"Resolution Improvement by Generalized Wavelet Thresholding for Set of 2D CT Scan Image"

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Abstract: DICOM image is formed from set of a projection that is sinogram. Due to the intersection of one or more projections radon transform and iradon transform does not obey bijective function. Hence information at this intersection is lost. This issue is removed by a partially fixed the radon transform. Information lost can be gained but it will add noise. Further various combinations wavelet and thresholding approach is applied for DICOM images of different parts of the body. And maximum signal to noise ratio obtained from suitable combinations wavelet and thresholding the method.

Keywords: Radon Transform, wavelet thresholding, DICOM image.

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I. INTRODUCTION

CT scan imaging is popular and plays a unique role in clinical diagnosis and treatment because it is a noninvasive and real-time. Now -a- days diseases like cancer need to be diagnosis at only early stage. So there is need for high resolution image to analyze 2D CT scan image. Approach satisfaction of bijective function using generalization suitable of wavelet and its proper thresholding method is targeted to improve resolution of image 2D DICOM image.

DICOM image is formed from set of projection that is sinogram. Major issue is radon transform and inverse radon transform as pair of function does not satisfy bijictive function. This leads to loss of information while constructing image from sinogram obtained from CT scan machine. This artifact is removed by using partially "fixed" the radon transforms [1]. The displacement of the off centered distance of the projections is made to shift by appropriate angle. By doing this information will not get lost but it add noise.

Analysis is done for DICOM Images of Face, Skull and Throat obtained from Sion Hospital, Mumbai. Radon transform of these images taken to obtain sinogram which is collection of projections. This projection represents column of radon transformed matrix. Signal to Noise ratio for set of projections of respective DICOM images for harr, daubechies, coiflets, biorthogonal, symlets and morlet is then obtained from Wavelet toolbox-Mutisignal Analysis from MATLAB. Signal to noise ratio (SNR) obtained for each column (that is for each projection) using maximum level of decomposition and fixed form thresholding technique. These set of projections are then imported in Matlab workspace. Then maximum mean signal to noise ratio is calculated among all wavelet used .From wavelet which got maximum SNR is analyzed by using different thresholding techniques that is fixed form thresholding, Rigorous SURE, Heuristic SURE, Minimax, Penalize high, Penalize medium.

The maximum of Mean SNRs which is calculated using various wavelets and thresholding techniques for DICOM image is the different. And we could get one perfect combination of wavelet and thresholding techniques which will have highest SNR and will be dynamically chosen for different part of body.

II. BIJECTIVE FUNCTION FOR RADON – IRADON TRANSFORMS FUNCTION

A bijection, or a bijective function, is a function *f* from a set *X* to a set *Y* with the property that, for every *y* in *Y*, there is exactly one *x* in *X* such that $f(x) = y$. It follows from this definition that no unmapped element exists in either *X* or *Y*.

Alternatively, *f* is bijective if it is a one-to-one correspondence between those sets; i.e., both one-to-one (injective) and onto (subjective).

The set of all bijections from *X* to *Y* is denoted as $X \leftrightarrow Y$. (Sometimes this notation is reserved for binary relations, and bijections are denoted by $X \rightarrowtail\!\!\!\!\rightarrow Y$ instead.) Occasionally, the set of permutations of a single set *X* may be denoted $X!$.

Every radon and inverse radon transform should have to act as bijection function. Here radon transform creates soinogram and if we take its inverse radon transform we should get original image. This indicates that radon and

Iradon transform satisfies bijection. Figure 1 shows DICOM image and its radon transform.

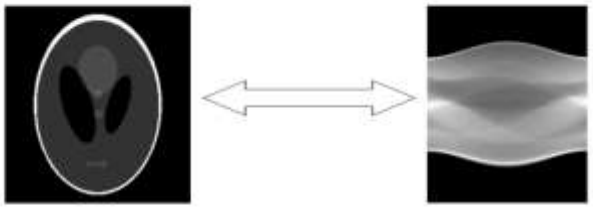

Figure 1 :Image and its radon transform

III. ISSUE OF RADON-IRADON BIJECTIVE FUNCTION:

Lets us take image of green squared at corner. Radon transform of this image at particular angle consists of bunch of sinogram that is many sines like waveform (projections) overlapping with each other. At this situation if we take inverse radon transform it will give error in from of mismatching or not obeying Bijective Function.

If we take radon transform of DICOM image then it does not satisfies Bijective Function. Figure 3.1 shows Original image, Radon transform and inverse radon transform with bijection fail. For image green squared at corner can be observe that when the dimension of A is a multiple of 2, pixel information is misplaced.

In figure 2 from Left to Right shows an original image green, then its MATLAB's radon transform (sinogram), then its MATLAB's inverse radon transform reed (aka iradon), then the position comparison between the original and reconstructed, non-matching pixel position: separate colors.

