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A Nobel Approach for both Denoising as well as decompressing a compressed image by Minimization Technique

H. Sunil[1], Dr. Sharanabasaweshwar G. Hiremath[2]
[1]Department of electronics and communication, Vemana IT, Bengaluru
[2]Professor and Head, Department of Electronics and Communication, EWIT, Bengaluru

INTRODUCTION

Today life of a human being has become too much application based. This is because of the technological increment and growth that even in medical world also the lakhs of reports of the stages of the human being has been captured through camera and stored in digital form. The dicom images are an example of this type of medically captured digital image. This progress is also being observed in wide field of digital images, which covers scanned documents, drawings, images from digital or video cameras, satellite images, medical images, works of computer graphics and many more. Many disciplines, like medicine, e-commerce, e-learning or multimedia, are bounded with ceaseless interchange of digital images. Thus helping the doctors to compare the present and the past condition of the images by the use of the digitally captured images helps in making the cure very reliable. But in case of the medical images, maintaining the accuracy is very important since a silly mistake may be very risky during the treatment. Medical Imaging came into being in 1895 when W. K. Roentgen discovered X-rays.

This invention was a great step forward for non-invasive diagnostics and rewarded with Nobel Prize in 1901. With time, other discoveries in the field of medical imaging were made that, like X-rays, support medicine and make possible more accurate and effective diagnosis. Since there are huge amount of images that need to be processed in a hospital or in any other channel, the need of reduction of the storage space is very necessary. This results in the foundation of image compression. Image compression is the compression of the data that hold the information and image decompression is the reconstruction of the compressed data. And this compression technique is of lossy and lossless technique. Image cannot be reconstructed in a better way in lossy compression but it can be reconstructed properly in lossless compression. Modeling and coding comprises of the lossless compression. The model gives importance on the information representation .It also gives importance on the type of data to be compressed, the differences, similarities, etc. In coding, it analyzes the coding for the symbols obtained in the modeling phase.

There are three basic groups in this compression .They are entropy-coding, dictionary-based and also the prediction based technique. Another technique used is a lossy compression. Here some amount of information are lost. Here the distortion rate is much more than the lossless technique. The lossy compression comprises of three parts. They are decomposition, quantization, and compression. The decomposition and quantization increases the effectiveness of the compressed image with lower complexity and also reduces the encoding and the decoding time. The decomposition may be of frequency, wavelet and fractal transforms. This phase actually determines the compression ratio, quality of the recovered image and size of information loss during encoding. Quantization reduces the number of symbols contained in the information. Thus the loss chapter is done in the quantization process. The loss is then leveled by the compression phase. Again the compressed part is reconstructed back to the original phase by means of dequantization.

Advantages of Data Compression

i) It reduces the data storage requirements
ii) The audience can experience rich-quality signals for audio-visual data representation
iii) Data security can also be greatly enhanced by encrypting the decoding parameters and transmitting them separately from the compressed database files to restrict access of proprietary information
iv) The rate of input-output operations in a computing device can be greatly increased due to shorter representation of data
v) Data Compression obviously reduces the cost of backup and recovery of data in computer systems by storing the backup of large database files in compressed form

Disadvantages of Data Compression

i) The extra overhead incurred by encoding and decoding process is one of the most serious drawbacks of data compression, which discourages its use in some areas
ii) Data compression generally reduces the reliability of the records
iii) Transmission of very sensitive compressed data through a noisy communication channel is risky because the burst errors introduced by the noisy channel can destroy the transmitted data
iv) Disruption of data properties of a compressed data, will result in compressed data different from the original data
v) In many hardware and systems implementations, the extra complexity added by data compression can increase the system's cost and reduce the system's efficiency, especially in the areas of applications that require very low-power VLSI implementation.

