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HYBRID METHOD FOR THE IMAGE RECONSTRUCTION USING THE MULTI-LEVEL DATA EVALUATION

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ABSTRACT

The image reconstruction plays the vital role in the data recovery from the projection data, which is always easier for the data backup storage systems as it take more than 90% less space for saving the image projection data than the original projection data. When the size of the image storage data rises up to the petabytes, exabytes or zetabytes, such as google images, facebook or flickr, it becomes really important to save the backup in the minimum storage space. The binary image reconstruction is playing the vital role in the image reconstruction, which may be improved to reconstruct the RGB or other 3-D or N-D images. The proposed model aims at reconstructing the images with higher accuracy than the existing model, which is indicated from the minimized reconstruction error. The time complexity of the proposed model is recorded higher than the existing model, which is due to the inclusion of the highly complex computations than the simulated annealing algorithm.

KEYWORDS: Image reconstruction, matrix reconstruction, swarm intelligence, binary matrix.

INTRODUCTION

Binary Image Reconstruction outlines the technique of reproducing an image from the traced image. [1] This traced image is acquired in the structure of projections such as diagonal, vertical and horizontal. [2] These projections are absolutely based on the type of an image that may be 2-D or 3-D image. [5, 7] This involves the concept of binary image reconstruction. A binary image is a digitalized image containing on white and black pixels where white pixels corresponds to binary value 1 &black pixels corresponds to binary value 0. [4, 6]

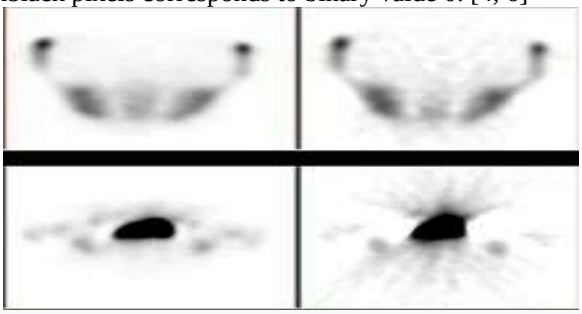

Figure 1: Example showing differences between filtered back projection (right half) and iterative reconstruction method (left half)

In binary images, Image reconstruction is a mathematical process that produces images from Horizontal-Vertical projection data derived from the different angles. [8] Image reconstruction has a major influence on image quality also on radiation noise.For a radiation dose it is necesary to reconstruct images with the lower noise without sacrificing spatial resolution and image quality. [3] Reconstructions methods that improve image quality can be converted into a decrease of radiation dose as images of acceptable quality can be reconstructed at lower dose. [9, 13]

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There are plenty of techniques of image reconstruction. Mostly used are:

i.) Analytical Reconstruction or Filtered back projections(FBP). [10]

ii.) Iterative reconstruction. [10]

Analytical Reconstruction constructs an image in a single step. [17] The widest use of this projection is in the field of clinical binary image scanners. [18] The major reason behind its use is its numerical stability and computation efficiency whereas Iterative Reconstruction constructs an image in multiple steps but provides a complete solution which leads to efficient reconstruction of an image as compared to filtered back projection. [19-20] Also it decreases the image artifacts like beam hardening and metal artifacts. [11]

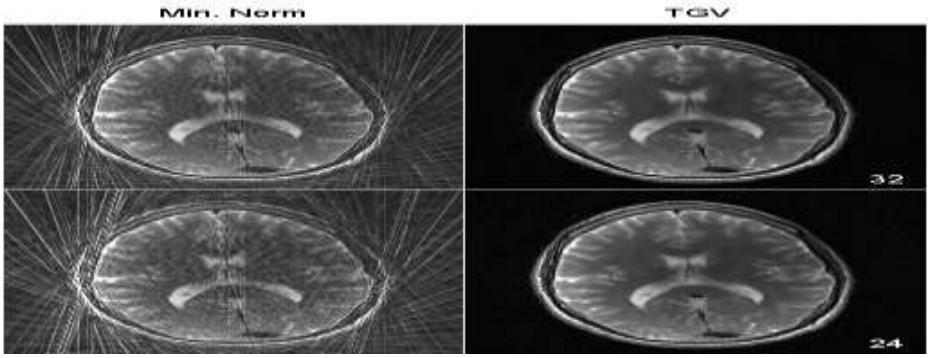

Figure 3: Reconstruction example over the MRI images

The existing work is done on simulated annealing that uses the two level solution for reproducing an image. [8] The simulated annealing inhibits the concept of metallurgy where it is enforced on glass or metal. [19] This provides the excellent strength in glass with accurate flexibility. In this, there are more chances of occurring error while reconstruction phase. As a result of which there is a need of single efficient initial solution algorithm that will produce more accurate results. [13]

This paper emphasizes on iterative reconstruction of binary images from HV projections analyzed from different angles. [14, 15, 16] It also emphasizes on obtaining the more efficient results as the solution of optimization problem or to a set of equations which are concluded in a iterative loop. [12]

