Segmentation of MRI Brain Tissues in a Few Seconds Using Fully Convolutional Network and Transfer Learning

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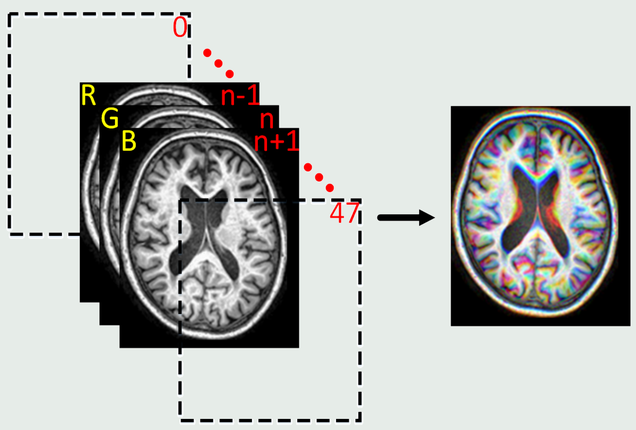
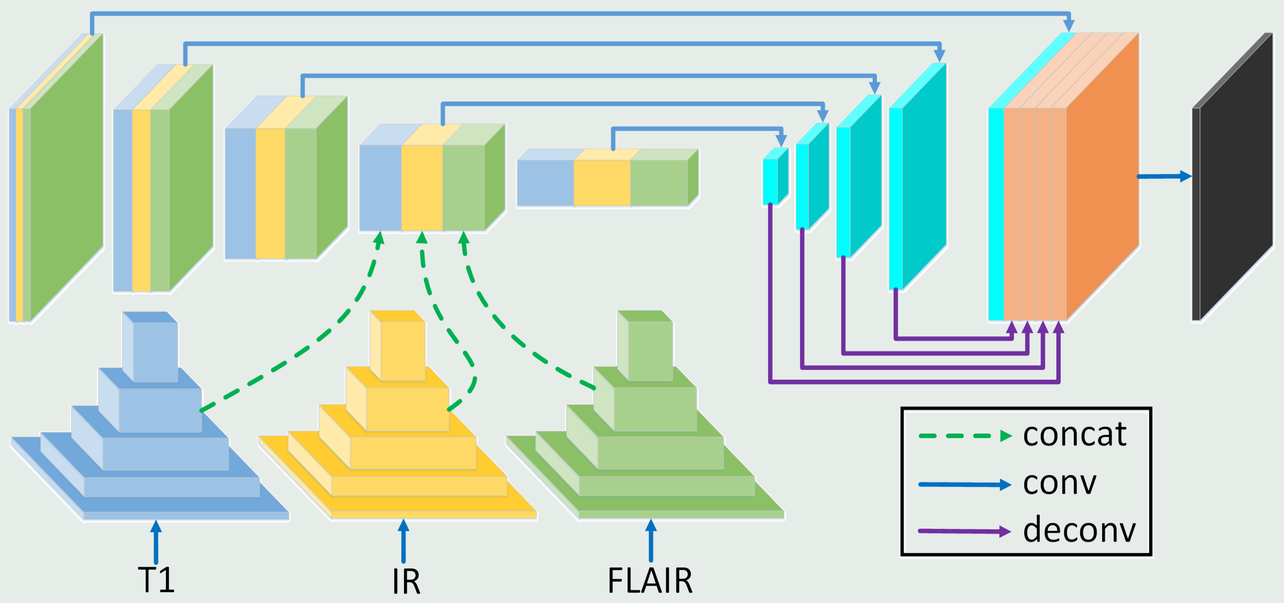
MICCAI MRBrainS Challenge, Poster ID xxxx

At a glance





Problem:

- The edge at the tissues boundary is not clear
- Some small tissue parts are difficult to segment

Conclusion:

- Shallow network works much better than deep network
- Transfer learning works for brain MRI segmentation, but also for other applications (such as WMH segmentation)

Why our approach is interesting:

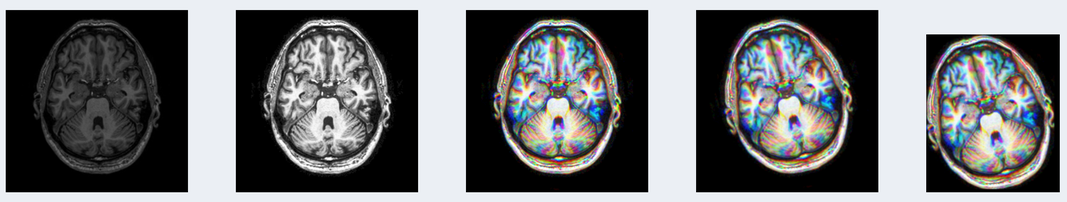
- Organize different modalities from coarse to fine
- It is simple, efficient, light, fast, and **versatile**

Github : https://github.com/hucanpei/MRBrainS18

Pre-processing

Steps:

- Histogram normalization (only for T1)
- Stack 3 successive slices of the **3D** volume $\rightsquigarrow$ a **2D** RGB image
- Flip and rotate for $[0, \pm 5, \pm 10, \pm 15]$ to augment data
- Crop to reduce background and to ensure dims can be divided by 16



Training datatest, test datasets, and challenge

Data:

- Bias field corrected T1+IR+T2 images

Training/test dataset:

- 7/21 patients
- Augmentation of training data with flip and rotations $[0, \pm 5, \pm 10, \pm 15]$
- Input images: a serie (3D volume) of 2D color images

For the challenge:

- Training on all the 7 training samples.
- Runtime on a 3D volume is around **15 seconds**

Learning and model

Network:

- From the **VGG-16 network, pre-trained** on ImageNet
- Each stage: Conv, ReLU and max pooling layers
- 4 first stages only

Parameters:

- Total number of iterations: 80k
- loss: CrossEntropy, optimizer: SGD
- base_lr: 10^{-3}, lr_decay: $0.1/4k$ iterations
- momentum: 0.99, weight_decay: 0.0005

Main Reference: http://publications.lrde.epita.fr/xu.17.icip

Y. Xu, T. Géraud, I. Bloch, "**From Neonatal to Adult Brain MR Image Segmentation in a Few Seconds Using 3D-Like Fully Convolutional Network and Transfer Learning**," in Proceedings of the 23rd IEEE International Conference on Image Processing (ICIP), pp. 4417–4421, Beijing, China, 2017.

Results

Quantitative results from our experiments:

Dice	CSF	GM	WM
3 × VGG-16	**0.8247**	**0.8353**	**0.8663**
VGG-16	0.8053	0.8203	0.8628
w/o transfer	0.7821	0.7995	0.8457
ResNet-50	0.7808	0.7896	0.8179

Competition quantitative results:

Qualitative results: