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RESEARCH ARTICLE

AN IMPROVEMENT IN BRAIN TUMOR DETECTION USING SEGMENTATION AND BOUNDING BOX

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ABSTRACT - Proper diagnosing of brain tumor is very important for the good treatment of tumor. This is possible by studying the previous cases of the brain tumor. The growth of tumor takes up space within the skull and interferes with the normal brain activity. So detection of tumor is very important in earlier stage. This paper focus on the MR images those are noisy due to poor acquisition process of the physical devices. This leads to improper visibility of the abnormality in MR images. The noise is removed first and then bounding box method is used to identify the location of the tumor.

Keywords- Brain tumor; poisson noise; salt & pepper noise; median filter; bounding box

I. INTRODUCTION

Brain tumor is an abnormal growth of cells within the brain. It is the mass of tissue in which some cells grows and multiply uncontrollably [1]. Brain tumor can either originate in brain itself, or come from another part of the body and travel to the brain. Brain tumor can be cancerous or non cancerous, depending on their behaviour. Image processing in medical fields [2] plays an important role to improve medical diagnostics and therapy. For early diagnosis of tumors in tissue samples, research and development activities are concentrated on the exploration of automatic image analysis. In order to decide the proper treatment of tumor, it is efficient to study the previous cases of the brain tumor. The study of the historical data helps in deciding that what type of tumor requires what type treatment.

Scanning of brain is done to obtain the image of the internal structure of the brain. Using computer technology, a scan compiles an image of the brain by photographing it from various angles. Magnetic resonance imaging [3] is a powerful tool for investing the body's internal structure. This technique uses radio frequency pulses of magnetic field to examine different organs and systems. The resulting information can be viewed as images on the computer.

While acquiring medical images, from the computer aided machines, there are cases, when these images are subjected to some noise [4]. The noisy image can be due to random disturbance of electronic devices, influence of surrounding

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environment or human factor [4]. Thus because of such noise in the image, visibility of tumor is reduced. Before locating tumor in image, this noise is removed. In this paper median filter is used to remove the noise in scanned image. After removal of noise, location of brain tumor is identified. The algorithm that is used to locate the tumor defines bounding box around the abnormal regions. An automated tumor location algorithm is proposed by [5]. This algorithm utilises the approach based on left to right symmetry of the brain.

NOISE IN IMAGE AND MEDIAN FILTER

1. Salt and pepper noise

It is also known as impulse noise. This noise can be caused by sharp and sudden disturbances in the image signal [6]. Its appearance is randomly scattered white or black (or both) pixel over the image.

2. Poisson noise

Poisson noise is signal-dependent, that is often seen in photon images [4]. The variance of the noise is proportional to the original image values. The noise model is described as

$$d(m, n) \sim 1/\lambda[\text{Poisson}\{ o(m,n)\}]$$

where o(m, n) and d(m, n) mean the pixel values in the original and degraded images, respectively. The degraded image is generated by multiplying the original pixel values by λ and by using these as the input to a random number generator which returns Poisson distributed values. The amount of noise depends on L.

3. Median Filter

Median filter [7] is used to reduce noise in an image. It is similar to the mean filter. In a median filter, a window slides along the image, and the median intensity value of the pixels within the window becomes the output intensity value of the pixel being processed. Median filter preserves edges in an image while reducing random noise.

II. TECHNIQUE USED

The location of brain tumor influences the type of symptoms that occur. Identifying the presence of a brain tumor is the initial step in determining the course of treatment. To identify the location and size of tumor the detection process involves various steps.

Firstly the MR image of the brain is obtained. Imaging plays the central role in the diagnosis of brain tumors. Brain scan is the picture of the internal structures in the brain. A specialized machine takes a scan in much the same way a digital camera takes a photograph. MRI is scanning device that uses magnetic fields and computers to capture images of the brain on film.

In medical image processing, medical images are corrupted by different type of noises. Low quality image is an obstacle for effective [8] feature extraction, analysis, recognition and quantitative measurements. Presence of noise during image acquisition degrades the human interpretation, or computer aided analysis of the images. Most common type of noises that are usually found in acquired medical images are salt and pepper or poisson noise. Salt and pepper noise appears as white and black pixels in the image. The medical data represented by the photon images has a tendency to be degraded by poisson noise. Due to presence of such noise, the tumor is sometimes not visible properly especially in case of salt and pepper noise. Also the tumor may not be located properly. In some cases combination of both salt & pepper and poisson noise may also be present.

