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Research Article

Brain Image Compression: A Brief Survey

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Abstract: Brain image compression is known as a subfield of Brain image compression. It allows the deep analysis and measurements of brain images in different modes. Brain images are compressed to analyze and diagnose in an effective manner while reducing the image storage space. This survey study describes the different existing techniques regarding brain image compression. The techniques come under different categories. The study also discusses the different categories.

Keywords: Compression, image compression, pros and cons, techniques

INTRODUCTION

The influence and effect of digital images on current civilization is incredible and image processing is currently a precarious constituent in knowledge and technology. Medical image processing had become a vast field with respect to medical prospectus. Huge work has been done in this regard but still more has to be done.

There are a number of techniques and methods that have been approved and proposed in the medical imaging field. Each method contains its own flaws and cons. But still there exists need of more accurate and precise work. Because subsequent computer technologies participate in significant tasks in dealing out and investigate medical images together with graphics in the modern computing systems, pattern acknowledgment etc., there exist three key explorations and research are as that are being considered and investigated through the process of medical image dispensation and evaluation; focus is on the processes like:

- Structural imaging
- Functional imaging
- Molecular imaging

Modern medical methods, techniques and devices provide a way out to analyze and diagnose the problems and diseases in an efficient and effective manner.

Now if we look inside the medical image processing, we can see that there are many medical issues being treated through this processing. These issues comprise subjects related to heart, brain, lungs, kidney, cancer diagnosis, stomach etc. Understanding concerning the significance of convinced portions of the nervous system for motor deed; perception and interpretation evolve incredibly bit by bit throughout the past centuries. Progress in neuroscience is interconnected with moral, permissible and communal matters. A number of matters alarm medical appliances such as the early judgment of infection, virus and illness, despite the fact that others narrate to the rising figure of studies by means of frontier neuro-technologies. When we talk about the brain diseases that can be handled through medical imaging, then in medical image processing there are an accepted figure of approved, protected imaging methods and procedures in exercise today in research services and hospitals throughout the world.

Medical image processing is basically done in order to carry out huge range of applications that can be analyzed in the Fig. 1.

The basic objective of this study is to analyze the brain image processing in the prospect of compression in detail. Here our main focus is on the methods, techniques, ways and issues that have been and still carrying out in the medical prospect through image processing in the field of brain image compression.

BRIAN IMAGE COMPRESSION

Image compression is basically a process of reducing the size in bytes of images deprived of

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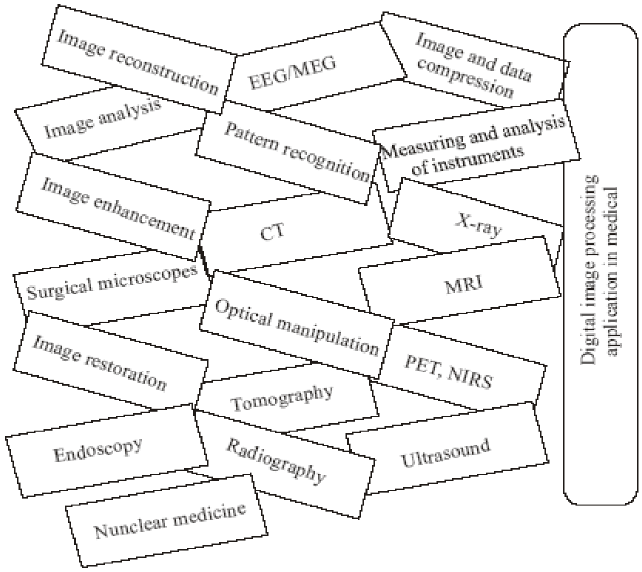

Fig. 1: Digital image processing applications in medical

demeaning the superiority and quality of the image to an objectionable level. The decrease in image size permits further images to be deposited in a specified quantity of disk or memory space. In order to present a part of human body in digital form, CT images are used. There exists a variety of work that has been done in dealing with the medical imaging process. Image compression is another way of handling such images. Huge amount of work has been done in this prospect. After knowing what exactly image compression is, we will now overview various methods and procedures presented in this prospect.