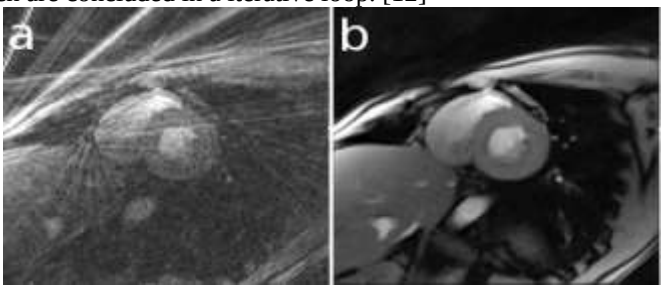

Figure 2: A single frame from a Real-time MRI movie of a human heart. a) direct reconstruction b) iterative (nonlinear inverse) reconstruction

LITERATURE SURVEY

Patel, Divyesh et al. [1] describes a technique for the reconstruction of h-convex binary images form its horizontal and vertical projections using the idea of simulated hardening. In this research, the use of convexity property in case of binary images is represented and it also downside the reproduction of h-convex binary image from its vertical and horizon ions. This downside is altered into two completely different optimization problems by the concept of two acceptable objective features. Then the two simulated hardening algorithms to untangle the two atomization problems are constructed by this algorithm. The sturmarbeiteilung algorithm are verified on infinite aimlessly generated test images. These algorithm verifies the weedy pictures. **Verma,Knife Kumar et al[2]** has constructed the blueprint for cost effective approach for the reconstruction of immolated binary pictures. i.e. Branch and sure method. In this research, the rule for reconstruction if immolated of binary images in the isolated pictorial representation generated cost effectively by the implementation of branch and sure method. The authors have completely focused on the anti-diagonal & diagonal projections and in contrast with the standard horizontal and

vertical projections. This paper completely shows that the calculated design is computational robust, efficient and produces quick reconstructive results. **Mohammed,Hadded et al. [5]** has concentrated on the combination of two rules named as simulated hardening and genetic rule for the reconstruction of HV convex binary matrices. In this paper, the authors have worked upon the row and column sums of umbellate binary matrices i.e. Horizontal and vertical. The major concept is the NP-Complete which is a replacement hybrid genetic rule with use of simulated hardening and is project to conclude the most approximate conclusion or answer. **Hantos,Norbert et al[6],**has worked on the individualismin the conclusion for the reconstruction of HV-convex polyominoes from the morphological skeleton and H-V projections. In this authors focused on the distinctiveness of the reconstruction of a H-V convex picture. The distinctiveness of the reconstruction method completely relies on the importance of its parameters.

EXPERIMENTAL DESIGN

The genetic algorithm (GA) has been utilized for the image reconstruction in the proposed model over the horizontal and vertical projections (also called HV-projections). The first stage includes the initial solution to produce the initial stage combination over the given projection data. The initial solution is based upon the chang's solution, which computes the number of bits in the horizontal and vertical projections and creates the nearest solution with the exact or perfectly near values. The initial solution produced by the chang's algorithm usually creates the image with higher reconstruction error, which has to be minimized to reconstruct the best image reconstruction solution. Then the genetic algorithm is applied over the solution computed over the chang's initial solution. The genetic algorithm is applied to find the fittest solution and to update the initial solution computed by the chang's solution. The genetic algorithm takes the input for the population size, binary image matrix and number of maximum iterations. Then the genetic algorithm produces the various news solution in the terms of major three stages: reproduction, crossover and mutation. The fitness function plays the vital role in the image reconstruction practices. At first, the first stage population is produced, which further plays the base for the further population generations in the latter three stage process. The genetic algorithm has been given below:

Algorithm 1: Image Reconstruction using Chang's Algorithm and Genetic Algorithm

Input: Horizontal and Vertical Projection data
Input: Maximum Iterations for chang's solution
Output: Reconstructed Image

1. Input the horizontal and vertical projection data to the chang's solution
2. Start the while loop till the situation is met
    a. Generate the combination of the binaries in the matrix form
    b. Reproduce the combination of binary matrix
    c. Test the case if it satisfied
        i. Return the while loop and return the image
    d. Otherwise go the 2(a) till the condition is met or the maximum iterations are over.
3. Input genetic parameters
    a. Input pop size
    b. Input mutation rate
    c. Input the population generation maximum capping
    d. Perform the parameter initialization
4. Create the first population over the input binary data after computing the fitness function based solution
5. Evaluate the fitness of the solution
6. Check if the maximum iteration or maximum convergence is achieved
    a. Return the matrix any of the termination condition is met
7. Otherwise perform the next steps
    a. Do the optimal selection of the binary data by analyzing them one by one in the form of P(t) to P(t+1)
    b. Apply the mutation function over the proposed solution

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c. Compute the crossover over the mutated solution
d. Perform the chromosome fitness in order to evaluate the compatibility of the solution
e. Increment the rotational counter
f. GOTO step 6

RESULT ANALYSIS

A typical example of a binary image of size 20x 20 and its projection set $\mathcal{P}$(R, C) are given in figure 5.6.
The proposed model has been tested over the wider variety of the input images of different sizes as the test cases of the verification of the proposed model efficiency in reconstructing the binary images of various types and various figures. The experiments have been performed over the images from the various sizes between 10 x 10 and 100 x 100 for the reconstruction test of the proposed model. The projection data is obtained from the input image and passed through the chang's initial solution production method. The following figure shows the typical 10x10 binary image undergone the test under this experimental evaluation of the proposed model.