So it becomes necessary to remove such type of noise from these images. Thus next step is the removal of noise which is very important step in medical imaging applications [8] to enhance and recover anatomical details that may be hidden.

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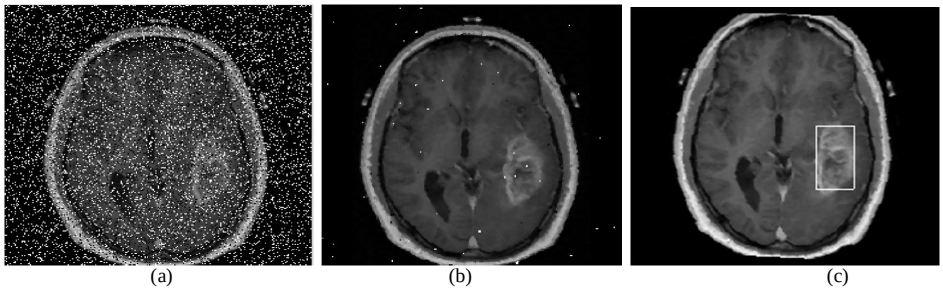
Median filter is the appropriate technique for removal of noise. As it is already discussed, median filter is similar to the mean filter. In median filter [7] each pixel is set to median of the pixel values in the neighbourhood of the corresponding input pixels.

Next step after removal of noise is to identify the location of the tumor. This is done by creating a bounding box around the brain abnormality in MR image. The bounding box method is based on the property of the symmetrical structure of the brain [5, 9]. That is left and right lobes are almost identical. The left right parts are similar until an abnormality occurs in any part of the brain. For creating a bounding box, first the skull is detected. Then line of symmetry [14] is drawn to create left-right symmetry of brain. Assumption is made that tumor is located in one of the two halves of the brain. One half acts as reference image while other as test image. The vertical and horizontal scan is performed on both sides, comparing to obtain the region of abnormality. This is done by obtaining a score plot function 'E' based on average intensities of the region of abnormality. All maximum and minimum points are obtained from the graph. From all the pairs, the pair (m, n) is found for which difference (E(m)-E(n)) is maximum. This defines the boundary of bounding box. The score plot function is defined by the Bhattacharya coefficient [11, 12]. This method uses the probability mass function, that is, normalized gray level intensity histograms.

III. **RESULT**

When MR images are corrupted by different type of noises, the visibility of tumor is greatly reduced. It becomes difficult for doctor to analyse this output. Thus to remove the effect of noise median filter is used. After removal of noise, bounding box is created around the tumor.

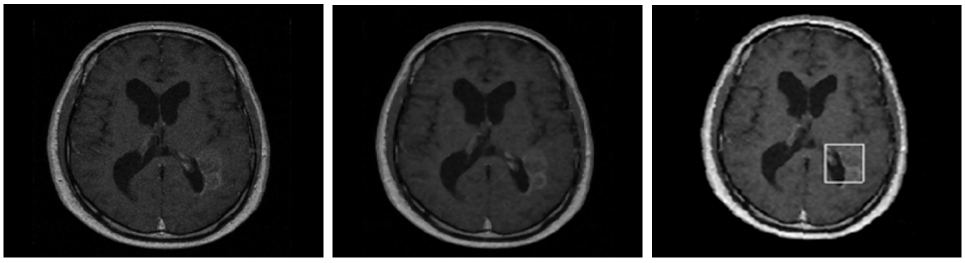
In case when image is corrupted by salt & pepper noise



(a) (b) (c)

Fig. 1: (a) Image with salt & pepper noise (b) Image after using median filter (c) Bounding box around tumor

When image is corrupted by Poisson noise



(a) (b) (c)

Fig. 2: (a) Image with poisson noise (c) Image after using median filter (d) Bounding box around tumor