The other important features to be considered are:

DICOM Standardization

DICOM standard has been incorporated in most of the medical imagining product. The DICOM standard uses the JPEG 2000 for both lossy as well as lossless compression because JPEG2000 is an established Standard, it also gives smaller files than ordinary JPEG, the capacity of JPEG is much more. It can support a large array of files. The JPEG 2000 also supports handling Meta data, web browsing, and non-proprietary compression schemes.

LITERATURE SURVEY

Lossy-to-Lossless Hyperspectral Image Compression Based on Multiplier less Reversible Integer TDLT/KLT. Lei Wang, Jiaji Wu, Licheng Jiao and Guangming Shi

In 2009 in this research we are trying to reduce the Bandwidth storage and cost for hyper spectral images. Lossy and lossless compression are good ever techniques. But to realize scalable coding we adopt DWT for 3D platform. Lossless compression systems take in quantization, prediction, integer transform. A prediction-based method implements well, but does not realize progressive lossy-to-lossless compression for transform-based method. Lifting scheme uses reversible integer WT for 3-D image compression that realizes the transform. In spatial domain, integer WT is main method to realize the transform. But the drawback of wavelet-based compression method is that lead to performance degradation. DWT cannot play the role with DCT as a result of memory loss. DCT has advantages such as low memory cost, flexibility at block-by-block level, parallel processing. Time- domain lapped transform (TDLT) improves transform efficiency by making the pixels as homogenous within filter Block. For hyper spectral image compression, we need to follow reversible transform method to realize lossy-to-lossless coding. In our proposed approach we replace integer WT with integer reversible TDLT in the spatial domain and realized using matrix factorization method. RTDLT can realize integer reversible transform and also reversible KLT. Zero Block coding is used to transform the coefficients. It can achieve integer to integer transform and good for lossy to lossless compression techniques.

A Survey on Lossless Compression for Medical Images. M. Ferni Ukrit, A. Umamageswari, Dr. G. R. Suresh

In 2011 in this paper we performed a survey on various lossless compressing techniques. Enormous amount of medical image sequences are accessible in innumerable hospitals and medical organizations, which conquers substantial storage space. Hence to reduce the stowage space there is a requirement for compressing medical images. There are numerous lossy and lossless compression techniques. Using lossy compression the innovative images are not recuperated exactly but using lossless compression techniques the original images can be recovered exactly. For medical image sequences using JPEG-LS and Interframe coding, the quality can be improved and to avoid the coding loss and significant increase of computational cost like correlation estimation approach is used. Once tested with all these algorithms JPEG-LS has best Compression Speed (CS) and Compression Ratio (CR). The speeds of JPEG 2000, PNG and CALIC are analogous but CALIC is slight faster than JPEG 2000 and PNG. When comparing the compression ratios JPEG-LS and CALIC are sophisticated than JPEG2000. But JPEG 2000 is better than PNG and Lossless JPEG.

Loganathan, R.; Kumaraswamy, Y.S., "An improved active contour medical image compression technique with lossless region of interest," Trendz in Information Sciences and Computing (TISC), 2011 3rd International Conference on , vol., no., pp.128,132, 8-9 Dec. 2011

Due to the large volume of images, image compression is required to accomplish fast and efficient transmission and reduction in storage space of medical images. Compression techniques used are very important while compressing digital medical images as the region of interest for diagnosis is generally small when compared to the whole image captured.

Lossless compression techniques compress with no data loss but have low compression rate and lossy compression techniques can compress at high compression ratio but with a slight loss of data. Using lossless techniques in medical image does not give enough advantage in transmission and storage and lossy techniques may lose crucial data required for diagnosis. To maximize compression, in this paper it is proposed to investigate multiple compression techniques based on Region of Interest (ROI). In this paper a novel active contour method is proposed which is adaptive and marks the ROI without edges. The marked area of ROI is compressed using lossless compression and the other areas of the image are compressed using lossy wavelet compression techniques. The proposed procedure when applied on diverse MRI images, achieved an overall compression ratio of 69-81% without loss in the originality of ROI.

