HYBRID APPROACH FOR DIGITAL IMAGE RECONSTRUCTION USING COMPRESSIVE SENSING REVIEW PAPER

[1]Khushbu Darji, [2]Prof. Jaymin Bhalani
[1]Research Scholar, [2]Professor
Bits Education Campus

ABSTRACT- At present multimedia transmission has made a big boon. Compressive sensing technique plays specific role for less time data and less space sending capability. Among those DCT, DWT are most famous methods. DCT is concentrating the energy of the transformed signal in low frequency and reduce the blocking effect Where wavelet analysis is provide long term interval in frequency plane decomposition and reconstruction of the image. Compare with the traditional sensing algorithm effectively improve the PSNR of reconstruction image. Moreover, in the improved algorithm uses different kind of matrix such as bernulie matrix, Gaussian matrix, hadamard matrix, Toeplitz matrix with measurement of sparse angle by using DCT on specific information part and also Euclidian reconstruction process is there. This all technique refers a hybrid itself.So in this paper try to improve the PSNR by using method DWT at high frequency domain, SPARSE angle technique in DCT at low frequency domain with better segmentation and also reduce overlapping.

Keywords – DCT, DWT, Sparse angle, PSNR.

I. INTRODUCTION

Compressive sensing process is an art and science to reducing size of data in digital imageprocessing. In digital system, the information is not similar to data, data means by which information conveyed because different amount of data can be uses to represent same information termed as redundancy. The quantity of the information in image take place as intensity of image with finite number of element which have specific value and location. In 2D intensity array suffer from three principle 1) coding redundancy 2) spatial and temporal redundancy and 3) irrelevant information. In coding redundancy, code is a system of symbols/number/bit used to represent a body of information or set of events. Each symbol assigned a code symbols called code word. The number of symbol in each code word called code length. Spatial redundancy, pixel is similar/ depends on neighbouring pixels value. 2D intensity array correlated spatially, information is unnecessary replicated in representation of correlated pixels. Temporal redundancy similar/depends on nearby frames and duplicated information. Irrelevant information is one of the simple ways to compress a set the data to remove which are ignore by human visual.[1]

Information contains large in image which bring a lot of difficulties for storage, processing and sending so compression is important and necessary. From those approaches lossy compression is famous because its compressive ratio is higher, reconstruction image adequate and reasonably closed. The compressive sensing has been used in many practical applications such as information theory, bio-medical, astronomy, radar imaging.

It is based in matrix measurement of wavelet coefficient M*N samples and represented in high frequency and low frequency domain. High frequency coefficient is around zero so that it having a sparse and low frequency consist on point of energy therefor in this process both coefficients to gather with multiplying high frequency resultant low frequency coefficient will be degraded performance.

In this review paper try to improve the compressive sensing reconstruction after wavelet transform process as well work low frequency coefficient to improve the effect and performance also reduce the overlapping within two pixels in image.

II. TRANSFORM CODING

Transform coding is general scheme for lossy image compression.it is reversible and linear as uniform transformation to de correlated original image in to the set of coefficient transform domain which is quantized and sequentially codded such as DCT,DWT,FFT,DFT.

A. DCT

Discrete Cosine Transform is generally used for image compression. It is transform quantity of the information in image to the spatial-frequency domain at specific value with its location.it takes real part of FFT where ever as compare others DFT usesset of harmonically-related complex exponential function and less energy concentration while DCT is uses only real valued cosine function image in spectral and sub band reconstruction with respect to image visual quantity. DCT generate good quality of image with more energy concentration with focus on low frequency transformation and reduce blocking effect better than others.[1]

Compose process:

$$F(u,v) = \frac{2}{N} C(u)C(v) \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} f(x,y) \cos\left[\frac{\pi(2x+1)u}{2N}\right] \cos\left[\frac{\pi(2y+1)v}{2N}\right]$$

for $u = 0,...,N-1$ and $v = 0,...,N-1$

where $N = 8$ and $C(k) = \begin{cases} 1/\sqrt{2} & \text{for } k = 0 \\ 1 & \text{otherwise} \end{cases}$

(1)

Decompose process:

$$f(x,y) = \frac{2}{N} \sum_{u=0}^{N-1} \sum_{v=0}^{N-1} C(u)C(v)F(u,v) \cos\left[\frac{\pi(2x+1)u}{2N}\right] \cos\left[\frac{\pi(2y+1)v}{2N}\right]$$

for $x = 0,...,N-1$ and $y = 0,...,N-1$ where $N = 8$

(2)

f(x,y)→ f(u,v) for most image of signal energy lies at low frequency appear in upper left concentration right hand side represent high frequency with small distortion.

B. DWT

Discrete cosine wavelet transforms. Wavelet is decomposition of the signal or image with respect to scales or resolution and on process of sub band coding. It consist data in set of high pass co efficient and low pass coefficient. Low pass coefficient having approximation and high frequency having details. Filtering for 1D and among 2D construct both rows and columns such as LH, HL, HH then measurement of LL. If using single layer wavelet low frequency coefficient is disrupted which consist more energy concentration. DWT provide the picture quality at high compression ratio, mainly at better energy concentration process, less duration and appropriate performance. [2]

DWT is reconstructed high frequency components of high resolution image and reducing some ringing and artefact degradation and also enhance sharpening.In wavelet terminology, the predictive function is referred to as the wavelet function. The wavelet function is paired with a scaling function. The wavelet function acts as a high pass filter. The scaling function acts as a low pass filter, which avoids aliasing (large jumps in data values).

Wavelet domain frequency decomposition[4]

$g(x,y) = 1/N \; \Sigma_m \Sigma_n G_\psi(m,n) \psi_{m,n}(x,y)$

$+ 1/N \; \Sigma_{I\text{-}H,V,D} \Sigma_M \Sigma_N G_\psi^i (m,n) \psi^i_{m,n}(x,y)$(3)

$b(x,y) = 1/pN \Sigma_m \Sigma_n B_\psi(m,n) \psi_{m,n}(x,y)$

$+ 1/pN \; \Sigma_{I\text{-}H,V,D} \Sigma_M \Sigma_N B_\psi^i (m,n) \psi^i_{m,n}(x,y)$

$G_\psi$represented (LL) sub band od DWT for g(x,y), φ is the scaling function. $G_\psi^i$and B_ψ^i for i ϵ {H,V,D} are LH,HL and HH sub band of DWT for g(x,y) and b(x,y), represented φ is the wavelet function $B_\psi$is the L sub band of DWT for b(x,y).

III. MSE AND PSNR

Peak signal to noise ratio is the ratio between maximum possible power of signal and power of corrupting noise that effect representation.it is commonly use foe measure the quality of reconstruction of lossy compression codes.

Mean square error:

$MSE = 1/mn \sum_{i=0}^{m-1} * \sum_{j=0}^{n-1} * [i(ij) - k(ij)]^2$ (4)

From this,

$PSNR = 10 \log(max_I^2 / MSE)$

$PSNR = 20 \log(max_I^1 / \sqrt{MSE})$ (5)

MAX_I is the maximum possible pixel value of the image.

IV. WORK DONE

From the base paper, compressive sensing is converts none uniform to uniform by using DWT transform function. However measure the high frequency wavelet function from matrix measurement and improve the performance. Compressive sensing consist three parts[2]

1)Expand the N*1 signal f and orthogonal process. In which x is sparse representation if the image with some coefficient are non-zero, the reason to use transform method. F=ψx

2) After satisfied all recover the signal or image, measure the matrix(φ) for it on the base of sparsity and get M*1 linear projection of original signal. Y=φψx

3) An optimization algorithm that can be minimize the sparse and reconstructed it. [2]

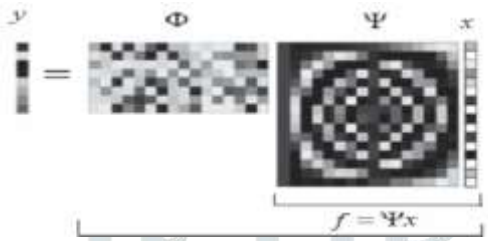

Figure1.The illustration on compressive sensing

The steps of algorithm

- **I.** Representation wavelet N*N image and construct four sub band
- **II.** Make a measurement of matrix for high frequency LH.HL, HH and keep the low frequency coefficient LL with unchanged.
- **III.** Reconstruct three high frequency matrixes ten with LL,to reconstruct the image.
- **IV.** The PSNR is employed xmn and x'mn are original grey level and reconstruction grey level respectively.

$$MSE= 1/mn\sum_{i=0}^{m-1} * \sum_{j=0}^{n-1} * [x_{mn} - x'_{mn}]2 \quad (6)$$

PSNR define $10loglo(255^2 /MSE)$.(M=100)

Table 1[PSNR comparison using different matrices for image reconstruction][2]

Measurement matrix	PSNR reconstructed image in (dB)
Gaussian random matrix	30.0455
Bernoulli matrix	30.1990
Toeplitz matrix	30.1518
Hadamard matrix	32.2892

In this measurement only point out the high frequency coefficient of wavelet transform and hadamard matrix performed better then other.