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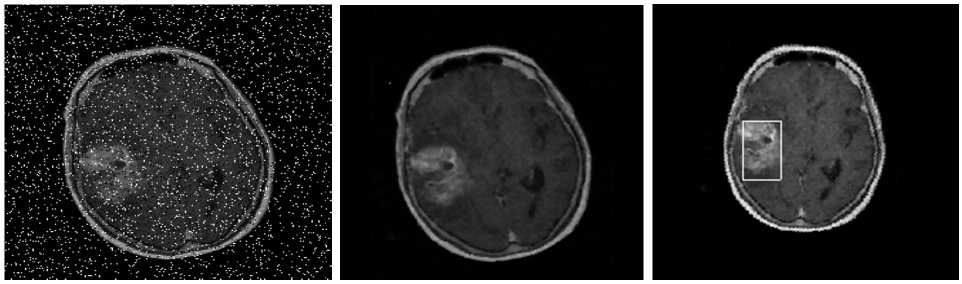
When image is corrupted by both types of noises



(a) (b) (c)

Fig. 3: (a) Image with both salt & pepper (b) Image after using median filter (c) Bounding box around tumor

Thus in medical image processing, medical images are corrupted by different type of noises. So it becomes necessary to remove such type of noise from these images. Median filter is the appropriate technique for removal of noise.

Quality of noisy image and de-noised image are measured by four quality measures [13]. Let x(i,j) represents the original image and y(i,j) represents distorted (modified) image of size MN.

PSNR = $10\log_{10}(2^n\text{-}1)^2/\sqrt{MSE}$

MSE = $\frac{1}{MN}\sum\sum(x(i,j)\text{-}y(i,j))^2$

Maximum Difference = MAX $\left| x(i,j)\text{-}y(i,j) \right|$

Mean Difference = $\frac{1}{MN}\sum\sum(x(i,j)\text{-}y(i,j))$

To show these measures ten different medical application images [10] are used.

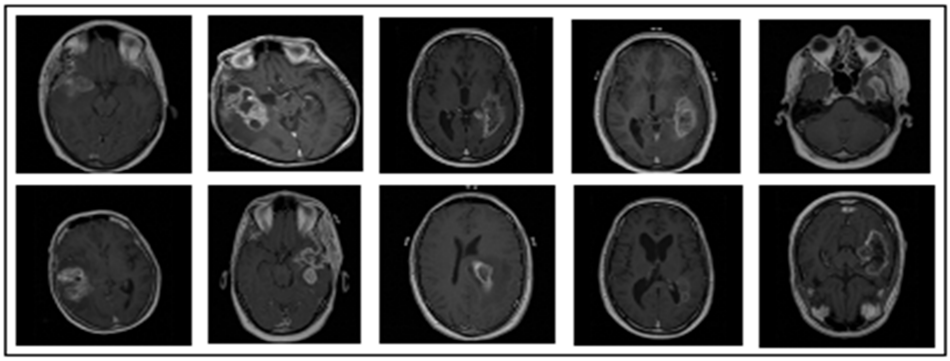


Fig. 4 MR Images of Brain Tumors

When these images are corrupted by noise then for noisy images, these measures are computed which are shown in the following table. Quality measures for all these images corrupted by both type of noises were computed. The results of these measures are shown below.

Table I: Quality measure for noisy images

Images	MSE	PSNR	Max Difference	Mean Difference
Image1	5314	10.8766	171	19.7988
Image2	5317	10.8741	174	19.9297
Image3	4939	11.1944	194	17.4846
Image4	4977	11.1611	158	17.6367
Image5	5484	10.7398	232	20.6833

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Image6	5074	11.0773	155	17.8696
Image7	5008	11.1342	210	17.3237
Image8	5246	10.9325	178	19.5617
Image9	4596	11.5070	255	14.3847
Image10	5026	11.1186	176	18.2712

After applying Median filter, the images are de-noised. For modified images the quality measures are shown in the following table.