EXISTING SYSTEM

TVCMRZ (Total Variation compressed MR imaging):

In TVCMRI for the reconstruction of the compressed MRI images, the compressed image is treated as a single image and that single compressed image is divided into smaller parts. Each of the compressed smaller part is then taken separately and given for the reconstruction process .Ones each and every smaller parts of the image are reconstructed, then all the individual smaller parts are combined together to obtain the original reconstructed image.

Under sampled Fourier measurements f, one could solve with

$$M = Pw{-}1$$

Where P is a partial fourier transform and w is a wavelet transform. The signals for MR images has a total variation of very less value. So to hold on this variation the total variation is minimized and considered as a problem.

$$\min F(s) = \mathbb{A}TV(w^{-1}s) + \mathbb{B}\|c\| + \frac{1}{2}\|Ms - v\|_2^2$$

Where $\mathbb{A}$ and $\mathbb{B}$ are two positive values.

Because of the complexity of the two parameters $TV(w^{-1}s)$ and $\|c\|$ the problem solution is different.
Using matlab 2012, a two dimensional code is developed for the TVCMRI i.e. (Total Variation compressed MR imaging) and then applied on MR images. Although reconstruction is done it resulted in a relative error

$$R_e = \frac{\|RI - OI\|_2}{\|OI\|_2}$$

PROPOSED SYSTEM

The compressed image has to be minimized and the minimization problem is considered as

$$\min_{a \in S^q} Z(a) = z(a) + \sum_{b=1}^{c} d_b\,(J_b a)$$

Here for minimizing the problem the big image problem is divided into smaller parts ranging from 1 to n number of smaller particles. And then the reconstruction algorithms will be applied on each divided image problem particle separately. Ones every single image part is decompressed, they are combined to form the original decompressed image.

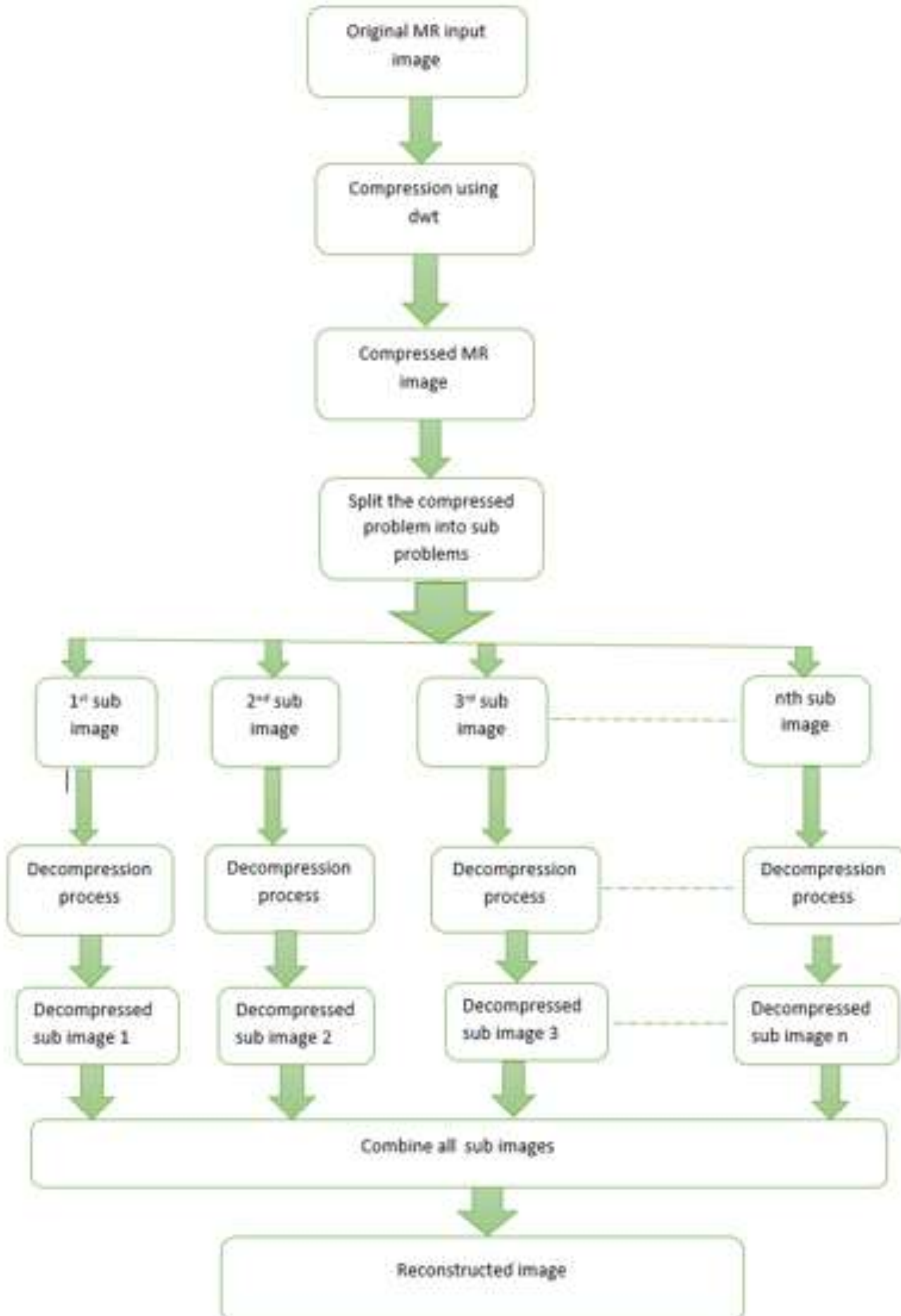
Here we have developed two splitting algorithms named as:

(1) Decompression based composite splitting Algorithm (DBCA)

(2) Modified Decompression Based Composite Splitting Algorithm (MDBCA)

These splitting techniques are used for the reconstruction of images based on performing multiple operations on the input. Ones the variable is splitted into a number of multiple sub variables ranging from 1 to n . And again each of these sub variables undergo operator splitting .Ones each of these sub variables finish up with their operators splitting, they are given for reconstruction process.

DDA (Denoising dividing algorithm) is a technique where along with dividing the compressed image into number of smaller images. The DDA algorithm is generally applied for dividing those problems which has got certain noise and non-smooth complexities. It completely chops the big problem into many number of easier smaller problems. Then each sub problem is worked on individually resulting in minimization of the problem and obtaining in solution without any problem.



Then the original problem is solved by averaging the results of the sub problems obtained by the dividing algorithm.

DBCA:

Combining the two algorithms DDA with RLTA (Repetitive Loss-Thresholding algorithm), a new algorithm is formed called the Decompression based composite splitting Algorithm (DBCA). Since working on a big problem is much more complex than working on smaller problems. So the very first step done by the DBCA is chopping down the image into smaller sub images. After the division of the image into sub problems, each sub problem is solved individually, i.e. the sub images are reconstructed separately and in parallel. Finally the original image free from the compression is obtained by combining the solution obtained from all the compressed image segments after reconstruction.

Steps for DBCA:
Start;
Give input: v=$1/l_c$, a^0
While
For W=1 to w
For j=1 to n

$$b_j^w = \text{prox}_v(d_j)\big(E_j(a^{w-1} - v\nabla z_j(a^{w-1})\big)$$

End

$$a^w = \frac{1}{n}\sum_{j=1}^{n} E_j^{-1}\, b_j^w$$

End

MDBCA:

MDBCA (Modified Decompression Based Composite Splitting Algorithm) is a modified version of the DBCA. It ensures faster splitting of the big compressed image problem into smaller sub images same like the DBCA. The only difference between the two chopping algorithms is the higher speed of the MDBCA as compared to DBCA. The 2nd algorithm is much faster than the first algorithm. It consumes a significant amount of iteration time as compared to the 1^{st} algorithm DBCA.

