International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 12, December-2014

Study of Low Visibility Digital Objects Using MATLAB

Aruna Bansal
Assistant Professor : ECE dept.
RCEW
Jaipur, India

Seema Sen
Scholar: ECE dept.
RCEW
Jaipur, India

***Abstract*— Low visibility digital objects are also called as ghost images. The ghost images are such images which comprise of positive and negative value pixels. These pixels are arranged such that they disappear when projected at certain angles. Here, in this paper we are discussing about these low visibility digital objects that is their origin, kernels, creation, type's mainly minimal and finite, effect in image space and their applications. We have also tried to use cosine space (DCT) along Fourier space (DFT) and has compared their results. We have used here MATLAB for our study.**

***Keywords*—Discrete Cosine Transform, Discrete Fourier Transform, Low visibility objects, Kernels, Finite and Minimal Ghost.**

I. INTRODUCTION

Low visibility digital objects are such images which show certain effects in the image space they are present. Generally, we called such objects as ghost images. In broad terms these ghost images can be defined as the images comprise of positive and negative arranged pixels, where pixels are arranged such that they vanish when projected at certain angles. These ghosts have strong links to the artifacts that are created when real images are reconstructed from projected views, as done in conventional x-ray CT[1,2]. These ghosts originate from a result obtained long ago by Katz that determines if any digital object can be reconstructed exactly from any set M of projected views.

II. GHOST IMAGES

In Image Reconstruction images are reconstructed using projections such as in x-rays, computerized tomography etc. The projections can be of low values. Low projection values may lead some missing values which give rise to certain images which disappear at certain angles such images are of low visibility and can be called as ghost images[1].

A. Ghost Origin

Ghost or low visibility digital objects are functions in reconstructed images that disappear at specific angles (i.e. their projections are zero valued). They generally arise from missing or incomplete projection[1].

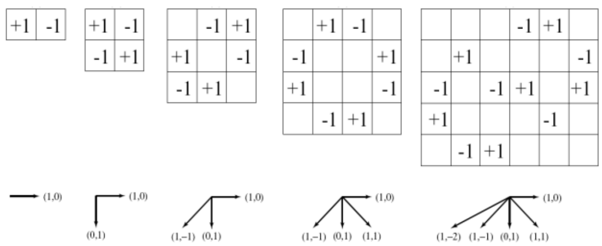

Fig.1 Depiction of Simple Discrete Ghosts in an Image[1]

B. Ghost Morphology

Ghost structures are constructed using dilations of 2- Point Structuring Elements (2PSEs). A discrete 2PSE is the rational vector [*q*, *p*] as shown in part (a) and (b) of Figure 2. Dilation by a 2PSE is the addition of the 2PSE to every point in the current structure. Equivalently, the dilation of *A* by *B* is given by the Minkowski Addition of *A* and *B* as[1]:

$$A \oplus B = \{a + b : a \in A,\ b \in B\}$$

An example of dilation is shown in Figure 2.

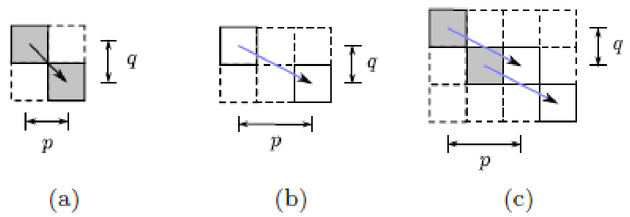

Figure 2 An example of Minkowski Addition or Morphological Dilation $\oplus$.
(a) and (b) shows 2PSEs based on the vectors [q,p] . (c) shows the construction of a parallelogram from the Minkowski Addition of (a) with (b)[1].

III. GHOST CONVOLUTION

The projections of Ghosts are zero-valued at certain finite angles $[1,m_j]$ by construction, so the 2PSEs must also be a Ghost at its finite angle, since they apply to each point in the image / structure. These then become Ghost convolution kernels[1]. An example of Ghost kernels can be seen in Fig.3.