Table II: Quality Measure after applying median filter

Images	MSE	PSNR	Max Difference	Mean Difference
Image1	88	28.6860	145	0.2389
Image2	87	28.7356	142	0.1316
Image3	90	28.5854	155	0.1919
Image4	88	28.6860	109	0.2517
Image5	100	28.1308	148	0.1951
Image6	105	27.9189	133	0.2352
Image7	91	28.5404	196	0.1087
Image8	88	28.6860	102	0.3041
Image9	154	26.556	210	0.4242
Image10	82	28.9927	139	0.2610

Graphically these values are shown as follows:

- Mean Square Error (MSE)

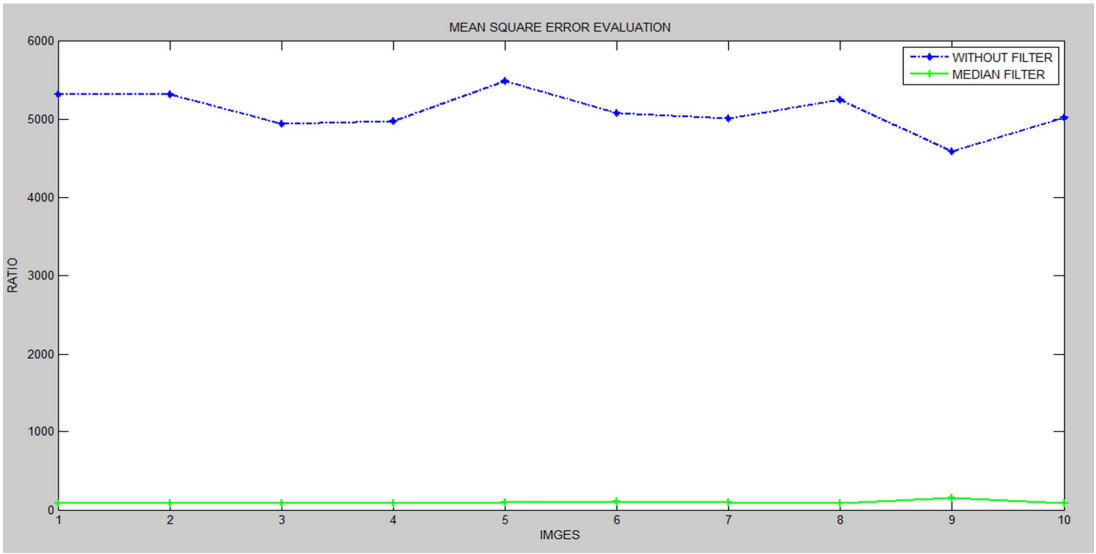

Fig.5 Graph for evaluation of mean square error

- Graph is plotted between the images (x-axis) and ratio (y-axis) that defines mean square error.
- Blue line shows the value of mean square error in case of noisy images.
- Green line is the result, after using median filter.

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➢ Peak Signal to Noise Ratio (PSNR)

