ISSN 2395-1621

Joint MRI-PET reconstruction

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ABSTRACT

Our project is based on image reconstruction. Image reconstruction means getting clearer images then the previous. One input image is taken which is combination of PET and MRI image this joint MR-PET image is reconstructed. The MR scanned images as well as the PET scanned images are taken these two images are combined so that we get a more clear image. We have to find the gradient of this image that is gradient in direction and magnitude. An efficient multi-modality reconstruction framework method is proposed using random transform. A dedicated multi- channel regularization functional that jointly reconstructs images from both modalities. In this way, information about the under- lying anatomy is shared during the image reconstruction process while unique differences are preserved. The image obtained from the random transform is the sinogram. The obtained sinogram is reconstructed using the back projection. The noise is removed from the reconstructed image by using various filters.

ARTICLE INFO

Article History

Received: 28th April 2017

Received in revised form :

28th April 2017

Accepted: 30th April 2017

Published online :

7th May 2017

Key Words: MRI-PET image, Slice filtering, 2DFFT filtering, Convolution Filtering

I. INTRODUCTION

The main aim of this project is to obtain more clear images. Our project is based on image reconstruction. Image reconstruction means getting more clear images of the boarder. An input image is taken which is joint or combined MR-PET scanned. Combined magnetic resonance/Positron emission tomography (MR/PET) is an emerging imaging modality that can provide metabolic, functional, and anatomic information and therefore has the potential to provide a powerful tool for studying the mechanisms of a variety of diseases. The MR scanned images as well as the PET scanned images are taken these two images are combined so that we get the input image which is joint MR-PET scanned image.

For the reconstruction of the image the input image under goes EM algorithm which is nothing but the Expectation Maximization Algorithm, which is used mostly for the reconstruction of PET images. Expectation maximization (EM) algorithm is an iterative method for finding maximum likelihood r maximum a posteriori (MAP) estimates of parameters in statistical models, where the model depends on unobserved latent variables.

After expectation maximization the gradients of images are found. An image gradient is a directional change in the intensity or colour in an image. Image gradients may be used to extract information from images. After finding the gradient we obtain two images one is gradient in direction and another is gradient in magnitude.

After obtaining the gradients that is the gradient in direction and also magnitude the random transform of the image is found where we get the sinogram of the image. The tomographic data acquisition is conventionally modeled by the Radon transform. Radon transform collects line integrals across the object at different angles. Measured data are collected as a sinogram matrix.

Reconstruction of the binary sinogram is performed in order to obtain the skull on the original image. Now we got the sinogram of the image but we have to reconstruct the image so we use the filtered back projection to get the original image.

By the filtered back projection we get the original reconstructed image but this image contains lot of noise so we can use different filters to remove the noise from the image. We have performed three types of filtering in our project one of them is convolution Filtering another one is the 2DFFT filtering and the last one is the Central Slice filtering. So after applying the image to the filters we get the

image which does not contain noise and we get clear reconstructed image. We get three different reconstructed images obtained from three different filters.

II. JOINT MRI-PET IMAGE

Joint/hybrid technique is used to integrate the advantages of each imaging technique. MRI, or magnetic resonance imaging, and PET, or positron emission tomography, are techniques that are designed to create images of what is going on inside the human organism. These scans are most commonly used to detect cancer, heart problems, brain disorder etc. Each technique has its unique characteristics in diagnosis of particular disease. But they have their own disadvantage too; MRI could give the blood flow and activity of brain cells, whereas CT cannot. Hence, hybrid techniques emerged to integrate the advantages of each imaging modality. Multimodality imaging's currently in use are PET-MRI scan gives the functional characteristics of the organs/tissues together with detailed anatomical structures like tissue density, organ size etc. hence dual and multimodality imaging gives better diagnosis.

