The Contents

Information Technology : Emerging Trends / Editor: Sunil V. K. Gaddam. 1st ed. New Delhi, Vitasta Publishing Pvt. Ltd. 2009. xiv, 273 p. ills. 29 cm.

It includes Mobile Computing, VoIP, Wireless LAN, Congestion in Mobile Networks, GSM Security, Cryptography Algorithm, Digitally Signed SMS, E-Governance, Bluetooth BaseBand Security, Data Mining, HMM for Multiple Sequence Alignment, Agriculture Research and more.

ISBN: 8189766406 KK-70675

"`Information Technology' : Emerging Trends is intended for students and all those who wish to know about various aspects of Information Technology and its ever expanding dimensions. The language used is simple. Well-labelled diagrams, tables, and abstracts provided in the beginning of each chapter offer a practical view to Computer Science applications.

The wide coverage of inter-disciplinary topics with primary focus on Computer Applications, Communication and Information Sciences (CCIS) in Biotechnology, Agricultural Technology and Pharmaceutical Technology, makes it a must-have reference book for students, the scientific community and IT professionals.

The book discusses the challenges facing mobile computing, requirements for a network administrator, wireless ad-hoc sensor networks - Time Synchronization Protocol (TPSN), a QoS (quality of service) based Self-adjusting Routing Protocol for mobile ad-hoc network (MANET) in handling emergency situations such as battlefields, earthquake, conferencing, etc., and Authenticated Routing Protocol and TCP for Ad-hoc Networks. It also talks about cryptography and network security, data warehousing and data mining and bio-informatics and computer."

[from Blurb]

Contents

Foreword

Preface

Acknowledgements

Section 1
Wireless Networking Technology

1. Challenges in Mobile Computing / Gopal Krishan, Ashish Siwach, Sanjay Sharma and Neha Khurana

2. Solving VoIP Problems on a Wireless LAN / Mayank Parashar and Manish Agarwal

3. Time Synchronization Protocol (TPSN) for Wireless Ad-hoc Sensor Networks / Arun Kumar Yadav and Pratap Sakhare

4. A QoS based Self-adjusting Routing Protocol (QSARP) for Mobile Ad-hoc Networks / Parul Tomar, Amit Goel and A. K. Sharma

5. Authenticated Routing Protocol for Ad-hoc Networks / Tanweer Alam and Bushra Jamal

6. TCP for Ad-hoc Networks / Ajay Kumar Bharti, Mohd Vakil, Anurag Jain and Tanweer Alam

7. MIET-NET-SPOT Wi-Fi : Emerging Wlan Technology in MIET Campus / Surendra Rahamatkar, Sunil V. K. Gaddam, Dharmendra Sharma and Pradeep Pant

8. Wireless Networks : A Revolution Ahead / Partho Ghosh, Manish Kumar, Sachin Malhotra, Saurabh Singh and Tanweer Alam

9. Problem of Congestion in Mobile Ad-hoc Networks / A. K. Jain, S. C. Sharma, Mohan Lal, S. Qamar and R. Jha

10. Mobile Networking through Mobile IP : A Survey / Vishnu Sharma, Brijesh Kumar Gupta, S. C. Sharma and S. Qamar

Section 2
Wireless Networking Technology and Emerging Trends of Information Technology

11. Energy Efficient Parameters for Controlling Physical Layer of Mobile Ad-hoc Networks / Kumar Manoj, Sandip Vijay and S. C. Sharma

12. SVEEN : Loss Rate Measurement in Ad-hoc Wireless Networks / Sandip Vijay, Kumar Manoj and S. C. Sharma

13. Capacity Analysis of CDMA System with Parameter Variation / Amit Dixit, R. P. Vats, S. Qamar, A. K. Jain and S. C. Sharma

14. An Analysis of GSM Security through ECC Technique / Tarun Kumar, Pankaj Kumar Gupta and Amit Garg

15. Performance Evaluation of Dynamic Source Routing Protocol for Wireless Sensor Networks / Abhilash, Amit Garg and Partho Ghosh

16. The Future of IPTV : Technology Challenges / Mayank Parashar and Manish Agarwal

17. IP-Based Mobility Management Issues in 4G Networks / Sumita Goyal Sapna Gambhir and Mohit Gambhir

18. Study of Artificial Neural Network and its Scope in Different Fields : A Review / Yogesh Kumar Sharma and Achish Bagla

19. Comparative Study of Discrete Fourier and Discrete Hartley Transform in Image Compression / A. C. Suthar, G. R. Kulkarni and R. S. Gajre

20. Role of E-Governance and E-Government in India / Manish Kumar, Sachin Malhotra, Saurabh Singh, Partho Ghosh and Tanweer Alam

Proceedings of the National Conference on

EMERGING TECHNOLOGIES IN COMPUTER SCIENCE (ETCS–2007)

22–23, September 2007

Edited by

Prof Sunil V K Gaddam

Sponsored by

All India Council for Technical Education (AICTE)
New Delhi–110 003

Organized by

Meerut Institute of Engineering and Technology (MIET)
Meerut–250 005

Vitasta

Vitasta Publishing Pvt. Ltd.
New Delhi

19

Comparative Study of Discrete Fourier and Discrete Hartley Transform in Image Compression

A C Suthar,[1] G R Kulkarni,[2] R S Gajre[3]

Abstract: *This paper is concerned with the image compression using discrete Fourier transform (DFT) and discrete Hartley transform (DHT). Here two different transforms, one is Discrete Fourier transform and other is discrete Hartley transform, are applied to the image pixels matrix and quantization is done to achieve image data compression. Our work in this paper is the comparative study of discrete Fourier transform and discrete Hartley transform for image compression. Discrete Hartley transform provides low root mean square error (RMSE) and high peak signal to noise ratio (PSNR) for the same compression ratio (CR) as compared to discrete Fourier transform.*

Keywords: Discrete Hartley transform, Discrete Fourier transform, Root mean square error, Peak signal to noise ratio.

1. Introduction

The usage of digital image is growing continuously, video and television transmission become more and more digital. In multimedia applications more and more digital data is being used. In their raw form, digital images require a tremendous memory capacity for storage and large amount of bandwidth for transmission. So, it is obvious that large images need to be stored and handled in a compressed form [1]. Image compression addresses the problem of reducing the amount of data required to represent a digital image. There are many methods used for realizing a compression process, and the choice of any method depends upon user's requests, referring to algorithmic complexity of the compression, the quality of the image obtained after compression and compression rate. The PSNR value used to measure the difference between a decoded image $\hat{f}$ and its original image f is defined as follows.

$$RMSE = \left[\frac{1}{MN}\sum_{i=0}^{N-1}\sum_{j=0}^{M-1}\left[\hat{f}(i,j) - f(i,j)\right]^2\right]^{1/2}$$

$$PSNR = 10\log_{10}\left[\frac{255 * 255}{RMSE^2}\right]$$

where M*N is the size of the images, $\hat{f}(i,j)$ and $f(i,j)$ are the matrix elements of the decompressed and the original images at (i,j) pixel[2]. In general, the larger PSNR value, the better will be the decoded image quality.

The joint photographic expert experts group (JPEG) has specified a lossy algorithm based on transform coding. Techniques of this kind create a frequency based representation of the image and discard some of the high frequencies to create redundancy and hence achieve compression.

2. Hartley and Fourier Transform

If linear transform T is Hartley transform, then it is defined as

$$T(f(x)) = g_H(u) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)cas(xu)dx \quad (1)$$

where $cas(xu) = \cos(xu) + \sin(xu)$

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The 2-D discrete Hartley transform for image is given by

$$g_f(u,v) = \frac{1}{2\pi}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} pixel(x,y)cas(xu)cas(yv) \quad (2)$$

The relation between Hartley transform and Fourier transform is given by

$$g_H(u) = \frac{1+j}{2}g_F(u) + \frac{1-j}{2}g_F(-u) \quad (3)$$

Where $g_F(u)$ is the Fourier transform of $f(x)$.

Above eqn (3) is the relation between Hartley and Fourier transform [3-5].

The 2D DFT transform is given by:

$$F(u,v) = \frac{1}{MN}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)\exp\left[-j2\pi\left(\frac{ux}{M}+\frac{vy}{N}\right)\right] \quad (4)$$

for $u = 0,1,2,\ldots\ldots M-1$

$v = 0,1,2,\ldots\ldots N-1$

3. Image Compression using DHT and DFT

In image processing, an important part is the compression. This means the reducing the dimensions of the images, to a level that can be used or processed. Image compression using transform coding yields extremely good compression, with controllable degradation of image quality. An image is first partitioned into non-overlapped n*n sub images as shown in figure1. A two dimensional DHT/DFT is applied to each block to convert the gray levels of pixels in the spatial domain into coefficients in the frequency domain. Then higher frequency coefficients are removed in a zigzag scan order. At decoder side simply inverse process of encoding by using inverse two dimensional DHT/DFT is performed [2],[4].

