Insight Medical Publishing

JOURNAL OF TRANSLATIONAL NEUROSCIENCES

Automatic segmentation of infarcted regions from Computed Tomography Perfusion Imaging using 3D Convolutional Neural Network

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Abstract

A cerebral stroke is the second most common cause of death among adults worldwide: more than 13 million people suffer from this type of disease each year. Time is a fundamental factor: the treatment window for thrombolysis is estimated on 4.5 hours from symptom onset. One of the most used technique to deal with patients affected by cerebral stroke is Computed Tomography Perfusion (CTP) imaging: a fast method that allows to accurately predict the prognosis of patients in the early stage of the treatment. CTP is performed through image acquisition of brain slices using an iodinated contrast agent injected in cubital veins to enhance contrast in the tissue over time. Parametric maps, extrapolated from the changes of the blood flow and other important factors inside the brain slices over the acquisition period, are studied to identify infarcted regions, the core (dead tissue), and the penumbra (tissue-at-risk). These maps aid in the medical decision on who needs immediate thrombolytic treatment and/or interventional thrombectomy. Past research has proposed semi-automatic methods for segmentation based on parametric maps; showing imperfected outcomes in accuracy and reproducibility. We propose a fully automated 3-dimensional convolutional neural network, mJ-Net, to segment the infarcted areas using the entire 4-dimensional CTP dataset as input. To our knowledge, this is the first study adopting this type of dataset to train a network. The training dataset consists of brain images from 10 anonymous patients collected at Stavanger University Hospital. Each brain slice is labeled with manual annotations of the areas realized by an experienced radiologist after a detail study of the corresponding parametric maps for testing purposes. mJNet shows very encouraging outcomes comparing to past methods: cross validated results display an averaged Dice coefficient of 97.1% in the accuracy. Less than a minute was necessary to generate segmented images for each patient.

Biography:

Luca Tomasetti is a PhD student at the University of Stavanger (UiS), Norway.

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9th International Conference on Neurological Disorders and Stroke | Rome, Italy | February 28-29, 2020

Citation: Luca Tomasetti, *Automatic segmentation of infarcted regions from Computed Tomography Perfusion Imaging using 3D Convolutional Neural Network*, Stroke 2020, 9th International Conference on Neurological Disorders and Stroke, Rome, Italy, February 28-29, 2020, 09