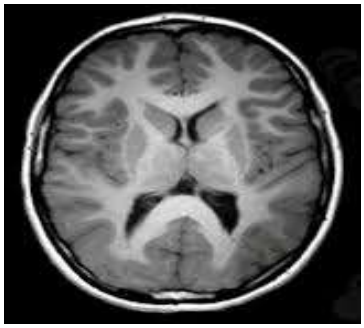


Fig 1 Joint MRI-PET image

III. BLOCK DIAGRAM

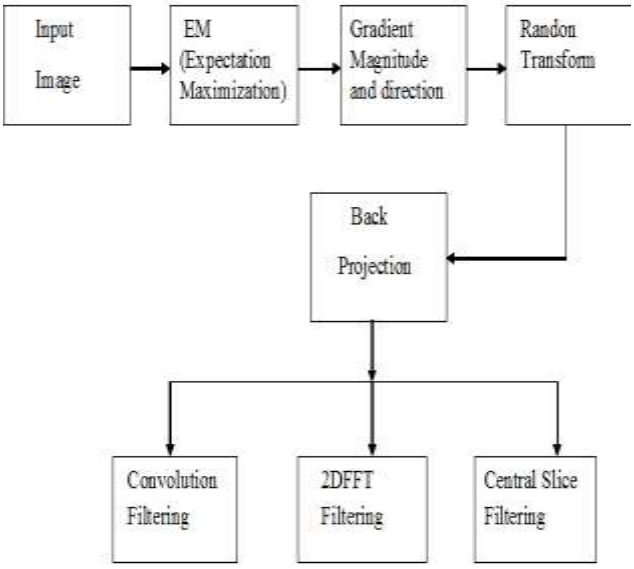


Fig 3.1 Block Diagram

The above diagram is the block diagram of the system. We can see that we have used one input image which is the combination of MRI image and the PET image. We have taken the EM of this image. Then we have found the gradients of the image that is the gradient in direction as well as magnitude. Then we have used the random transform where we get the sinogram of the image. The sinogram of the input image is then reconstructed by using the back projection method, where we get the reconstructed input image. But this reconstructed image contains noise which needs to be removed. This noise from the image is removed by using various filtering processes that is convolution filtering, 2DFFT filtering and Central Slice Filtering. So we get a reconstructed image which is filtered by various filters and we get three different filtered images.

IV. RESULT AND ANALYSIS

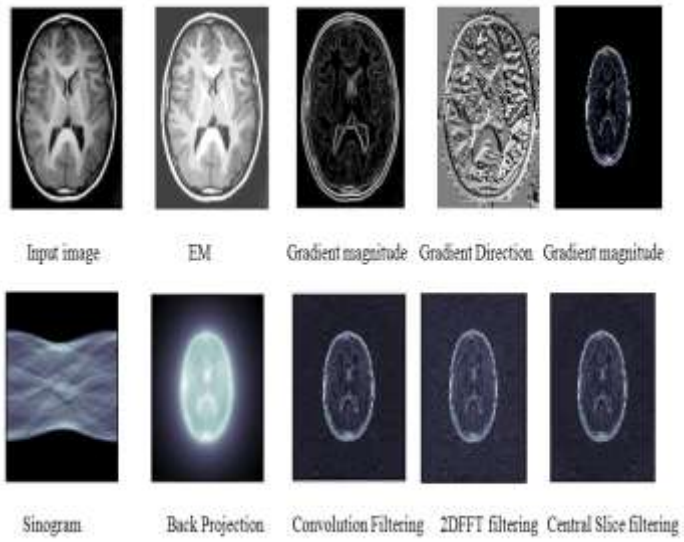


Fig.4.1 Result

The above ten images show us the result or output of the code in which the first image is the input image. The input image which we have taken is the joint MR-PET image which is to be reconstructed. The MR scanned images as well as the PET scanned images are taken these Two images are combined so that we get the input image which is joint MR-PET scanned image.

The second image obtained is the EM image which is the Expectation Maximization Algorithm. Expectation maximization (EM) algorithm is an iterative method for finding maximum likelihood maximum a posteriori (MAP) estimates of parameters in statistical models, where the model depends on unobserved latent variables.

