Development of 3D DL methods for automatic detection of brain pathologies (epileptogenic lesions)

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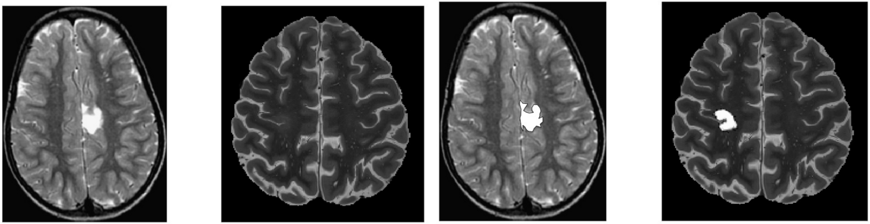
18 мая 2022 г.

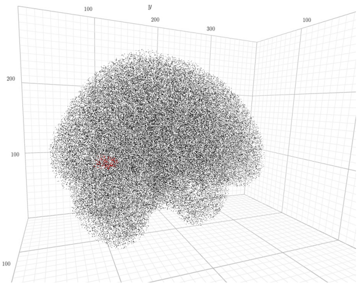
Brain with tumor | Brain with FCD | Brain with tumor with mask | Brain with FCD with mask

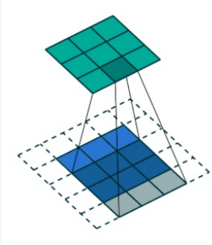


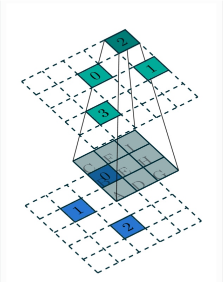
184 subjects diagnosed with pharmacoresistant epilepsy:

- 21 subjects acquired with EPI NMHC1 protocol (non-sedated);
- 163 subjects Acquired with EPI HARNESS protocol (sedated);
- biggest dataset compared to recent study datasets;
- resulting brains are aligned with a standard atlas (MNI152 1mm).

Minkowski Algorithm[1,2]







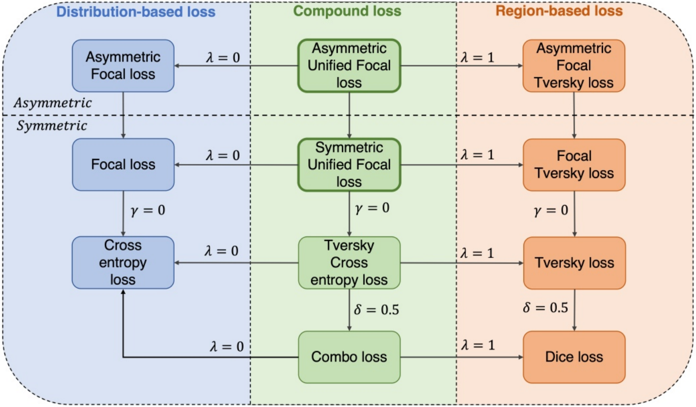
$$\mathbf{x}_{\mathbf{u}}^{\text{out}} = \sum_{\mathbf{i} \in \mathcal{V}^D(K)} W_{\mathbf{i}} \mathbf{x}_{\mathbf{u}+\mathbf{i}}^{\text{in}} \text{ for } \mathbf{u} \in \mathbb{Z}^D,$$

$$\mathbf{x}_{\mathbf{u}}^{\text{out}} = \sum_{\mathbf{i} \in \mathcal{N}^D(\mathbf{u}, \mathcal{C}^{\text{in}})} W_{\mathbf{i}} \mathbf{x}_{\mathbf{u}+\mathbf{i}}^{\text{in}} \text{ for } \mathbf{u} \in \mathcal{C}^{\text{out}}$$

[1] C. Choy, 4D Spatio-Temporal ConvNets: Minkowski Convolutional Neural Networks, CVPR'19

[2] B. Graham, Submanifold Sparse Convolutional Networks, CVPR'19

Possible losses (current experiments)



$$L_{BCE}(y, \hat{y}) = -(\beta y \log(\hat{y}) + (1-\beta)(1-y)\log(1-\hat{y}))$$

$$L_{focal}(y, \hat{y}) = -(\beta(1-\hat{y})^{\gamma} y \log(\hat{y}) + (1-\beta)\hat{y}^{\gamma}(1-y)\log(1-\hat{y}))$$

Results