DeepHealth partner University of Turin

released open-access dataset UniToBrain

The University of Turin (UniTo) released the open-access dataset UniToBrain collected for the homonymous Use Case 3 in the DeepHealth project (https://deephealth-project.eu/). UniToBrain is a dataset of Computed Tomography (CT) perfusion images (CTP). The dataset includes 258 consecutive patients; a subsample of 100 training subjects and 15 testing subjects (https://zenodo.org, UniToBrain) were used in a submitted publication for the training and the testing of a Convolutional Neural Network (CNN, see for details: arXiv, paperwithcode, medRXiv).

The UniTo team released this dataset publicly at https://ieee-dataport.org/ (UniToBrain).

CTP data were retrospectively obtained from the hospital PACS of Città della Salute e della Scienza di Torino (Molinette). CTP acquisition parameters were as follows: Scanner GE, 64 slices, 80 kV, 150 mAs, 44.5 sec duration, 89 volumes (40 mm axial coverage), injection of 40 ml of Iodine contrast agent (300 mg/ml) at 4 ml/s speed.

We calculated perfusion maps, including CBF, CBV, Delay, MTT, TTP, using a standard pipeline of spatial pre-processing and a state-of-the-art fast model-based non-linear regression (NLR) method developed By Bennink e al. [1]. Motion correction was done using a rigid registration method and subsequently all images were filtered implementing a bilateral filter [2,3]. Arterial input function (AIF) calculation was done automatically on a 100 voxels sample. The box-shaped model developed by Bennink et al. describes the impulse response function (IRF) of the perfused tissue in terms of CBV, MTT, and tracer delay. The box-shaped IRF enables fast NLR analysis, which is critical in a clinical setting such as ischemic stroke.

For normalization Elastix 4.8 was used with a 3D Euler transform (i.e., rigid, size preserving), 2 resolution levels (8x with 2000 samples, 1x with 8000 samples), and the 'Advanced Mean Squares' similarity metric, all linear interpolation.

The software was written in Matlab (userinterface) and C (filtering, analysis). Regarding the bilateral filter, the spatial kernelsize was 3 mm (SD) and the range kernel (i.e., intensity) size was 20 HU (SD).

The AIF extraction was fully automatic, and part of 'in-house' software. The AIF is determined from the aligned CTP by averaging all attenuation curves in an automatically segmented part of the arterial tree. The AIF was rescaled such that its AUC equals that of the automatically segmented VOF (to correct forpartial volume effects).

Time attenuation curve of the tissue and the relative CBF, CBV, Delay, MTT, TTP maps are estimated using the calculated AIF with the computed IRF.

This dataset contains the description of image acquisition parameters in plain text format, the raw images, the realigned images, the filtered images, and the perfusion maps (CBF, CBV, Delay, MTT, TTP) zipped in a single file. Inside the 7z file subjects are recorded in DICOM format following the data structure. You can find the metadata and data structure in pdf format along with data and acquisition format at https://ieee-dataport.org/ for the full dataset and at https://zenodo.org for the subsample dataset.

In figure 1 an example of IRF and CNN computed maps is shown.

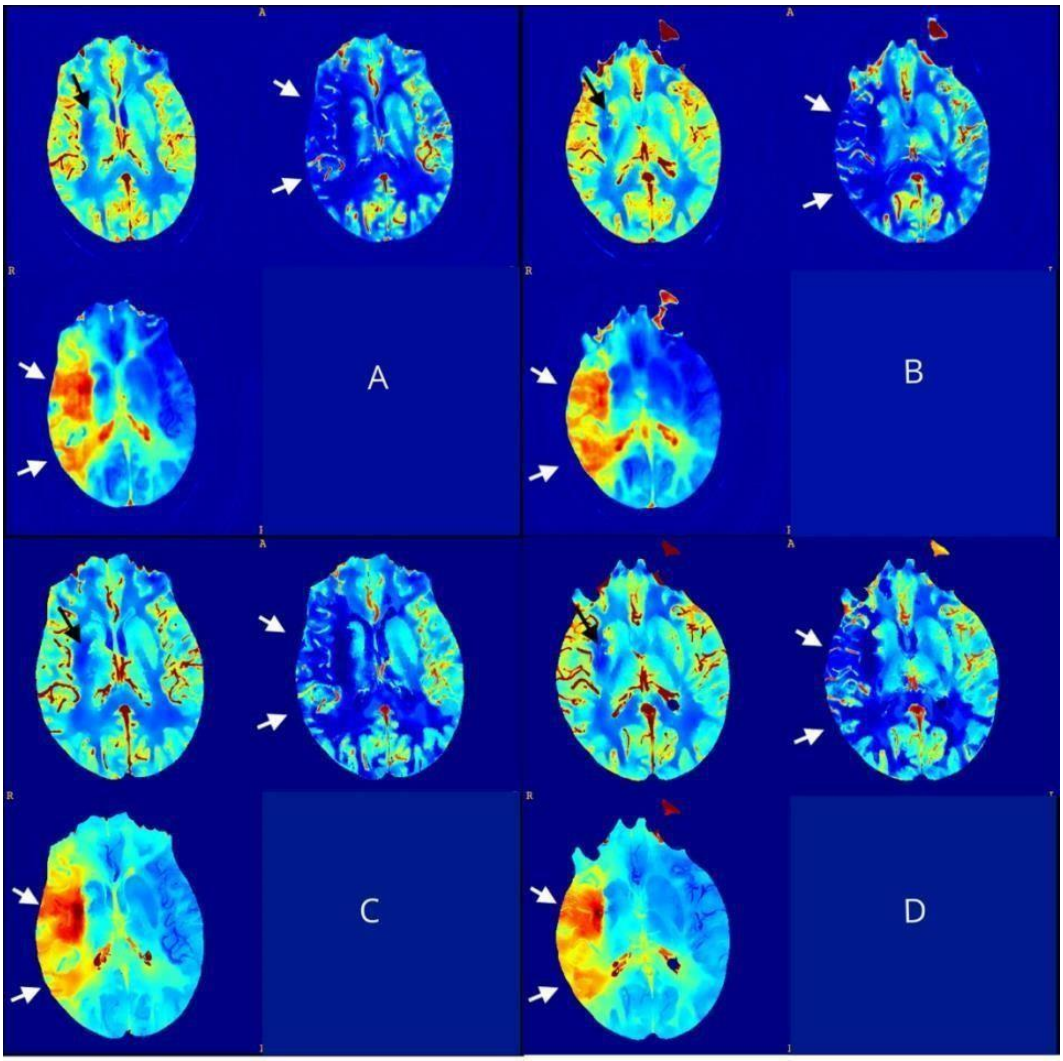
References

1. Bennink E, Oosterbroek J, Kudo K, Viergever MA, Velthuis BK, de Jong HWAM. Fast nonlinear regression method for CT brain perfusion analysis. Journal of Medical Imaging 2016. https://doi.org/10.1117/1.jmi.3.2.026003.

2. Klein S, Staring M, Murphy K, Viergever MA, Pluim JPW. Elastix: A toolbox for intensity-based medical image registration. IEEE Transactions on Medical Imaging 2010. https://doi.org/10.1109/TMI.2009.2035616.

3. Tomasi C, Manduchi R. Bilateral filtering for gray and color images. Proceedings of the IEEE International Conference on Computer Vision, 1998. https://doi.org/10.1109/iccv.1998.710815.

Figure 1. CTP Maps



A-B IRF Maps, C-D CNN Maps (CBV, CBF, TTP)