PROPOSED WORK

Based in improve the CS algorithm, measure only high frequency wavelet and compare with traditional CS algorithm and measurement matrices in different form to achieve high PSNR so , future work would be included to not only focus high frequency because low frequency consist high energy concentration of the image.

A proposal work will be work on the low frequency by using hybrid approaches DWT for high frequency coefficient and to make more appropriation in image work with low frequency coefficient by using DCT with sparse angle technique as such sparsity is critical for high-performance signal processing operations of high-dimensional data of cross correlation. The sparsity of the underlying signal in our proposed correlation domain aids in the recovery mechanism to obtain reliable range estimates. The main idea was to use a Toeplitz matrix with the time-shifted reference signal as the dictionary that leads to sparser representation than processing in other domains such as DCT.Moreover including Euclidian reconstruction to reduce the overlapping between two pixels. And compare with the matrices measurement and try to improve PSNR with reduce the MSE.

For more appropriate understanding, a flow chart would be describes about future work as shown below. In their mention step by step process that would be applies for implementation work and gets better result.

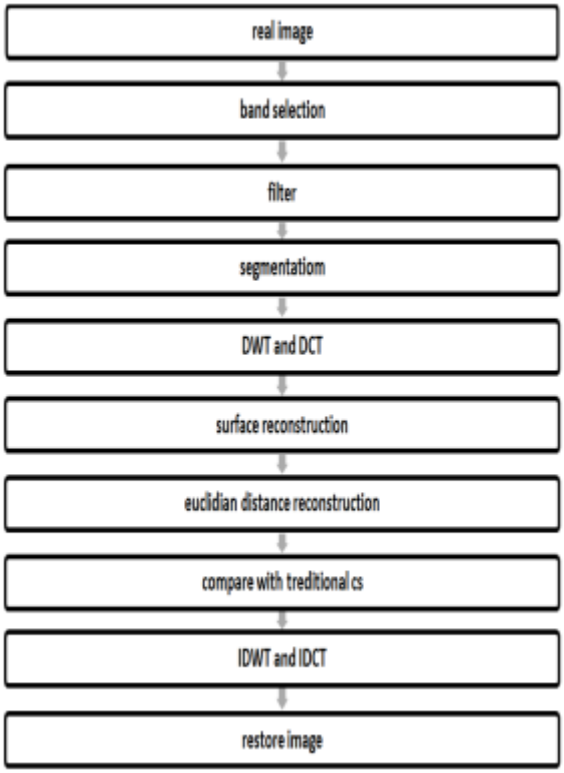

Figure 2: Flow chart

As per based paper[2]concern and implement would be like as shown a flow chart. in this, consist Gaussian filter which would be get smoothing and reduce the noise after that segmentation process to make more sharp by using canny edge detectionand morphological filter technique on the non-texture pixels. This method is defining a dilation operation about a neighbourhood including a first pixel; and defining an erosion operation includes finding a maximum intensity value among all sample pixels in said neighbourhood each sample pixel having an intensity value. Features by the human visual system so for that morphology is most commonly applied to digital images but it can be employed as well on graphs, surface meshes, solids, and many other spatial structures. Then start the process in transform function on high and low frequency coefficient with sparse angle operation with respect to DWT and DCT.Set onEuclidian distance function to reduce overlapping each pixel. Compare with traditional CS with measure value in matrices method and would be increases PSNR as compare the old output. Reconstruct the image and store as per application.

V. CONCLUSION

As per implement in simulation on compressive sensing PSNR would be increases to work not only high frequency coefficient but also in low frequency coefficient by use of sparse angle technique in DCT.it would be more effectively also to apply Euclidian reconstruction in image. This CS algorithm would be improving the performance with compare the different matrices function.

VI. REFERENCES

[1]Rafael C. Gonzalez, Richard Eugene; “Digital image processing”, Edition 3, 2008.

[2]Xiamen Li School of Intonation Science and Engineering Hangzhou Nonnal University Hangzhou, China e-mail: xiumeUi@hotmail.com, School of Electrical and Electronic Engineering Nanyang Technological University Singapore e-mail: egbi@ntu.edu.sg” Image Reconstruction Based on the Improved Compressive Sensing Algorithm” 978-1-4799-8058-1/15/$31.00 ©20l5lEEE.

[3]Y. Tsaig and D. Donoho, "Extensions of compressed sensing," Signal Processing, vol. 86, no. 3, pp: 549-571,2006.

[4] Seonyung Kim, Donggyun Kim, Tae-Chan Kim, *Member, IEEE*, Monson Hayes, *Fellow, IEEE*,andJoonkiPaik,*Member, IEEE*,Selective Frequency Decompos_ition in the Wavelet Domain forSingle Image-Based Super-Resolution,2012 IEEE.