AbstractID: 5378 Title: Fuzzy segmentation of brain tissue and optimum number of clusters: Application to quantitative assessment of arterial spin labeling perfusion maps

Purpose: To perform brain tissue segmentation using Fuzzy C-means (FCM) clustering and find the optimum number of clusters for application in brain perfusion quantification employing Flow-sensitive Alternating Inversion Recovery (FAIR) arterial spin labeling technique.

Method and Materials: For this study a single-shot spin-echo EPI-FAIR imaging sequence was employed. Imaging was performed using FAIR inversion times of 300, 450, 600, 800, 1000 and 1200. Other imaging parameters were 64x64 matrix, TE/TR=20/2000, 8-channel phased array head coil, and 40 consecutive selective and non-selective inversion recovery (IR) image pairs of healthy volunteers (n=5) were acquired. A FCM algorithm was developed and implemented for clustering the IR images. Also another algorithm was developed to determine the optimum number of clusters based on validity indices proposed in the literature including Partition Index (PI), Separation Index (SI), Beni's Index (BI) and Dunn's Index (DI).

Results: Optimum TI value for best segmentation results turned out to be TI=800msec. The optimum number of clusters for quantitative analysis of perfusion maps was found to be 6. The measure for the goodness of the clusters was based on a combination of the meaningfulness of the generated clusters and the value of validity indices mentioned above. With 6 clusters, a cluster of grey matter would appear with more tissue homogeneity and less partial volume effect which would result 20-25% increase in average measured signal in that whole segment which would lead to a higher SNR for more robust quantification of perfusion in that area. Partial volume effect seems to be more problematic at grey matter and CSF border

Conclusion: FCM is a powerful method for the purpose of brain segmentation since fuzziness could be considered as a measure to account for partial volume effect present in the brain images specially at lower resolutions used for perfusion imaging.