TECHNIQUES OF IMAGE COMPRESSION

The image compression methods are generally categorized into two central types. The major objective of each type is to rebuild the original image without affecting any of its numerical or physical value.

The main types of image compression are as follow: (Fig. 2).

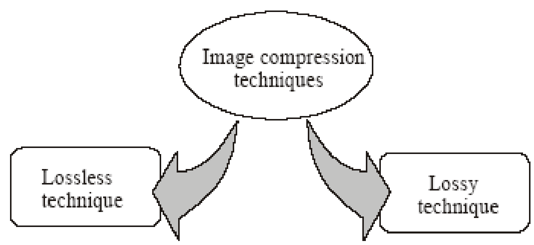

Fig. 2: Image compression techniques

Lossless compression: The process of lossless compression basically uses the encoded i.e., compressed image in order to recover the original image. The basic properties of this method are that it is a noiseless and entropy based method because it does not add any sort of noise to image and makes use of methods like statistics/decomposition to exclude the redundancy factor. Lossless compression has limited uses by inflexible necessities such as medical imaging. The types of lossless compression can be analyzed in the Fig. 3.

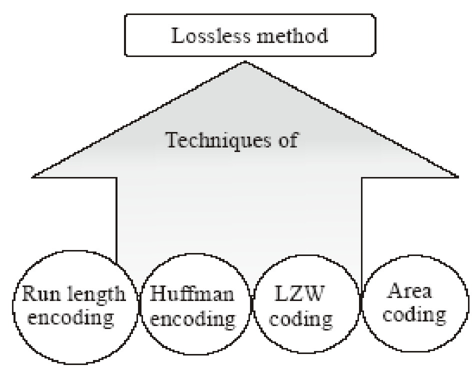

Fig. 3: Lossless methods

Run length encoding: The method is an easy compression process utilized for sequential statistics. It is basically valuable and cherished in the prospect of repetitive records. The method alternates instructions of matching pixels.

Huffman encoding: The method makes use of statistical occurrence frequencies (probabilities) to carry out the process. Each pixel of the image is treated as a symbol. The symbols that arise commonly are allocated a slighter amount of bits whereas the symbols that arise fewer are allocated a comparatively greater amount of bits.

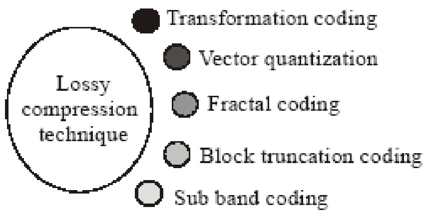

Fig. 4: Lossy compression techniques

LZW coding: The method is basically a static dictionary coding process; dictionary is static throughout the encoding decoding procedures.

Area coding: Area coding is a practice of run length coding method that deals with two dimensional characters of images. The method does not make much logic to deduce it as a sequential stream as it is, in fact, an array of sequences.

Lossy compression: Lossy systems deliver considerably greater compression percentages than lossless methods. Lossy techniques are extensively utilized in the prospect of compression as the superiority of recreated or reconstructed image is acceptable for maximum uses. Through this method, the original and decompressed images are not the same, however, practically near to each other. The lossy compression methods are given in the Fig. 4:

Transformation coding: Transform coding is a form of data compression for data like audio signals or photographic images. The method basically makes use of transforms such as Discrete Fourier Transform and process of Discrete Cosine Transform. These processes are taken into action to set the pixel values of real image into the frequency domain to carry out the compression method.

Vector quantization: The method generates fixed size vectors. In this process the image is converted into a number of fixed size vectors. These vectors are then indexed in a dictionary from where the indexes of vectors are used in order to carry out the compression method.

Fractal coding: This process makes use of methods such as color separation, edge detection, spectrum and texture analysis in order to segment out the image. After the image is being segmented out, every segment is observed in a library of fractals. The library consists of codes named Iterated Function Systems (IFS); those are dense groups of numbers.

Block truncation coding: The method works by splitting the image into non overlapping blocks of pixels. After doing that, process of calculating the threshold and reconstruction value of each block is carried out. Next a bitmap is created containing the values of pixels having value greater or equal to the defined threshold. After this reconstruction values are determined from the bitmap to carry out the compression process.

