

Static-Image-based Non-invasive Construction of Parametric Images In Neurological Functional Imaging

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1. Aim of Project

- To develop a Non-invasive approach to Normalize PET images
- To expand and combine current methods that only use patient height and weight by including image based features

2. Introduction

- Position emission tomography (PET)
 - Medical imaging technique using a radioactive tracer.
 - Useful for detecting subtle functional changes prior to structural changes.
- Invasive measurement of plasma activity time curve (PTAC).
 - PTAC the amount of Glucose in the plasma at any given time.
- Used as a input function of a underlying physiological kinetic model
 - Can derive physiologically meaningful functional parameter.

- Regional cerebral metabolic rate of glucose(rCMRGlc)
 - Concentration of glucose in brain.
 - Widely used in clinical diagnosis of neurological disorders, such as dementia and epilepsy.

3. Approach (Fig. 5)

- Obtained images spatially normalized using Neurostat. (Fig. 1)
- Neurostat maps the images to an Atlas
 - The Atlas is an image that is a standard size and shape.
 - Allows us to remove regions or volumes of interest.
- Regions combined to form a scale factor:
 - Cerebellar Hemisphere
 - Cerebellar Vermis
- Japanese method[1] uses Standard Input Function(SIF) using height and weight.
- Scale factors from all methods were multiplied to a base PTAC
- Estimated PTACs for the patient used to process the image into rCMRGlc form[2].

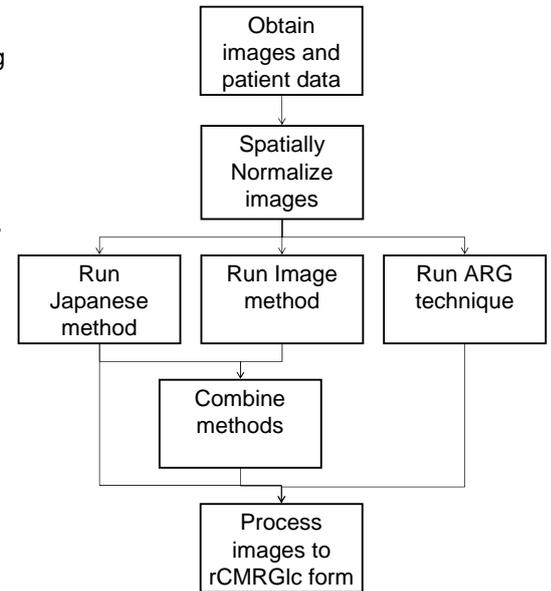


Figure 5. Flow of Approach

4. Results (Table 2)

- $SF_{Image} = CH^{0.4} + CV^{0.5}$
- $PTAC_{Comb} = 0.55 * PTAC_{Japan} + 0.4 * PTAC_{Image}$

Method	AUC (%)	rCMRGlc (%)
Japan	15.00 ± 33.37	14.28 ± 15.28
Image	16.17 ± 30.80	-
Combined	14.39 ± 29.74	16.61 ± 16.85

Table 2. Results

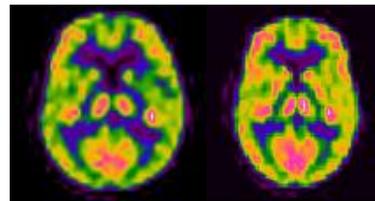


Figure 1. Original (left) Normalize (right)

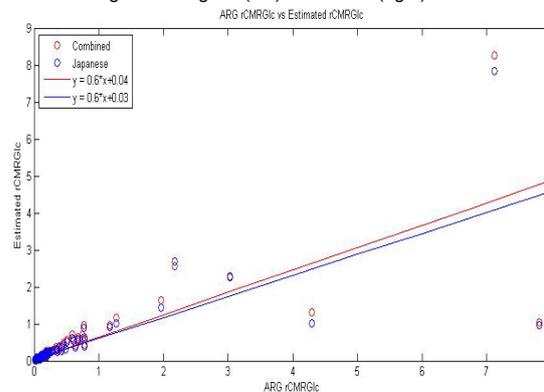


Figure 2. rCMRGlc results

1. Arterial Sampling

- The gold standard
- Requires many blood samples
- Can cause patient discomfort and pain.
- Dangerous for staff to take blood samples and to handle blood.

2. Autoradiographic Technique (ARG)

- Industry standard.
- Requires only two blood samples
- Reduces exposure blood samples.
- Less discomfort for the patients.

3. Standard Uptake Value (SUV)

- Non-invasive method
- High bias
- Uses body weight and inject dose
- Can include height to reduce bias

4. Dynamic Image Derived Input Function

- Sensitive to noise
- Requires a long scan time
- Unviable for busy clinics

No. of Subjects	Age	Body height (cm)	Body Weight (kg)	Glucose	Inject Dose	Uptake Time
379 (186M/193F)	37.2 ± 10.4	171.0 ± 10.3	73.9 ± 17.9	81.1 ± 14.2	365.9 ± 49.0	51.4 ± 5.3

Table 1. Summary of Subjects

6. References

- T. Shiozaki, N. Sadato, M. Senda et al., "Noninvasive Estimation of FDG Input Function for Quantification of Cerebral Metabolic Rate of Glucose: Optimization and Multicenter Evaluation," *J Nucl Med*, vol. 41, no. 10, pp. 1612-1618, October 1, 2000, 2000.
- S. Ebert, A. R. Anayat, R. R. Fulton et al., "Evaluation of two population-based input functions for quantitative neurological FDG PET studies," *European Journal of Nuclear Medicine and Molecular Imaging*, vol. 24, no. 3, pp. 299-304, 1997.

5. Conclusion

Although the AUC showed promise in combining the Japanese groups SIF and image features, this was shown not to be the case when rCMRGlc values were compared. Further research could show that other image features or in different amounts could make combining these methods more accurate.

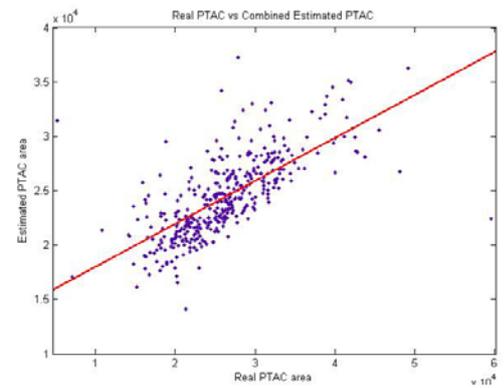


Figure 3. (above) Real PTAC area vs Combined Estimate of PTAC area

Figure 4. (below) Real PTAC area vs Japanese Estimate of PTAC area