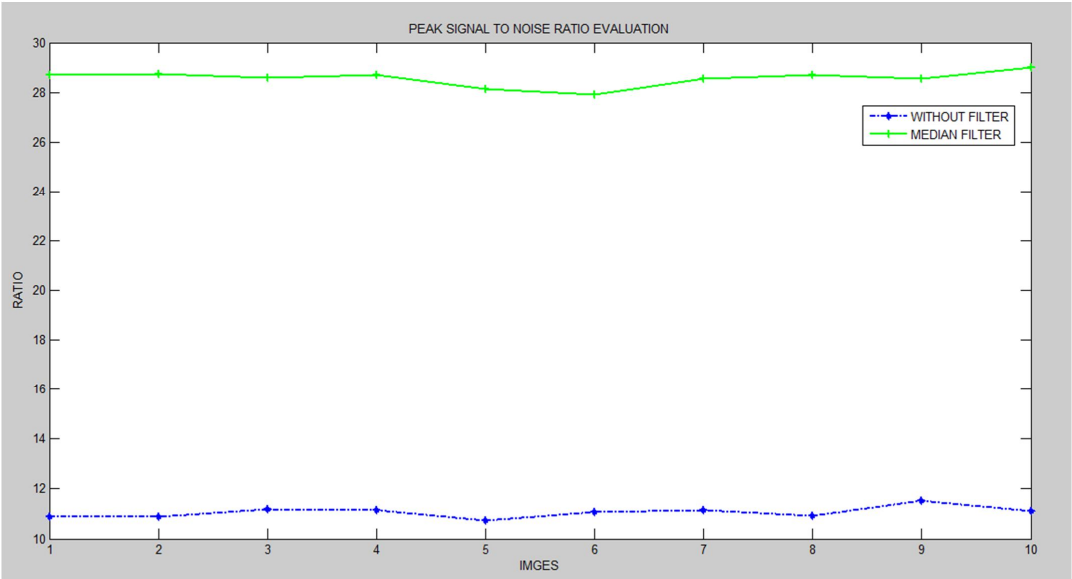

Fig. 6 Graph for evaluation of peak signal to noise ratio

- This graph is plotted between ratio of peak signal to noise ratio (y-axis) and images (x-axis).
- Here blue line is the result when images are subjected to noise.
- Green line is after using median filter.

➢ Maximum Difference

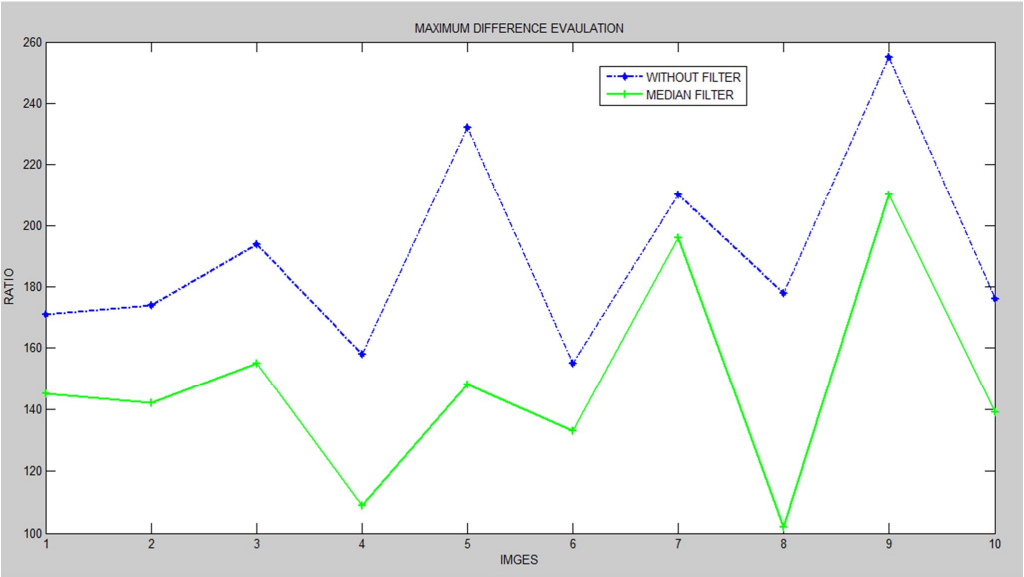

Fig. 7 Graph for evaluation of maximum difference

- This graph is plotted between maximum differences (y-axis) and images (x-axis).
- Blue line determines the values of MD in case of noisy images.
- Green line is obtained after using median filter.