Start for MDBCA:
Give input: v=$1/l_c$, $\mathbb{A}$, $\mathbb{B}$,
For $w = 1$ to W

$$a_k = s^w - v\nabla z_j(s^w)$$
$$a_1 = \text{prox}_v(2\mathbb{A}\|a\|_{tv})(a_k)$$
$$a_2 = \text{prox}_v(2\mathbb{B}\|\theta\|_1)(a_k)$$
$$a^j = {(a_1 + a_2)}/{2}$$
$$t^{j+1} = (1 + \left(\sqrt{1 + 4\,(t^j)^2}\right)/2$$

end

EXPERIMENTAL RESULTS

The composite splitting techniques are taken and applied to compressed images. Here dicom images are taken as input which are compressed and then again the compressed images are decompressed to obtain the reconstructed image .The results for different dicom images are shown below:

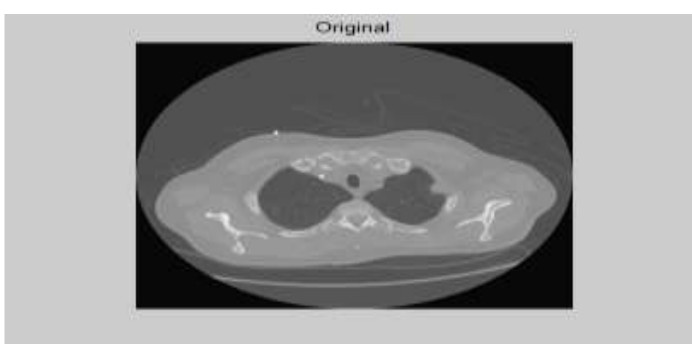


Figure 1: Original MR brain image before compression

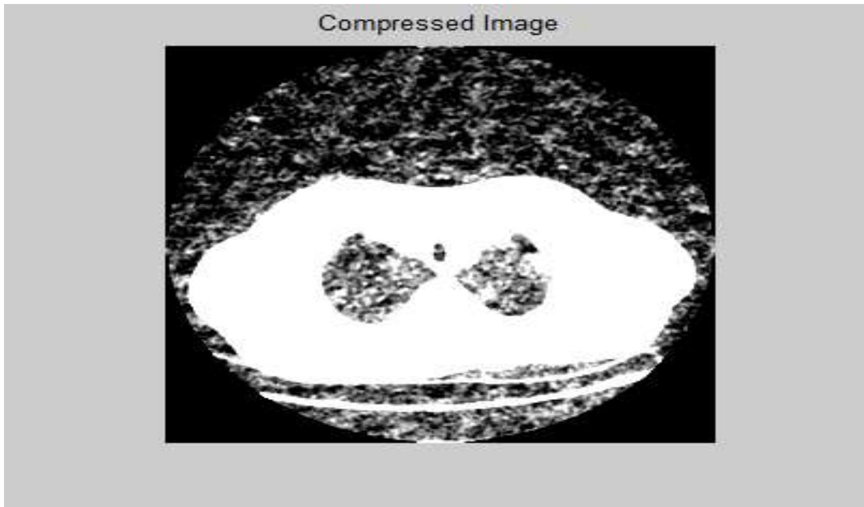


Figure 2: MR brain image after compression

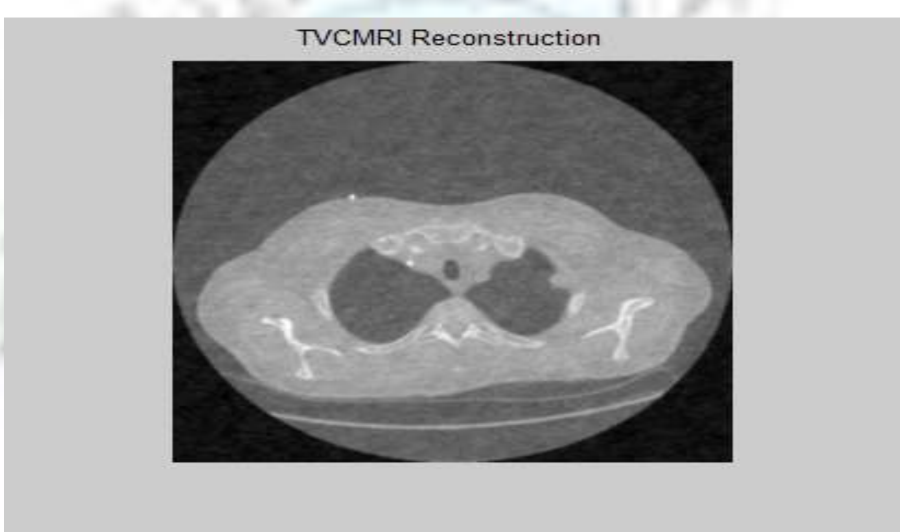


Figure 3: Decompressed MR brain image by TVCMRI reconstruction

Figure 4: Decompressed MR brain image by DBCA reconstruction

Figure 5: Decompressed MR brain image by MDBCA reconstruction

	Iteration time
Compression	3.58sec
(ES) TVCMRI	3.56sec
(PS) DBCA	2.91sec
(PS) MDBCA	2.81sec