4. Results and Conclusion

Numerical simulations have been performed in order to compare the image compression using DHT and DFT. The original standard images was the picture of Lena and Cameraman with 256*256 pixels, which is shown in fig2 (a) and 3(a) respectively. Fig 2(b)-(c) shows the decompressed Lena image using DFT for CR%=90.6250 and 84.3750 respectively. Fig 2(d)-(e) shows the decompressed Lena image using DHT for CR%=90.6250 and 84.3750 respectively. Fig 3(b)-(c) shows the decompressed Cameraman image using DFT for CR%=90.6250 and 84.3750 respectively. Fig 3(d)-(e) shows the decompressed Cameraman image using DHT for CR%=90.6250 and 84.3750 respectively.

The curves of RMSE, PSNR versus CR for both techniques i.e. DFT and DHT for both images have been calculated and depicted in fig4 and fig5. It is clear from fig4 that as CR increases, RMSE increases. For same amount of compression, DHT gives better result as compare to DFT. From fig5, as CR increases, PSNR decreases. Generally there is a trade off between image quality and CR. As CR increases, error increases, image quality degrades.

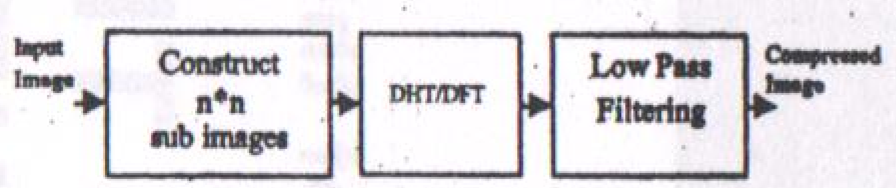

Figure 1(a)

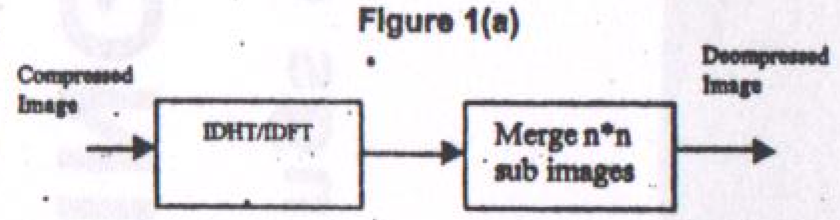

Figure 1(b)

In conclusion a high amount of compression can be achieved using DHT as compare to DFT for same RMSE. It is clear that as CR increases, RMSE increases whereas PSNR decreases.

Figure 2(a) Original Lena image

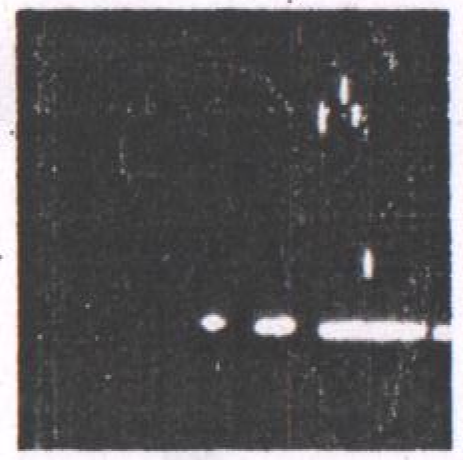

Figure 2(b) Decompressed Lena image using DFT
(CR% = 90.6250)

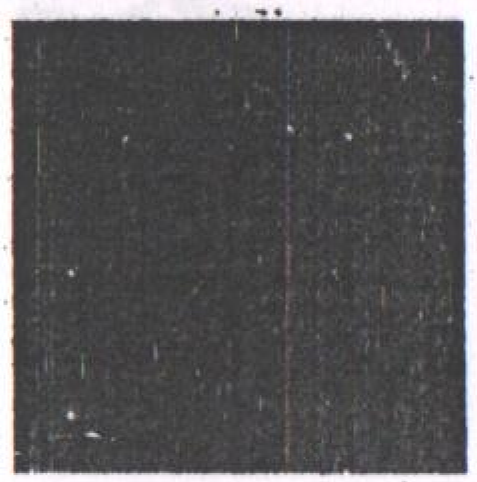

Figure 2(c) Decompressed Lena image using DFT (CR% = 84.3750)

