



Automated estimation of tissue T1 corrected CBF and ATT from multi-PLD ASL using a 3D CNN

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Introduction: The purpose of this study was to reduce the total scan time of multiple post labeling delay (multi-PLD) pseudo-continuous arterial spin labeling (PCASL) by estimating tissue T1-corrected cerebral blood flow (CBF) and arterial transit time (ATT) maps using a convolutional neural network (CNN).

Methods: Twelve subjects (age: 68.92 ± 6.87 years) had MRI including a multi-PLD PCASL sequence with 6 averages and 9 TIs. To test the feasibility of CNN, ideal ASL tag and control images were generated from the estimated CBF, ATT, and tissue T1 maps using a voxel-wise non-linear model fitting. Nine randomly chosen subjects were used for network training and the remaining 3 were used for testing. Tissue T1 map was estimated from an independent standard CNN. A hierarchically structured CNN (H-CNN) with the PWI and the estimated tissue T1 was used to estimate ATT and CBF because of the physiological relationship between CBF and ATT. Reduced numbers of PLDs were also tested.

Result: Based on the overall root mean square errors (RMSEs) from the non-linear model fitting and H-CNN with the reduced numbers of PLDs, our H-CNN outperformed the non-linear model fitting method in tissue T1-corrected CBF and ATT estimation (Figure 1). Total scan time reductions by the reduced number of PLDs from H-CNN were 11.08%, 9.18%, 29.75%, 31.33%, 50%, 59.18%, and 74.05% by the selected 8, 7, 6, 5, 4, 3, and 2 PLDs, respectively.

Discussion: The proposed method feasibly estimated tissue T1-corrected CBF and ATT from multi-PLD PCASL. The proposed method also showed a higher estimation accuracy than the non-linear model fitting with the reduced numbers of PLDs.

Conclusion: The reported results showed that a smaller number of PLDs can be used to generate tissue T1-corrected CBF and ATT in significantly shorter scan time without significant discrepancy from the reference in multi-PLD PCASL scheme.

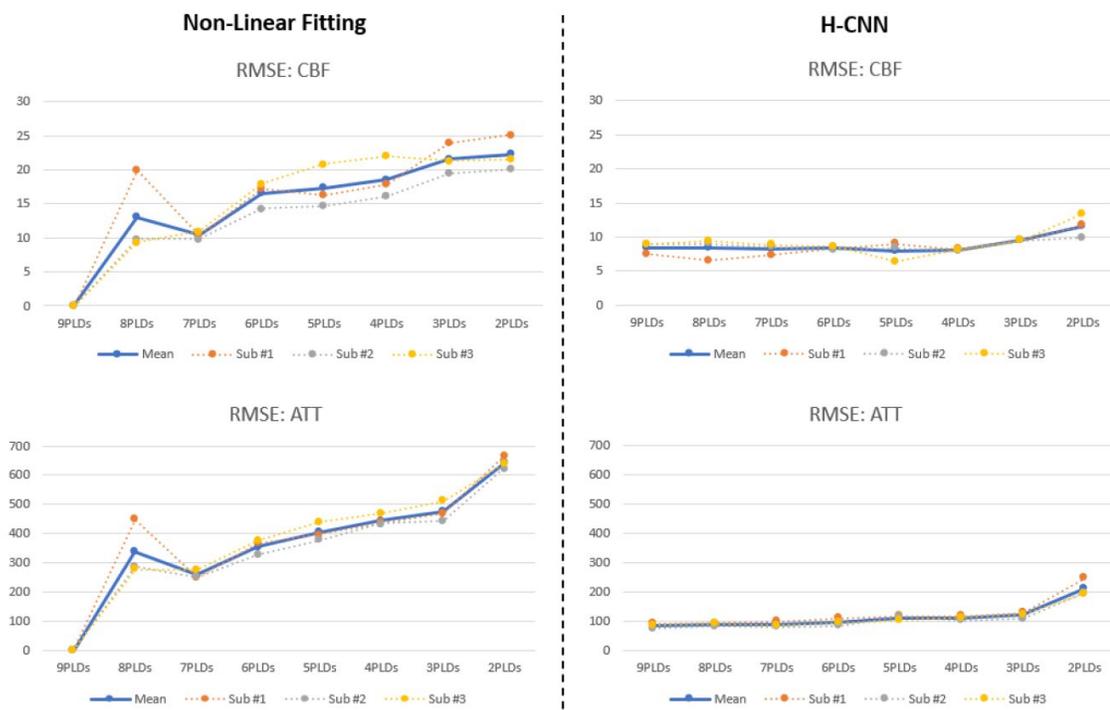


Figure 1. The overall RMSEs of the estimated tissue T1-corrected CBF and ATT maps from the nonlinear fitting (left) and H-CNN (right) using the reduced numbers of PLDs. Tissue T1-corrected CBF and ATT maps from the non-linear model fitting with 9 TIs were used for the ground truth reference images for the RMSE calculations.