Loss Ensembles for Intracranial Aneurysm Segmentation: An Embarrassingly Simple Method

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Background

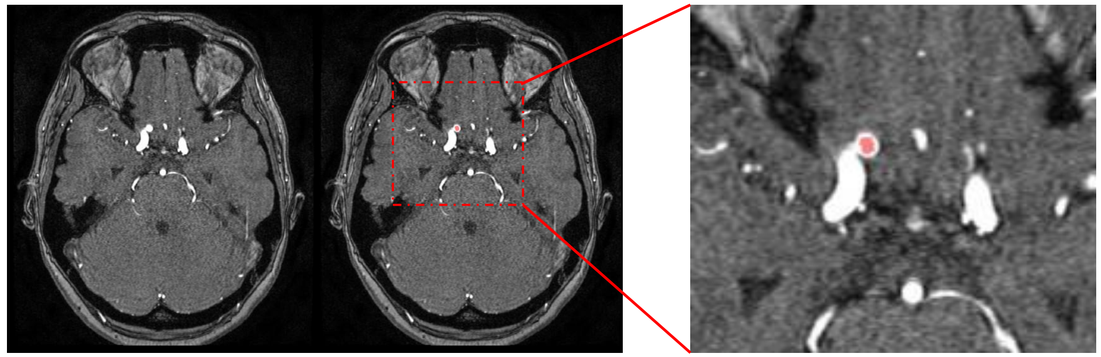


Fig 1. Examples of intracranial aneurysm in training set.

Foreground vs Background: 8.3×10^{-6}

How to deal with the highly label-imbalance?

Key Idea: Loss ensembles

Loss: Dice loss + Cross entropy

$$1-\frac{2\sum_{i=1}^{N} g_i s_i}{\sum_{i=1}^{N} g_i^2+\sum_{i=1}^{N} s_i^2}-\frac{1}{N}\sum_{i=1}^{N} g_i log s_i$$

Loss: Dice loss + TopK loss

$$1-\frac{2\sum_{i=1}^{N} g_i s_i}{\sum_{i=1}^{N} g_i^2+\sum_{i=1}^{N} s_i^2}-\frac{1}{\sum_{i=1}^{N} 1\{s_i<t\}}\sum_{i=1}^{N} 1\{g_i<t\}log s_i$$

Training

Network: 3D U-Net (nnU-Net implementation)
Optimizer: SGD + Momentum;
Patch size: 56*256*224; Batch size: 2
Five-fold cross validation; GPU: TITAN V100

Testing

Five-fold ensemble
~~Test time augmentation~~

Code and trained models

https://github.com/JunMa11/ADAM2020

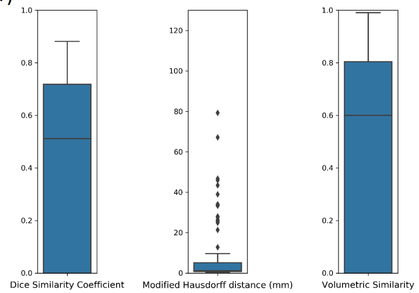
Results

Team: Junma

Task 1 Rank:	**0.07**	**Task 1 Place:**	**3 rd**
Task 2 Rank:	**0**	**Task 2 Place:**	**1 st**

(lower rank is better)

Task 1	False Positives	Sensitivity
Average	0.18	0.61
Rank	0.01	0.13



Task 2	Dice Coefficient	Modified Hausdorff Distance (mm)	Volumetric Similarity
Average	0.41	8.96	0.5
Rank	0	0.01	0

Table 1. Quantitative segmentation results (Dice) of different loss functions.

Fold	Dice loss + Cross entropy	Dice loss + TopK loss
0	0.4370	**0.4921**
1	**0.5476**	0.4888
2	**0.5108**	0.4926
3	**0.6173**	0.5998
4	0.4404	**0.5240**