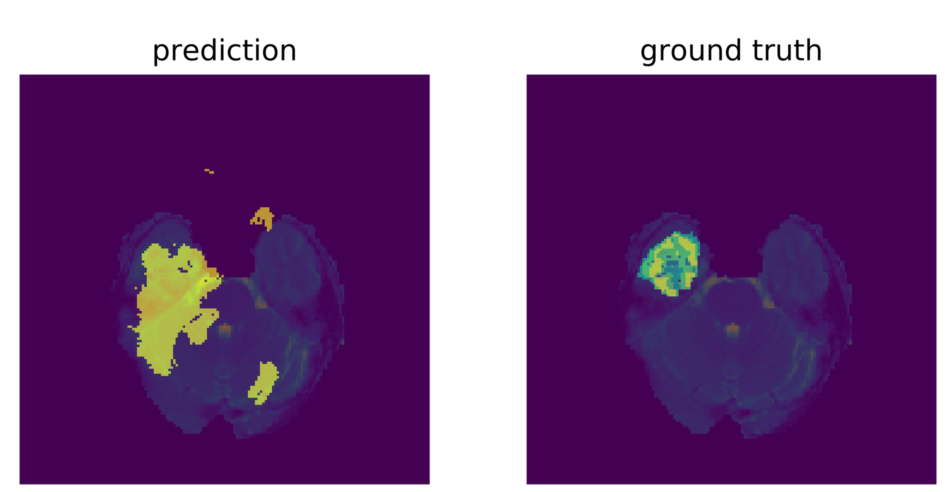
- + Easier to understand
- + Rarely overfits
- + Single pixel training
- − No GPU training
- − No incremental training (for vanilla RF)
- − Features have to be hand-selected

Comparison

	Dice [%]	Sensitivity [%]	Specificity [%]
Random Forest	65.9	77.1	99.1
U-Net			

RF: Results

- training time $\approx 13\,\mathrm{h}$
- inference time $\approx 2-20s$ per image
- load time $\approx 310s$
- disk space ≈ 15 GB (pickled)
- memory space during inference ≈ 20 GB



Methods

Results

Conclusion

Additional Information

References

[1] M. Ristin, M. Guillaumin, J. Gall, and L. Van Gool. Incremental learning of random forests for large-scale image classification. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 38(3):490–503, March 2016.

Acknowledgements

UNIVERSITÄT HEIDELBERG ZUKUNFT SEIT 1386