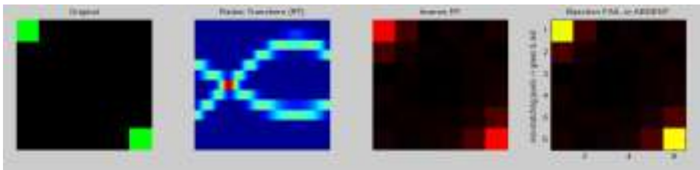

Figure 2 : Original image, Radon transform and inverse radon transform with bijection fail

IV. PARTIALLY "FIXED" THE RT

Halfway "altered" the RT of the picture so IRT would translate the positions of the back projections in the best possible spot. Somewhat in light of the fact that transformed all projection qualities to another (better) relative separation for iradon to decipher, which here is sufficient to demonstrate the radon-iradon reproduction issue. The cross-like example encompassing the primary FIXED remade pixel in light of the fact that the exact settled potbp ought to take after a sinusoidal moving example, in this way it would give no cross-like example.

Figure 3 shape left to right Shows my physically changed sinogram, then its MATLAB's iradon reed, then the position examination between the first and reproduced, MATCHING pixel position: GREEN+RED=YELLOW. This shows data lost is recouped however it will include commotion. To expel this clamour speculation of appropriate wavelet and its thresholding procedure need to summed up with a specific end goal to evacuate most extreme commotion.

Figure 3: Original image, Radon transform and inverse radon transform with bijection improvement

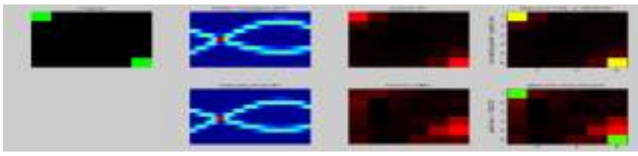

Figure 4: Comparision Original image, Radon transform and inverse radon transform with bijection fail or absent and bijection improvement

V. WAVELET THRESHOLD FIXATION APPROCH

At each projection that is every angle from 0 to 180 degree. The collection of projection now represent matrix such that each column represents one single projection at given set of angle. This matrix of set of projections then imported in Mutlisignal Analysis of Wavelet Toolbox of Matlab and analysis is done column wise. All Harr, Daubechies, Coiflets, Biorthogonal, Symlets and Morlet wavelet has applied for set of projection of DICOM Images of Face, Skull and Throat obtained from Sion Hospital, Mumbai. All analysis is done for level 6, fixed soft form thresholding. It can observed from figure 5 that signal to noise ratio (SNR) is for each column (that is for each projection) using level of decomposition 6 and threshold technique fixed is different. Maximum mean signal to noise ratio is then calculated among all wavelet used.

Wavelet which has got maximum mean of signal to noise ratio is kept constant and different thresholding techniques are varied. In figure 6 it can be seen that mean maximum signal to noise ratio is different for different thresholding method.

If considered other part's DICOM image then get different combination of wavelet thresholding method which give maximum signal to noise ratio.

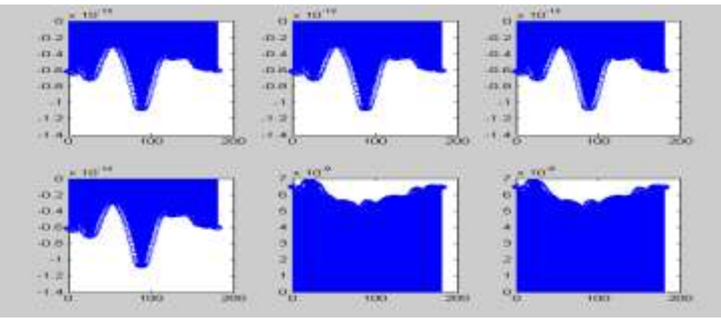

Figure 5 Comparison of different thresholding method for face DICOM image

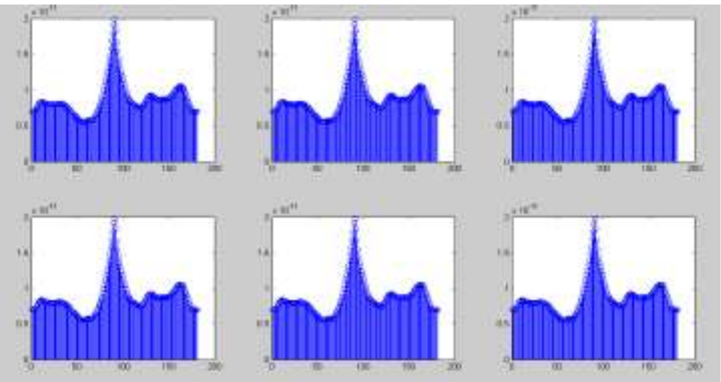

Figure 6: Comparison of different thresholding method for face DICOM image

VI. CONCLUSION:

Overlapping point or sometimes area of intersection of two or more sinogram will give of signal give situation of dilemma that which intensity point is belongs to which projection. This leads to major issue for of satisfying bijictive function for radon transform and inverse radon transform as pair of function. This leads to loss of information while conduction of image from sinogram obtained from CT scan machine. This artifact is removed by using partially "fixed" the radon transform. The displacement of the off centred distance of the projections is made to shift by appropriate angle. But it adds extra noise to set of projection. So to remove this noise wavelet generalization has done. For particular part of the body only valid combination of wavelet transform and thresholding method should be use and that is obtained from highest signal to noise ratio for set of projections from wavelet toolbox.

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