Sub band coding: The method basically examines the image to output the components comprising frequencies in precise groups, the sub bands. Consequently, quantization and coding is functioned to every band.

TECHNIQUES OF BRAIN IMAGE COMPRESSION

So far we have discussed different compression techniques. Now we will analyze and discuss different methods and techniques practically implemented and developed to carry out the compression process. The study is basically based on techniques and methods of brain compression, so we will analyze different techniques based on the image types which are:

- Magnetic Resonance Imaging (MRI)
- Computed Tomography (CT)
- Positron Emission Tomography (PET)
- Electroencephalography (EEG)

We will also analyze some basic methods applicable to overall medical image compression.

Computed Tomography (CT): CT essentially is made of investigating dimensions of an image of brain centered on the degree of alteration presence of X-rays. CT process is comprised of examination of the subject being controlled. Now we will analyze some of the techniques that have been proposed in this prospect:

The work done in (Sepehrb and *et al*., 2010) basically deals with the lossless compression of CT images. It is a transforming method called Differential Pulse Code Modulation (DPCM). In this method first the image is transformed and then the entropy encoding is done. After that bit stream compression is applied to entropy encoded image. Next entropy decoding is done followed by the step of inverse transformation which is then used to reconstruct the image. Huffman encoding is applied in the whole process. The results showed that it is a very simple and accurate method for the compression of CT images. Another CT compression method using the concept of spectral frequency is proposed in (Ju and Seghouane, 2009). The work done in (Rhodes *et al*., 1985) is another way of CT image compression. The method basically preserves the contents of the image. For this purpose they first computed the entropy measures of several hundred CT

Table 1: CT brain images compression methods comparison

Application	Advantage	Limitation	Results
Compression of brain CT images (Sepehrband *et al*., 2010)	Has the smallest entropy and very easy to implement on hardware	Specific to CT brain images only	Compresses the CT brain images without the loss of information
Compression of CT images (Rhodes *et al*., 1985)	Images are heavily compressed	Worst case of system exists that does not compress the image and computationally expensive	The images were compressed 5% of their original size
CT image compression (Hashimoto *et al*., 2004)	Adequate image quality is obtained	Computationally expensive	The whole image has improved eminence and has power of enlightening the excellence of pixels through the process of level of interest
3D CT compression (Lee *et al*., 1991)	Applicable for both 2D and 3D data	Computationally complex	Effective and efficient method for compression
CT compression (Li *et al*., 2006)	Preserves the image quality and details	Applicable to a specific type of images	Meaningful portion of image was chosen and compressed and the process of examining image delivers acceptable outcomes
PET-CT compression (Signoroni *et al*., 2009)	Increase of both reliability and coding efficiency	Comparably a slow system	The potentials of the proposed algorithm were assessed both in terms of algorithm performance and in PET-CT image quality and the results are effective in each regard
CT compression (Ju and Seghouane, 2009)	Image quality is not affected	Comparably complex system	The method provides 96% sensitivity for polyps

images by the help of differential streams. Next a method called flexible run-length procedure of compression is applied on the images. The results showed that Image entropy procedures were revealed to be an extra complicated compression method as compared to standard entropy. Another method called level of interest is carried out in (Hashimoto *et al*., 2004) for CT image compression. The study basically describes two methods; first one is called Level of Interest (LOI) and the other is called Region of Interest (ROI). The LOI works by giving primacy to the pixels consuming a specific pixel value whereas the method ROI works by giving priority to the pixels of a specific area or region within the image while encoding or decoding the image. The results showed that high-quality compression through lossless process is attained by developed integer technique being proposed.

The 3D CT compression (Lee *et al*., 1991) is an Estimated Inter-frame (DEI) method proposed for the purpose of compression; the results indicate that the process is applicable for both 2D and 3D images. The above discussion is summarized in the Table 1.

Electroencephalography (EEG): EEG is the measurement of electrical activities and schedules of brain through recording electrodes located on the scalp. EEG has an ability to discover the power, strength and position of electrical deeds in dissimilar brain zones. Now we will analyze some of the techniques that have been proposed in this regard:

Technique presented in (Kok-Kiong and Marziliano, 2008) works on EEG brain signals. The method deals with the signals compression of EEG signals through the process of sampling theory created in favor of signals in the company of finite rate of innovation. The working flow is composed of the creation of non-uniform linear splines which are the results of modeled seizure signals. After this the next step being carried out is the sampling and reconstruction process which is produced on behalf of the signals having limited proportion of improvement. The method shows that the signals of EEG are greatly compressed at the same time protecting their morphologies. Another method of EEG compression can be analyzed in (Madan *et al*., 2004); the method mainly makes use of the process called Power Spectral Density. EEG data compression using independent component analysis is proposed in (Sameni *et al*., 2008). The method makes use of Karhunen-Loeve Transforms (KLT) and wavelets. The method proposes redundancy reduction by means of Independent Component Analysis (ICA) in order to discover a further competent code. Consequences obtained from the method by means of ICA, the process of compression, produce extreme lesser reconstruction faults. Another technique in this prospect is proposed in (Sriraam and Eswaran, 2008). The study presents a process of the EEG signals compression through lossless process by means of adaptive error modeling structure. The technique makes use of aninterpreter and error modeling method. Histogram computation is used in order to predict the error modeling. A heuristic search is applied to find two areas having minimum value. Next context-based bias cancellation scheme is utilized to improve the compression process. Results are constructed on the signals of EEG developed under diverse physical and mental circumstances and the performance is appraised in provision of the compression ratio. EEG compression using JPEG2000 is proposed in (Higgins *et al*., 2010a; Garry *et al*., 2000). Another way of lossless compression is by the use of neural networks. This type of work is done in (Sriraam, 2007). The method basically deals with the process of lossless compression of EEG signals by the use of neural networks. Threshold process is used to detect the errors among the real and predicted signals. A non-uniform manner is used to quantize the threshold error samples. In order to further improve the compression effectiveness and flexibility, arithmetic encoder is used. Single layer neural network, multilayer neural network and Elman network together with two classical adaptive predictors are used in this process. The outcome of this method is measured in sense of compression ratio. Distinction of error limit and quantization step had a great impact on the results and performance of this method. A new EEG compression technique can be analyzed in (Aviyente and Selin, 2007).The method is based on a gabor frame and the results show that it is effective for recovery of EEG signals commencing a minor amount of projections. EEG compression using JPEG200 is proposed in (Higgins *et al*., 2010b). In this method the recreated EEG signals are used to REACT, a state-of-the-art seizure detection algorithm to regulate and analyze the compression ratio. Lossless Multi-channel EEG Compression can be analyzed in (Wongsawat *et al*., 2006). The method makes use of Karhunen-Loeve transform in order to produce the inter-correlation between the EEG frequencies. Lifting schemes are utilized in order to approximate the transform. The outcomes showed that the method is effective for EEG compression. Another EEG compression method based on lossless EEG compression is given in (Srinivasan and Ramasubba, 2010). Compression through the process of near lossless and lossless technique in regard of EEG signals is projected in (Cinkler *et al*., 1997). One more context based compression method for EEG can be analyzed in (Memon *et al*., 1999). The results

Table 2: EEG brain images/signals compression techniques comparison

Application	Advantages	Limitations	Results
Compression of EEG Signals (Kok-Kiong and Marziliano, 2008)	Compressing the EEG signals with preserving their morphologies	The EEG signals are reconstructed with only 2K contiguous fourier coefficient with a low reconstruction error	The method outperformed with classical compression rate with no loss of information and signal quality
Compression of EEG signals (Sriraam and Eswaran, 2008)	Appropriate for the real time broadcast of EEG signals	Complexity of the system is a drawback	Compression rate of 3.23 and efficiency of 70% is recorded
Compression of EEG signals (Sriraam, 2007)	Fast and reliable in case of compression and preservation of image details	Computationally complex	Results shows that the disparity of error boundary and quantization phase elect the complete compression output
EEG data compression (Antoniol and Tonella, 1997)	Easy and firm encoder/decoder structure proficient of real-time enactment	Not much effective	the results showed that acceptable compression can be achieved through the process
EEG compression (Cinkler *et al*., 1997)	Fast and accurate	Memory limitations problem	Method provides advanced compression ratios. reproduction results through a huge diversity of data sets are stated
EEG compression (Memon *et al*., 1999)	Involves less than 1% error rate	Computationally a bit large method	results show that the method provides higher compression ratios (up to 3-bit/sample saving through less than 1% fault). compression consequences are stated for eeg's recorded innumerous clinical circumstances
EEG compression (Aviyente and Selin, 2007)	Uses small number of data	Quality of the reconstructed signals is bit affected	Results provide acceptable compression outcome
EEG compression (Higgins *et al*., 2010a)	Reduces wireless transmission requirements and, therefore, saves power	No accepted limit exists for the maximum tolerable level of PRD for EEG data	PRDs of up to 30% can be tolerated without overly affecting the system's performance
EEG compression (Madan *et al*., 2004)	-	limited to single occipital and single frontal station	Results being obtained are: the normal complete contract associated besides manual recording of seven sleep accounts of EEG is 68.5%
EEG data compression (Sameni *et al*., 2008)	Slighter quantity of memory is required in order to store data	Yields far smaller reconstruction errors	-
EEG compression (Wongsawat *et al*., 2006)	minimizes the temporal redundancy	Computational complexity	The method outputs an alterable understanding below limited accuracy processing
EEG compression (Srinivasan and Ramasubba, 2010)	Less encoding delay	-	Results showed the preprocessed EEG signals gave improved rate-distortion performance
EEG compression (Higgins *et al*., 2010b)	Minimizes power requirements	Computationally complex	Results showed that method performs well in relation to other EEG compression methods proposed in the literature
EEG compression (Garry *et al*., 2000)	Signal quality is persevered	-	Algorithm performs well in efficiently compressing EEG data without significant loss in signal fidelity

indicate less than 1% error in the compression method. The above discussion is summarized in the Table 2.

Magnetic Resonance Imaging (MRI): The basic function of MRI is to measure the activity of brain. MRI operates on magnetic grounds and radio waves in order to produce superior and enriched value comprised of two or three dimensional images of brain's association and structure particulars lacking infusing radioactive tracers. Now we will discuss some of the compression techniques presented in this prospect:

MRI compression by means of the process called A Heterogeneous Wavelet Filters Bank is proposed in (Gornale *et al*., 2007). Image compression is achieved by the process consisting of three steps. The first step is the use of decomposition filter that decomposes the image and transforms the coefficients in each detailed sub band. After that the number of coefficients is placed as constant in the process of preprocessing. The last step involves the reconstruction of image by means of reconstruction filter coefficients. The results showed that the ratio of compression basically depends on the form of image and category of transforms since no filter exists with the intention of performing the most excellent compression for the entire image. Therefore, there is at all times essential to choose the suitable threshold assessment to obtain superior compression and the smallest amount of loss of image contents. MRI compression using reversible procedure is presented in (Midtvik and Hovig, 1999); the method makes use of stagnant based procedures intended for the background and foreground distinctly. Lossy compression for MRI

Table 3: MRI brain images compression techniques comparison

Application	Advantage	Limitation	Results
Compression of MRI (Gornale *et al*., 2007)	Can handle variety of images with different ranges of frequency and intensity	Images with higher frequency does not encompass promising results	The compression ratio is based on the kind of image and category of transforms since no filter exists that achieves the greatest compression ratio on behalf of every image
MRI and BT images compression (Yilmaz and Kilic, 1998)	The particulars of the real image are protected in there built image and are conserved	Problems of empty cells in the image do exist	high compression rate is achieved with minimum utilization of SNR values
Compression of MRI (Raghavan *et al*., 2002)	Substantial compression will be acquired if the MRI images have even areas	In some cases the storage for the image increases	The results indicate that significant compression is attained for mask images that contain huge sum of even areas
Compression of MRI (Cavaro-Menard *et al*., 1999)	also effective for segmentation	Limiting the compression ratio	the method provides a compression ratio of 67:1
MRI compression (Badawy *et al*., 2002)	Preserves image quality	Large and complex system	Obtained acceptable compression ratio
MRI compression (Gornale *et al*., 2007)	Preserves frequency contents	Low frequency contents based images are only effective for this method	The results showed that the outcome of the compression procedure usually rests on the image features
Compression of MRI (Karras, 2009)	Does not require user defined parameters	The chief area handled in this case is the removal of obstructive possessions in the divider borders	Effective outcomes are acquired regarding rebuilt process of image excellence in addition to protection of important image particulars
MRI reconstruction (Liu and Zhang, 2008)	Preserves image quality and details	-	results showed that proposed method significantly improves the quality of reconstructed MR images
3D MRI compression (Yodchanan, 2008)	Reduces computational complexity	Handles the material only in the skull region of MRI	Results showed that proposed method advances enactment by dint of over 40%
MRI compression (Karras, 2009)	Does not require user Defined parameters	-	the results showed that the method obtained auspicious outcomes regarding recreation process of image excellence in addition to protection of important image particulars whereas conversely attaining great compression rates
MRI compression (Corvetto *et al*., 2010)	Also handles 3D images	-	-
MRI compression (Dhouib *et al*., 1994)	Handles 3D data	Image storage requirements are high	The results showed that the method is effective for compression but requires more memory for storage
MRI compression (Millar and Nicholl, 1994)	Minimizes space requirements	-	Results showed that system attains compression ratio of 1.49
MRI compression (Midtvik and Hovig,1999)	Fast system	Computationally complex	The outcomes demonstrated that this compression method can provide bit rates analogous to the finest current alterable approaches
NMR relaxation enhancement (Hu *et al*., 2010)	Reliable and effective	Complex system	Acceptable compression rates by great contrast with outstanding spatial resolution are attained by the process

can be analyzed in (Cavaro-Menard *et al*., 1999); the method makes use of two other methods called JPEG and wavelet transform to compress the MR images. Similar work can be analyzed in (Badawy *et al*., 2002); the method also makes use of wavelet transform for MRI compression. Another wavelet transform method for MRI compression is proposed in (Gornale *et al*., 2007). It is a multi-resolution system. Similar approach is presented in (Karras, 2009). Similar work is proposed in (Karras, 2009) that makes use of wavelet transform and Bayesian method. Technique proposed in (Hu *et al*., 2010) is a compression method for MR images. Another approach for MRI reconstruction is presented in (Liu and Zhang, 2008). The method works by widening the one dimensional Auto Regression (AR) representation to two dimensional AR model. The method has offered a new sensitivity map assessment system to enlarge the evaluation correctness. MRI compression using concept of Foreground is proposed in (Corvetto *et al*., 2010). MRI compression based on wavelet can also be analyzed in (Dhouib *et al*., 1994). Table 3 summarizes the techniques.

Positron Emission Tomography (PET): PET was the early and initial investigation procedure to deliver functional information concerning the brain. Similarly PET and FMRI provide familiarity concerning neural activities and schedules in various brain zones as pointed by means of the level of academic blood stream. Now we will analyze some of the methods presented in PET compression:

PET images data compression is done in (Weidong *et al*., 1998). The method is a compression system for PET images using a knowledge based data compression algorithm. The system works for both spatial and temporal domain. The method makes use of FDGtracer to carry out and validate the data compression algorithm. Optimal Image Sampling Schedule (OISS) is applied to basically slighter the number of temporal frames. The acquired temporal frames are then classified as single indexed image and further compressed by using a cluster analysis method. The single indexed images are then compressed using portable network graphics.Theresults computed in this case show that the proposed compression algorithm is able to decrease the storage area for image by 95% without giving up image excellence and considerably diminishes the computational complication of producing PET data. Another work in this prospect is presented in (Yilmaz and Kilic, 1998). The system deals with the compression of MRI and BT images by the use of hierarchical finite state vector quantization process. The results of the algorithm showed that the obtained outcome of the compression method is very high as compared to other compression techniques. One more MR images compression makes use of pyramid encoding to carry out the process. The work can be analyzed in (Raghavan *et al*., 2002). KLT method for MRI compression is presented in (Yodchanan, 2008). Different methods used for PET compression can be analyzed in (Dahlbom *et al*., 1994). The author also proposes a method based on the masking concept to improve the performance of these processes. Compression techniques of EEG are discussed in (Antoniol and Tonella, 1997). Method for 3D PET compression can be analyzed in (Macq *et al*., 1994). The method works by using the process of an Adaptive Differential Pulse Code Modulator (ADPCM). After that a Universal Variable Length Coder (UVLC) is utilized to carry out the compression process. Comparing through Lempel-Ziv (LZ) that mainly functions on an entire sinogram, UVLC works precisely efficient on small data chunks. Another PET compression approach using wavelet transform can be analyzed in (Min-Jen *et al*., 1995). PET compression using PCA is proposed in (Zhe *et al*., 2003). The method showed that noise standardized PCA provides comparable ratios of compression to OSS, however, provide double accuracy. In the sinogram area PCA provides comparable measurable correctness to OSS and improved precision than PCA. Aimed at ROI lessons, the SPCA joint by means of straight assessment of the region of interest commencing the sinograms by the Huesman procedure provided the greatest precise outcomes and highest computational competence and proficiency. A further approach for PET-CT compression is given in (Si *et al*., 2009). The method makes use of articulated coding system allowing the usage of effectual compression of PET/CT multimodal datasets. Some techniques from the above discussion are summarized in the Table 4.

Medical image compression: In this section we will overview some of the methods presented for overall medial image compression:

A method of compression of medical images using the procedure Level of Interest (LOI) is presented in (Hashimoto *et al*., 2004). This study proposes a system of lossless compression by using the method (ROI) by means of optimal degree, motion remunerated and lossless compression in additional areas. The process works by firstly applying the segmentation process to the input image. After that motion compensated coding is applied. The next step involves the utilization of entropy minimizing coding of motion vector. The results are tested on CT images. The experimental results showed that 2.5% rate can be achieved by the compression method being proposed.

Usage of wavelet transform for medical image compression is proposed in (Wang and Huang, 1996); the method contains a 3Dcompression technique of

Table 4: PET brain images/signals compression techniques comparison

Application	Advantage	Limitation	Results
Compression of PET image (Weidong *et al*., 1998)	Compression procedure significantly decreases the computational difficulty of additional clinical image dispensation for instance production of functional images	Most of the pixels concerning the background are neglected	Compression of up to 95% was achieved without affecting the image quality
PET image compression (Dahlbom *et al*., 1994)	High speed processing system	Sensitive to quality of image	Compression rate of 1.7% is acquired with preservation of the image important statistics
3D PET compression (Macq *et al*., 1994)	Real-time implementation	De-correlation step (ADPCM) in compression should be improved before processing	Results showed that compression and decompression at a rate of 27MBytes/sec is achieved
Positron emission tomography compression (Min-Jen *et al*., 1995)	Preserves great reliability for the rebuilt image that can be utilized in the PACS scheme and for analysis atmosphere	Not suitable for medical tomographic imaging (like PET) for chunk relics sub sequent after the chunk centered DCT constant quantization	Outcomes recommend that system has robust potential to deliver both great image excellence and optimal compression competence when used with medical imaging
PET compression (Zhe *et al*., 2003)	Computational efficiency and noise removal	-	-
PET compression (Panins, 2008)	Easy parallelization	Complex system	-

Table 5: Medical brain images/signals compression techniques comparison

Application	Advantages	Limitation	Results
Medical image compression (Hashimoto *et al*., 2004)	Can handle both 2D and 3D medical images	Involves too many processes	Compression ratio of 2.5% is achieved
Medical images compression (Wang and Huang, 1996)	Image quality is preserved by removing the noise factor	A bit slow system	MRI compression rate was enhanced by 70% and CT compression was enhanced by 35%
Image compression (Rodet *et al*., 2000)	Procedure permits to handle the compression ratio, the superiority and excellence of signal	Limitations of signal quality	A great compression rate with minimization of the processing time was achieved through the process
Image compression (Tzong-Jer and Keh-Shih, 2010)	image quality is preserved	Expensive system	The proposed method demonstrates an improvement of more than 40% in compression ratio than original image without deterioration in image quality
Medical image compression (Kanoun *et al*., 2006)	Noise removal	Quality of image is affected	Acceptable and promising compression rates are achieved through the process
Compression of medical images (Karadimitriou and fenstermacher, 1998)	Improved image compressibility	Image quality is bit affected	Greatest development rates by +129% are achieved
Medical image compression (Shaou-Gang *et al*., 2009)	Image quality is preserved	Coding is activated only when inter-frame correlation is high enough	Compression gains: 13.3% and 26.3%
Compression method analysis (Bharti *et al*., 2009)	Region of interest is focused and analyzed	-	-

