Visualization of Volume Information from PET Data

Oyewole Oyekoya, Xiaohong W. Gao

[1] School of Computing Science, Middlesex University, Hendon, London NW4 4BT, UK
{O.Oyekoya, X.Gao}@mdx.ac.uk

1 Objective

The ability of brain imaging methods such as PET (Positron Emission Tomography) data in enabling quantification of human brain function in three dimensions have been useful in clinical diagnosis. Through the use of a diverse range of tracers, PET can provide quantitative measurement about the location of brain activity. To exploit the potential of PET, this research concentrates on using intensity information from the PET data to construct surface and volume information for three-dimensional visualization.

2 Theory

PET images have relatively low spatial resolution and lack apparent anatomical information. This has hampered research into effective visualization techniques [1][2][3][4]. Metabolic activity is expressed in terms of intensity levels, and this research focuses on the surface and/or volume visualization of these intensity levels. Volume visualization is the creation of graphical representations of data sets that are defined on three-dimensional grids. PET volume data sets are characterized by multidimensional arrays of scalar data using Matlab's visualization functionality.

In Figure 1, a PET scan of a patient with a lesion on the left part of the brain is shown in axial view. Figure 2 shows the 3D view obtained strictly from the intensity values of the PET volume data. It shows the surface visualization of the lesion in red, with the surface visualization also extracted from the PET data. In constructing the 3D view, it was found that the mean value of the scan produces information that can be useful in determining the surface properties of the regions of interest. This hypothesis is subject to further research. However, it will be interesting to extract information from PET scans without reference to subjective information. This may be useful in building a Content Based PET Image Retrieval System. Figure 2 is computed as follows:

1. Extract surface of the region of interest (i.e. head) using canny edge detection algorithm.
2. Compute mean of the intensity levels of the PET image.
3. Use mean value to create 3D patch which displays the surface of the head.
4. The sub-volume functionality is then used to display a slice in the 3D view.

5. Finally the lesion is computed using a lesion detection algorithm which subtracts the flipped image from the original image. The resulting volume is displayed within the surface of the head.

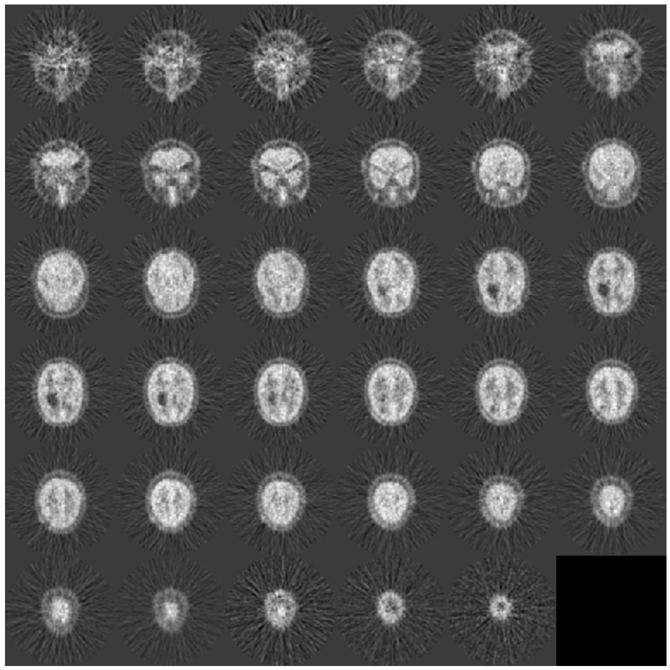

Figure 1: Slice view of PET scan with lesion on the left

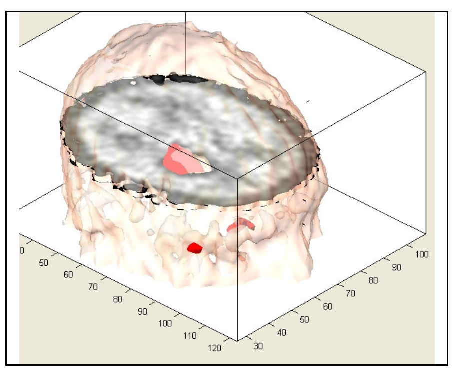

Figure 2: 3-dimensional volume visualization of a PET scan (Red ROI is the lesion).

Information within PET volume data may be useful for extracting information without reference to any subjective information. The current framework is a good starting point for further research, and has the potential to be integrated with a Content Based Image Retrieval System. The GIFT (GNU Image Finding Tool) client-server software is being integrated with the system (Figure 3). It is envisaged that the end-system (PET CBIR system) may be useful for computer-aided diagnosis. More importantly, it provides a basis for further study of 3D retrieval methods (i.e. how to use geometric volume information such as the red lesion identified in figure 2 as feature vector for improved similarity search) [5].

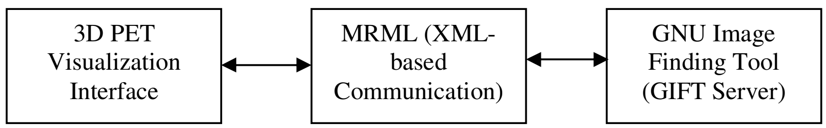

Figure 3: Proposed Architecture

References

[1] K. Mueller, T. Welsh, W. Zhu, J. Meade, and N. Volkow (2000). "BrainMiner: A visualization tool for ROI-based discovery of functional relationships in the human brain", New Paradigms in Information Visualization and Manipulation (NPIVM) 2000, Washington DC, November 2000

[2] Brett M, Johnsrude IS, Owen AM (2002). "The problem of functional localization in the human brain", Nat Rev Neurosci. 2002 Mar;3(3):243-9.

[3] IEEE Computer Graphics and Applications Staff 1991. "Visualizing 3D PET Images". IEEE Comput. Graph. Appl. 11, 5 (Sep. 1991), 11-13. DOI= http://dx.doi.org/10.1109/38.90562

[4] Xiaopeng Han, Shuqian Luo, The Extraction and Visualization of the ROI of PET Brain Functional Images, Proceedings of International Conference on Medical Imaging and Telemedicine (MIT 2005), pp.-171, Aug. 16-19, Wuyi Mountain, China. ISBN: 1-85924-252-9.

[5] Bustos, B., Keim, D., Saupe, D., Schreck, T., and Vranic, D. 2004. An Experimental Comparison of Feature-Based 3D Retrieval Methods. In *Proceedings of the 3D Data Processing, Visualization, and Transmission, 2nd international Symposium on (3dpvt'04) - Volume 00* (September 06 - 09, 2004). 3DPVT. IEEE Computer Society, Washington, DC, 215-222. DOI= http://dx.doi.org/10.1109/3DPVT.2004.30