Figure 2(d) Decompressed Lena image using DHT
(CR% = 90.6250)

Figure 2(e) Decompressed Lena image using DHT
(CR% = 84.3750)

Figure 3(a) Original Cameraman Image

Figure 3(b) Decompressed Cameraman image using DFT
(CR% = 90.6250)

Figure 3(c) Decompressed Cameraman image using DFT
(CR% = 84.3750)

Figure 3(d) Decompressed Cameraman image using DHT
(CR% = 90.6250)

Figure 3(e) Decompressed Cameraman image using DHT
(CR% = 84.3750)

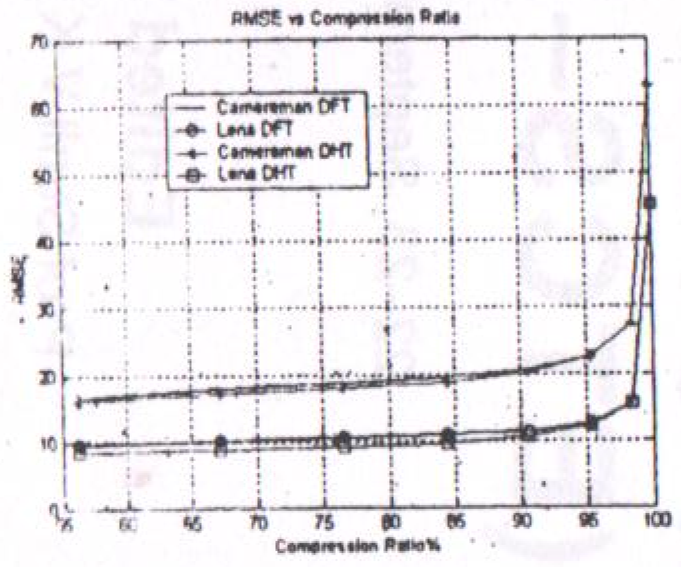

Figure 4 RMSE versus CR%

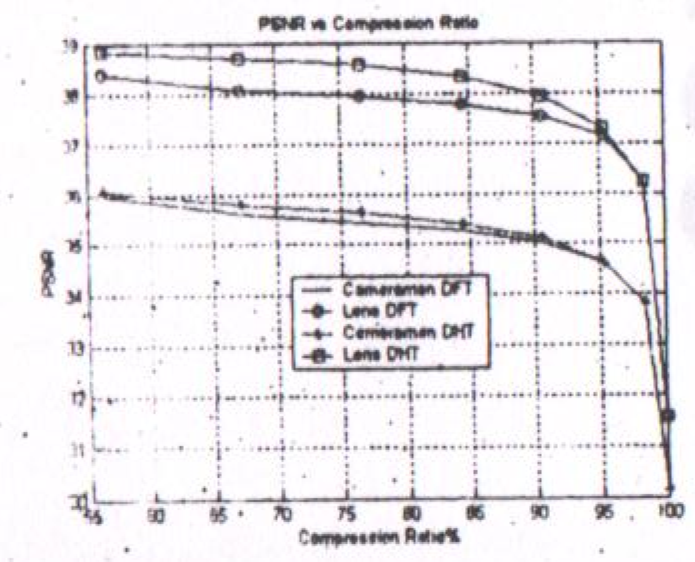

Figure 5 PSNR versus CR%

5. References

1. C. C. Chen, On the Selection of Image Compression Algorithms, *Proc. International Conference on Pattern Recognition*, Brisbane, Australia, 1998.
2. R. C. Gonzalez, R. E. Woods, *Digital Image Processing* (Addison-Wesley Co., 1993)
3. O. Johansan, On The Redundancy of Binary Huffman Codes, *IEEE Trans Information Theory*, vol.26, no.2, pp.220-223, 1980.
4. Tanaka and s. Kitamura, Block Permutation Coding of Images Using Cosine Transform, *IEEE Trans. Comm.*, vol.43, pp.2233-2246.
5. A. K. Jain, *Fundamentals of Digital Image Processing* (Englewood Cliffs, Prentice-Hall, Inc, 1989).