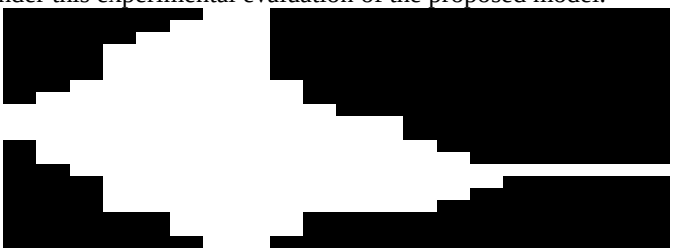

Figure 4.1: The 10x10 binary image for the testing of proposed image reconstruction method.

The figure 4.2 shows the results obtained from the proposed and existing algorithms, where the proposed model based upon the genetic algorithm has been obtained as the proposed model, whereas the existing model is based upon the simulated annealing algorithm. The proposed model has shown the significant improvement in the terms of regeneration over the image containing the four percent of noise.

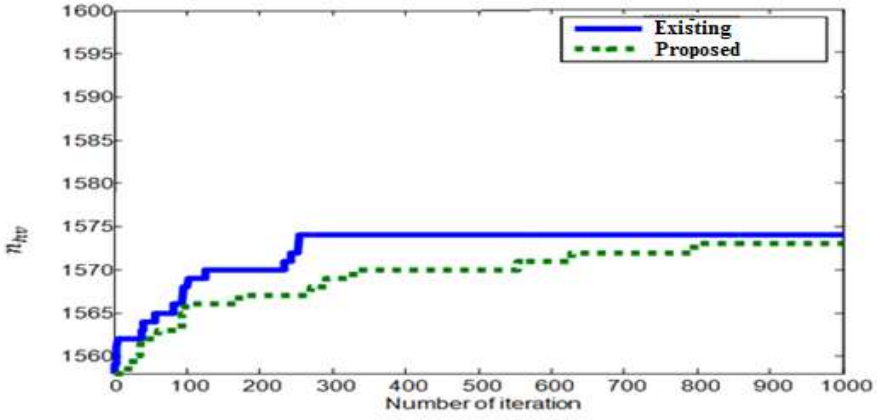

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Figure 4.2: Reconstruction convergence rate over the binary image of 40x40 with four percent of image.

The figure 4.3 shows the results obtained from the binary image of size 40x40 with five percent noise. The results indicate that the reconstruction quality rises with the higher order noise in the input matrix for the image reconstruction. The proposed model has completely outperformed the existing solution by produced the minimized error.

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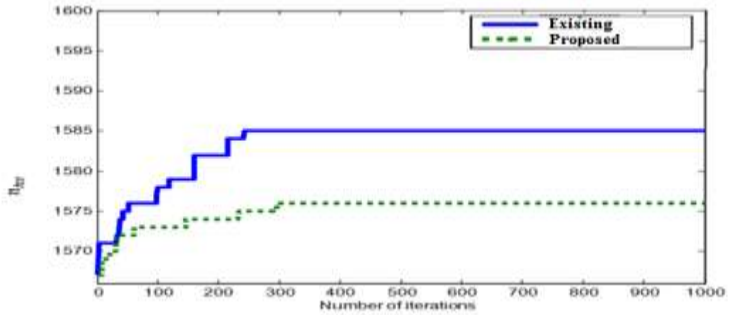

Figure 4.3: Reconstruction convergence rate over the binary image of 40x40 with five percent of image

Table 4.1: The performance evaluation of the proposed model against existing model

Image Size	Existing Time (seconds)	Error (%)	Existing Time (seconds)	Error (%)
10x10	0.8	24	3.0	3.4
20x20	2.6	25.5	7.5	3.1
30x30	6.2	31.6	10.0	4.7
40x40	12.2	28.4	16.3	2.34
50x50	20.5	27	28.5	3.14

The proposed model is the clear winner when evaluated on the basis of the accuracy in the image reconstruction when compared to the existing model. The proposed model has produced the minimized error by more than 80 percent, which is the significant rise in the accuracy of the reconstruction indicated by the sharp fall in the error in comparison with the existing model based upon the simulated annealing algorithm. But in the term of elapsed time, the proposed model has been found with higher time complexity because the genetic algorithm is more complex than the simulated annealing algorithm.

CONCLUSION

The proposed model has been developed with the combination of the genetic algorithm and the simulated annealing algorithm for the image reconstruction. The proposed model has been evaluated over the noisy and non-noisy data. In both of the domain, either with noise or without noise, the proposed model has been performed better than the existing model on the basis of reconstruction accuracy and image reconstruction error. The proposed model has been found efficient by almost 80 percent than the existing model in reconstructing the binary image up to the 50x50 pixel size. The proposed model has been found computationally expensive, which can be further improved with the realization of the the quick response genetic algorithm.

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