medical images in regard of CTMR images that custom a divisible nonuniform3D wavelet transform. CT image compression using region selective Embedded Zero tree Wavelet Code is proposed in (Li *et al*., 2006). Another compression technique based on Multi-frequential approach is proposed in (Rodet *et al*., 2000); the method makes use of steps named decomposition, quantification and un-compression. Fourier decomposition is applied in this case. Method presented in (Tzong-Jer and Keh-Shih, 2010) can also be analyzed here. The method is based on lossless compression of medical images with a feature that enhances the image by eliminating the noise factor without damaging the image quality.

Statistical model for medical image processing can be analyzed in (Kanoun *et al*., 2006). The method makes use of DCT which is the most common method among the compression methods. The results indicate that it can be applied to different medical modalities together with the feature of image quality preservation factor. Image Compression in Medical Imaging is presented in (Karadimitriou and Fenstermacher, 1998).The method proposed in (Shaou-Gang *et al*., 2009) is a Lossless Compression Method for Medical Image Sequences Using JPEG-LS and Inter-frame Coding. The above discussion is summarized in the Table 5.

DISCUSSION

So far we have analyzed different approaches and methods proposed and developed in the prospect of medical and brain image compression. From the above analysis we can conclude or say that compressing an

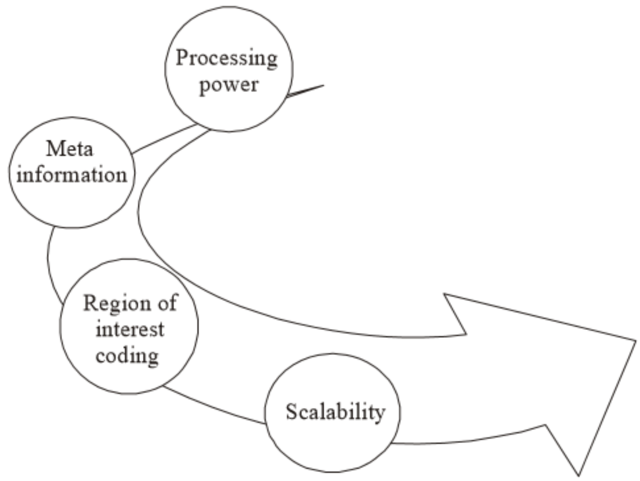

Fig. 5: Properties of image compression

image is considerably diverse than compressing unrefined binary information. Certainly, common principle compression programs are mainly used to compress images, although the consequence is fewer than best. This is for the reason that images contain convinced numerical properties which can be broken by encoders purposely planned and developed for them. Also, some advanced information in the image can be given up for the sake of saving a more bandwidth or storage room. This also concludes that lossy compression methods can be utilized in this prospect. In view of the methods discussed above we can conclude that image excellence at a specified compression rate is the chief objective of image compression, though there are additional significant possessions of image compression system which are shown in Fig. 5.

These properties must be considered before applying any compression method. Scalability commonly denotes to an excellence lessening accomplished by manipulation of the bit stream or file. In the concept of Region of interest coding, definite portions of the image are programmed through advanced eminence than others. This might be mutual with scalability. In Meta information compressed data might contain statistics about the image which may be utilized to classify, examine or peruse images. Such data might embrace color and texture figures, insignificant trailer images and author or copyright data and details. The concept of processing power refers to the amount of power one method requires to compress different sort of images. If these properties are kept in mind, effective and efficient compression can be achieved.

CONCLUSION

This study provides the brief overview of some brain image compression techniques. The sub-classifications of two different types of brain image compression are discussed in detailed here. The study provides the thorough comparisons of different image compression techniques regarding to the brain image compression with their advantages, disadvantages and results. It is found that instead of a lot of existing techniques, still there is a huge contributions required in this field.

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