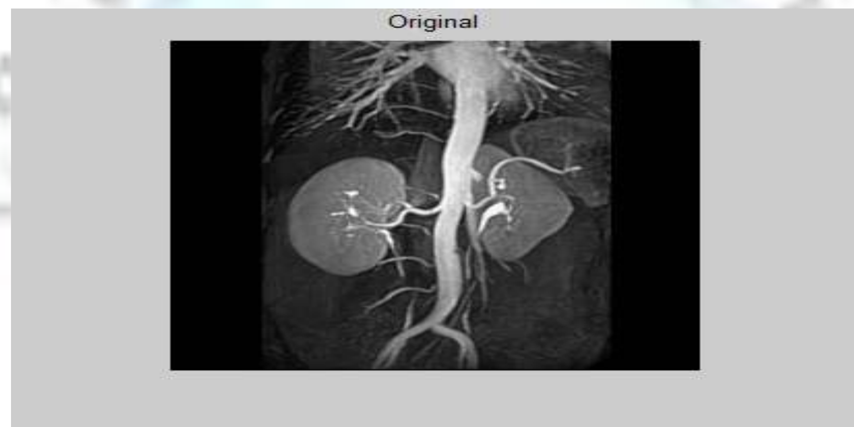


Figure 6: Original MR arteries image before compression

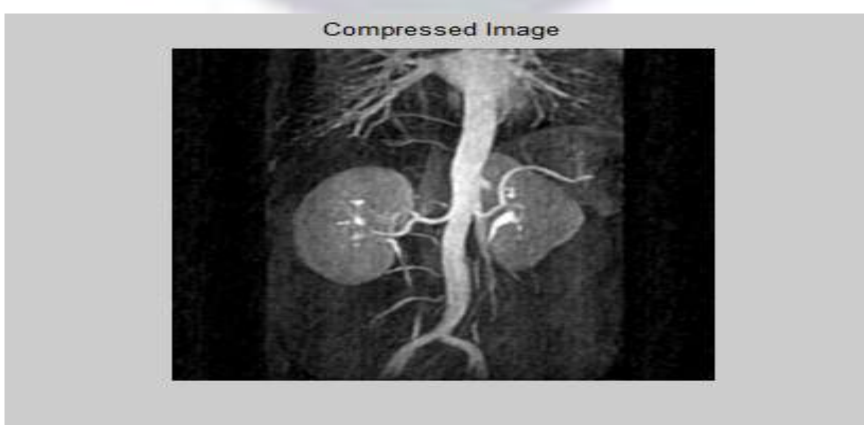


Figure 7: MR arteries image after compression

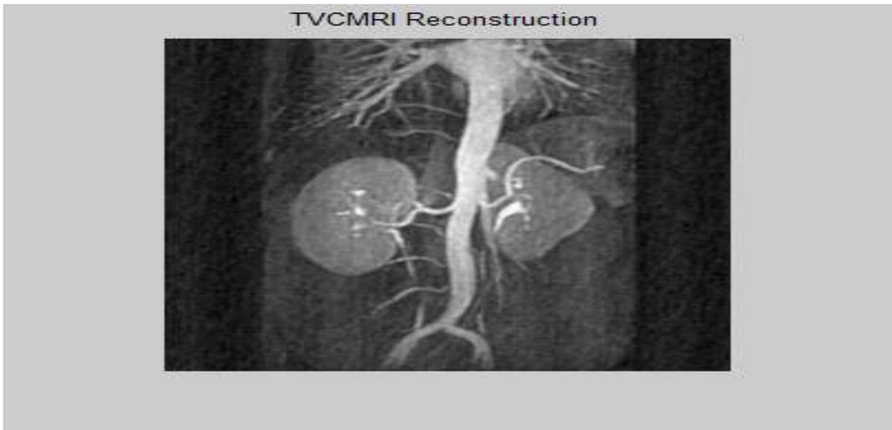


Figure 8: Decompressed MR arteries image by TVCMRI reconstruction

Figure 9: Decompressed MR arteries image by DBCA reconstruction

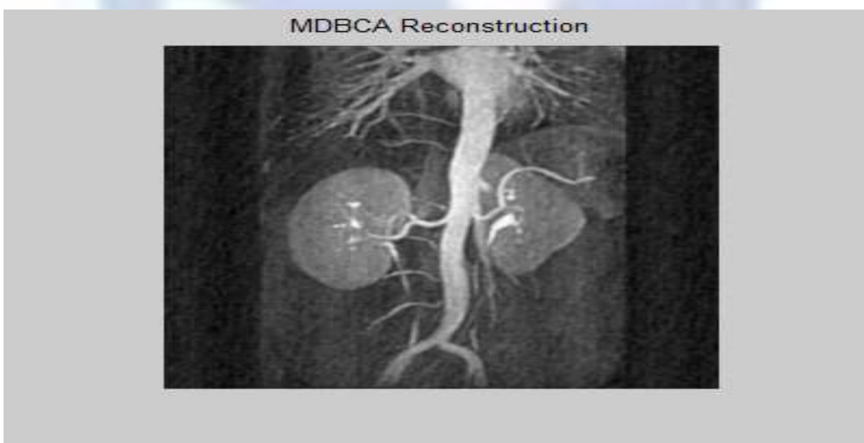


Figure 10: Decompressed MR arteries image by MDBCA reconstruction

	Iteration time
Compression	3.48sec
(ES) TVCMRI	3.56sec
(PS) DBCA	2.75sec
(PS) MDBCA	2.69sec

CONCLUSION

In this paper we have proposed a decompression technique involving two algorithms namely DBCA and MDBCA. We have considered the reconstruction algorithm TVCMRI as the existing system. The DBCA is obtained by combining two algorithms namely DDA and RLTA. By using DBCA the decompression of MR Dicom images having non-smooth characteristics is done. Along with decompression, DBCA is also able to denoise the image. The MDBCA also does the same task like DBCA but the only difference between them is that MDBCA consumes less iteration time. The experimental results have shown that the proposed system have shown improved results than the existing one. In future, the same proposed algorithms will be used for more application and on large scale data.