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➢ Mean Difference

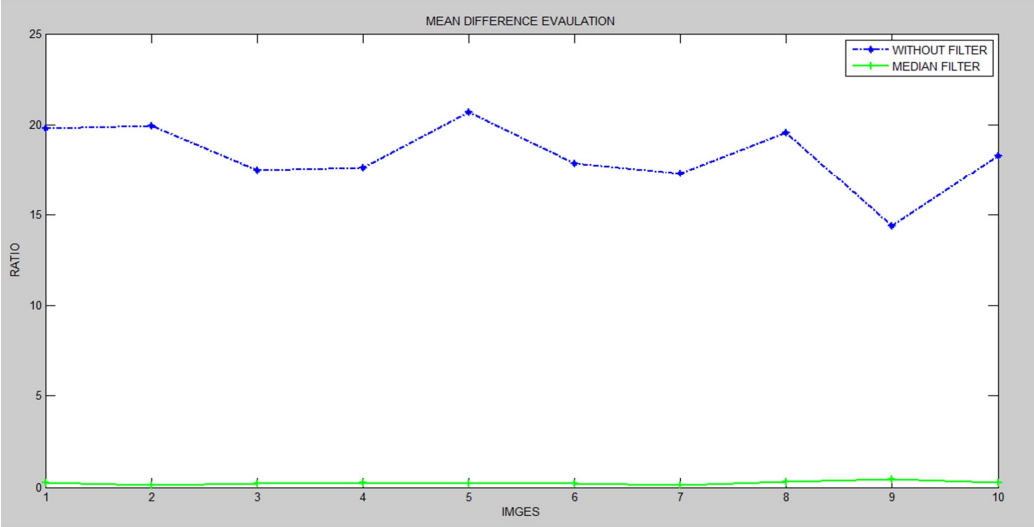

Fig. 8 Graph for evaluation of mean difference

- This graph is obtained between average or mean difference (y-axis) and images (x-axis).
- Blue line represents the value, in case, when noisy image is used.
- Green line is the result after using median filter.

After evaluation of these results, next step is to determine the region of interest. This is determined by creating a bounding box around the region of abnormality. Thus it is seen that, the cases when images are subjected to some unwanted noise, the tumor is not visible properly and thus becomes difficult to locate. So to remove these inconsistencies, those images are de-noised and then tumor is located.

IV. CONCLUSION

The brain MR images are noisy when acquired through physical mechanism. The noises leads to improper visibility of the abnormality of the brain, that is, tumor. In this paper two types noises are studied, that is, poisson noise and salt & pepper noise. Also the effect of combination of both type noises is studied. Thus median filter is used to remove such noise. After removal of such noises bounding box method is used to identify the location of the tumor. This method is fast and automated.

REFERENCES

[1] T.Logeswari and M.Karnan, “An Enhanced Implementation of Brain Tumor Detection Using Segmentation Based on Soft Computing”, IEEE International Conference on Signal Acquisition and Processing, pp. 243-247, 2010.
[2] Doru, Iacob, Mihaela, “Digital Image Processing in Medicine”, Software Engineering, Volume 2, IS10, 1992.
[3] “National Brain Tumor Society”. [Online] [Available] http:/www.braintumor.org/patients-family-friends/about-brain tumors/brain-tumor-faq.html.
[4] Rodrigues, Isabel, Joao Sanches, and Jose Bioucas-Dias. "Denoising of medical images corrupted by Poisson noise." Image Processing, 2008. ICIP 2008. 15th IEEE International Conference on. IEEE, 2008.
[5] Ray, Nilanjan, Saha, and Brown. "Locating brain tumors from mr imagery using symmetry." Signals, Systems and Computers, 2007. ACSSC 2007. Conference Record of the Forty-First Asilomar Conference on. IEEE, 2007.
[6] James Matthews “An Introduction to Noise Processing” [Accessed] August 23, 2013 [Online] [Available], http://www.generation5.org/content/2004/noiseIntro.asp.
[7] Shintaro Eda and Tetsuya Shimamura. “Image Denoising for Poisson Noise by Pixel Values Based Division and Wavelet Shrinkage”, International Symposium on Nonlinear Theory and its Applications, 2007.
[8] Nobi, yusuf, “A New Method to Remove Noise in Magnetic Resonance and Ultrasound Images” Journal of scientific research, 2011.

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[9] Hugdahl, Kenneth. "Symmetry and asymmetry in the human brain." European Review 13.S2 (2005): 119-133.
[10] Saha, Baidya Nath, Ray, "Quick detection of brain tumors and edemas: A bounding box method using symmetry." Computerized Medical Imaging and Graphics 36.2 (2012): 95-107.
[11] Derpanis, Konstantinos G. "The Bhattacharyya Measure." (2008).
[12] Khalid, M. Sohail, Saquib, Asim, "Bhattacharyya coefficient in correlation of gray-scale objects." Journal of Multimedia 1.1, 56-61, (2006).
[13] Ravi Kumar, Rattan, "Analysis Of Various Quality Metrics for Medical Image Processing", IJARCSSE, Volume 2, Issue 11, November 2012.
[14] Pedoia, Binaghi, Balbi, Benedictis, Monti, "Glial brain tumor detection by using symmetry analysis," CProc. SPIE 8314, Medical Imaging 2012: Image Processing, 831445. February 23, 2012.

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