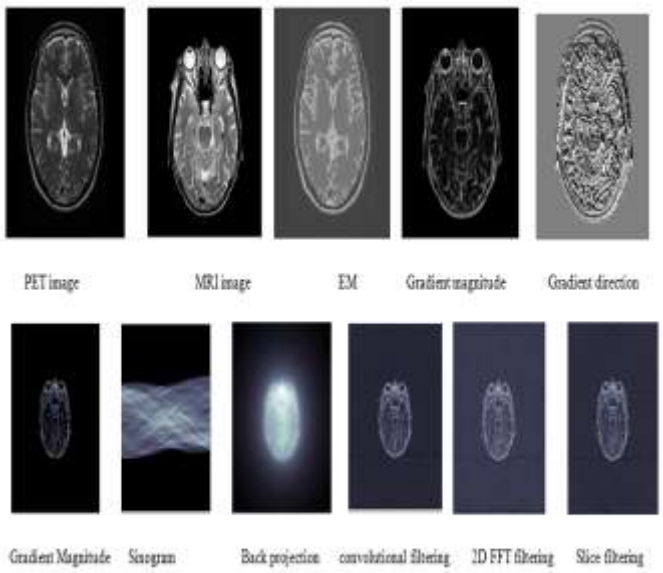
After expectation maximization the third and fourth images obtained are the gradient images. Gradients of the input images are found. An image gradient is a directional change in the intensity or colour in an image. Image gradients may be used to extract information from images. After finding the gradient we obtain two images one is gradient in direction and another is gradient in magnitude.

Now for the reconstruction purpose we consider the gradient in magnitude image, which is the fifth image. After obtaining the gradients that is the gradient in direction and also magnitude the random transform of the image is found where we get the sinogram of the image. The tomographic data acquisition is conventionally modeled by the Radon

transform. Radon transform collects line integrals across the object at different angles. Measured data are collected as a sinogram matrix. Thus, the sixth image obtained of the sinogram.

Now we got the sinogram of the image but we have to reconstruct the image so we use the filtered back projection to get the reconstructed image. So by using filtered back projection we obtain the seventh image which is the back projection image.

By the filtered back projection we get the original reconstructed image but this image contains lot of noise so we can use different filters to remove the noise from the image. We have performed three types of filtering in our project one of them is convolution filtering another one is the 2DFFT filtering and the last one is the Central Slice filtering. So after applying the image to the filters we get the image which does not contain noise and we get clear reconstructed image. We get three different reconstructed images obtained from three different filters. The eighth image obtained is convolution filtered image, the ninth image is the 2DFFT image whereas the last filtered image obtained is the central Slice filtered image.



Now we have considered two input images one is MRI scanned and another is PET scanned. The expectation maximization of the PET image is found, then these two images are combined and the gradient is found the gradient of direction and magnitude is found. The gradient of magnitude is found of which the sinogram is obtained. After obtaining the sinogram we have to reconstruct the image this is reconstructed by using the back projection method. After reconstruction the image contains noise which is to be removed, so we use filters to remove the noise. The filters used are convolution filters, 2DFFT filter, slice filter.

V. ALGORITHM

1. Read the input images

2. Find out the expectation maximization of the input image

3. Obtain the gradients of the image gradient in direction as well as gradient in magnitude.

4. Consider the gradient in magnitude image for further process.

5. By using the random process we obtain the sinogram of the image.

6. The back projection algorithm is used for the purpose of reconstruction.

7. This reconstructed image is contaminated with noise which is removed by using filters.

VI. CONCLUSION

Thus, in our project we have reconstructed the image; we can obtain clearer images, which is very helpful in medical fields for tumor detection.

The reconstructed image obtained after combining the MRI and PET images which is the input image. We obtain Gradient-directions and magnitude for input image and difference of directions of this is obtained, so that we get gradient magnitude and gradient direction. Then the gradient magnitude image is reconstructed. By using random transform we obtain the sinogram of the image. After obtaining the sinogram we have to reconstruct the image for reconstruction we used the back projection algorithm.

Now the image obtained after back projection is the reconstructed image, but it contains noise. We have to remove the noise from the image so we used various filters to remove the noise from the image.

Thus, we obtain the reconstructed image which is clearer.

VII. ACKNOWLEDGEMENT

It gives me immense pleasure in presenting the report on “Joint MR-PET reconstruction”. There are many people whom I would like to thank for their contribution in completing this project as well as report successfully.

Firstly I would like to thank my guide, Prof. D. N. Naiknaware, for their guidance and support. I would always remain thankful and grateful for their constant support and guidance extended by guide in making this project and report. Through our many discussions, it made helpful for us to implement our ideas and workout on them. We wish to express my sincere thanks to the Head of Department Dr. S.L. Lahudkar. I would also like to thank all my group members for understanding my ideas, asking questions and providing feedback and suggestion for improving my ideas.

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