Dual-scale fully convolutional neural network for final infarct prediction

David Robben and Paul Suetens

Medical Image Computing (ESAT/PSI), KU Leuven, Belgium

Pre-processing Relative time-to-peak (rTTP) is calculated per voxel as the time-to-peak (TTP) minus the first quartile of the TTP within the brain mask. Since convolutional neural networks work best on normalized data, the input images are linearly transformed. The given modalities have physical units that can be interpreted absolutely, hence we use per modality the same transformation for all subjects: subtraction by the median mean value and scaling with the median standard deviation. The metadata are normalized similarly, after converting the TICI score into a numerical value.

Segmentation We perform a voxelwise classification to predict the final infarct. Inspired by Kamnitsas et al. [1] we implement using Keras a fully convolutional neural network with two pathways, one on the original resolution and one on a lower resolution (in plane subsampled with a factor 3). Both pathways have first 3x3x1 kernels and then 3x3x3 kernels to account for the anisotropy of the voxel size. Both pathways and the metadata are subsequently fed into fully connected layers before the final classification is made. Since the amount of training data is limited, we regularize the network heavily (drop-out and an l2-regularization) and augment the training data with elastic deformations, flips along the x-axis, Gaussian noise and small linear intensity transformations. Hyperparameters are chosen by evaluating the network's performance during cross-validation on the training set.

Post-processing The voxelwise probabilities produced by the network are thresholded by the dice-optimal threshold [2], resulting in a binary segmentation.

References

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