# MR-based Partial Volume Correction for $^{18}$F-PET Data Using Hoffman Brain Phantom

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## ABSTRACT

Partial volume averaging effect of PET data influences on the accuracy of quantitative measurements of regional brain metabolism because spatial resolution of PET is limited. The purpose of this study was to evaluate the accuracy of partial volume correction carried out on $^{18}$F-PET images using Hoffman brain phantom. $^{18}$F-PET Hoffman phantom images were co-registered to MR slices of the same phantom. All the MR slices of the phantom were then segmented to be binary images. Each of these binary images was convolved in 2 dimensions with the spatial resolution of the PET. The original PET images were then divided by the smoothed binary images in slice-by-slice, voxel-by-voxel basis resulting in larger PET image volume in size. This enlarged partial volume corrected PET image volume was multiplied by original binary image volume to exclude extracortical region. The evaluation of partial volume corrected PET image volume was performed by region of interests (ROI) analysis applying ROIs, which were drawn on cortical regions of the original MR image slices, to corrected and original PET image volume. From the ROI analysis, range of regional mean values increases of partial volume corrected PET images was 4 to 14%, and average increase for all the ROIs was about 10% in this phantom study. Hoffman brain phantom study was useful for the objective evaluation of the partial volume correction method. This MR-based correction method would be applicable to patients in the quantitative analysis of FDG-PET studies.

**Keywords:** Partial volume correction, PET, ROI analysis, Hoffman brain phantom

## 1. INTRODUCTION

Positron emission tomography (PET) is designed to provide in vivo quantitative estimates of regional cerebral metabolism, blood flow, or neuroreceptor concentration [1]. And, in the image scanned by PET, if the concentration of radioactivity within an object is held constant, the apparent concentration in the image decreases as object size decreases[2]. This underestimation of radioactivity concentration called partial volume effect is caused by the spatial resolution of PET. In this study we evaluate this partial volume effect in PET using the Hoffman brain phantom. After appling ROIs obtained from MR image to corrected PET, we measured the activity concentration within ROIs. The correction method of this study does not correct for partial volume effects between gray and white matter elements but extracortical regions. In this study we show how this correction improves the atrophy of extracortical.

## 2. MATERIALS AND METHODS

$^{18}$F-PET Hoffman phantom images were co-registered to MR slices of the same phantom. All the MR slices of the phantom were then segmented to be binary images. Each of these binary images was smoothed 4mm of FWHM with the spatial resolution of the PET. But, no axial smoothing was applied. The original PET images were then divided by the smoothed binary images in slice-by-slice, voxel-by-voxel basis resulting in larger PET image volume in size. This enlarged partial volume corrected PET image volume was multiplied by original binary image volume to exclude extracortical region. 6 ROIs are drawn in 12$^{th}$, 13$^{th}$, 14$^{th}$, 15$^{th}$ Hoffman MR slices, and the same ROIs applied corrected Hoffman phantom PET image that registered with Hoffman MR image. Pixel mean value (pixel value has from 0 to 255) within each ROIs was measured and compared uncorrected PET image with corrected PET image.

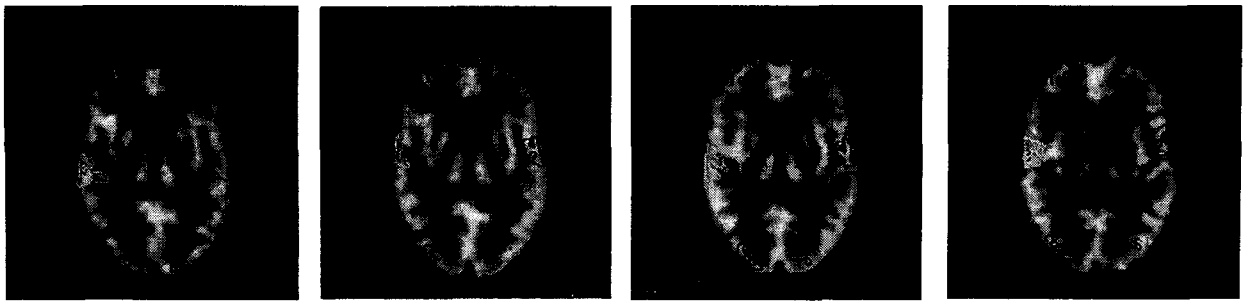

Fig.1.Applied ROIs to 12,13,14,15th corrected PET images

## 3. RESULT

From the ROI analysis, pixel mean values of each 6 ROIs per one slice increased from about 4 to 14%, and the sum of pixel mean values of all 6 ROIs within one slice increased about 7 to 8%. Total pixel mean value of ROIs within 4 slices increased about 8 %.

Table.1. % increased mean value of Each slice and all slice

| Slice Number | $12^{th}$ | $13^{th}$ | $14^{th}$ | $15^{th}$ | Mean of All slice |
|---|---|---|---|---|---|
| increment of mean value(%) | 7.6 | 8.1 | 7.4 | 7.8 | 7.7 |

## 4. Discussion And Conclusion

Because of using Hoffman phantom, Age-related declines in regional cerebral blood flow did not affect. But errors for course of image processing could not be disregared. First error could be occurred in miss registration of PET and MR image. Second error could be occurred in segment of MR image to be binary image. And third error could be occurred in smoothing binary image because 4mm of FWHM is not same with PET resolution exactly[3]. Hoffman brain phantom study was useful for the objective evaluation of the partial volume correction method. This MR-based correction method will be meaningful physiological assessments of regional flow and metabolism and applicable to PET image of patients with brain atrophy.

## REFERENCES


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