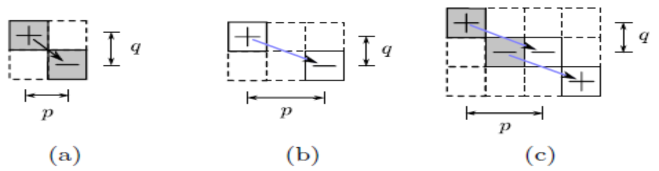

Fig. 3 An example of Ghost Kernels as an extension of Figure 2(a) and (b) shows kernels based on the vectors[1,m_j] for each of the missing projections.(c) shows the construction of a parallelogram from the 2D convolution of (a) with (b)[1].

Then the Ghost kernels can be used in an initial method to construct Finite Ghosts by computing the 2D convolution of the Ghost kernels as follows[1]:
1) Compute the DFT of the initial structure and each of the 2PSEs.
2) Multiply the coefficients of each 2PSE, together with the coefficients of the structure, in DFT
space to compute the 2D convolution.
3) Compute the inverse DFT to get the Ghosts in image space.
The resulting Ghost will be invisible for those projections at the finite angles used to construct them.

IV GHOST APPLICATION

There are many applications where we can use ghost effect in images such as Digital Watermarking, Efficacy of Image Reconstruction, Exact recovery of lost projection data (provided there is some redundancy in image data) etc.

A. Digital Watermarking

Digital Image watermarking is useful for image labeling and for security application. Below is the example showing use of ghost image in another image.

(a) (b)

Fig. 4 Use of low visibility digital objects in digital image watermarking. (a) original image, (b) image with ghost effect.

B. Image Reconstruction

Image reconstruction is widely used in field of medical imaging, radio astronomy, optical interferometry. Ghost Images can be used to check to check the efficacy of various image reconstruction algorithms. In Fig. 5 we can see how ghost appears for missing projections in (b) and in fig 5. (c), (d) we can see reconstruction using parallel beam and fan beam. Their efficacy can be check using PSNR and MSE values as shown in Table 1. For testing purpose we have use phantom image.

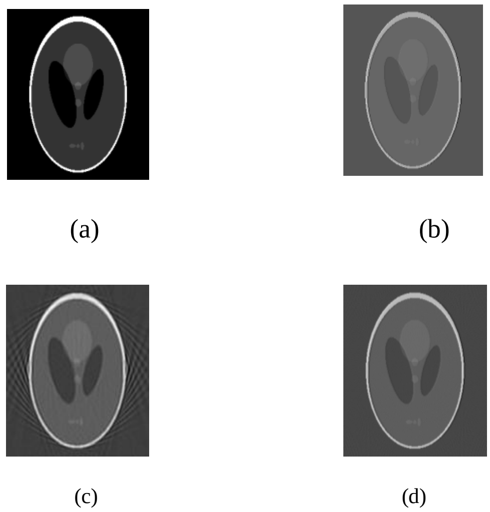

Fig.. 5 Application of ghost effect in testing efficacy of image reconstruction. (a) Original Image, (b) Image with ghost effect , (c) Image reconstruction using fan beam, (d) Image Reconstruction using parallel beam.

Table I

Comparison between Image Reconstruction

Image Reconstruction Technique	PSNR(dB)	MSE
Parallel Beam	64.0343	0.0257
Fan Beam	62.2013	0.0392

V GHOST COMPLEXITY

In ghost convolution we have seen that how we use Fourier transform to recover missing slices. We know that DCT(discrete cosine transform) has many advantages over FFT[6] thus here we have tried to use ghost convolution using DCT instead of FFT and has observed results are much better for DCT. Results are compared using PSNR and MSE values.

Table II

Comparison between Image Reconstruction Approach

Reconstruction Method(D=100, θ=1)	Base	PSNR(in dB)	MSE
Parallel Beam	FFT	64.0343	0.0257
FanBeam (arc)	FFT	62.2013	0.0392
Parallel Beam	DCT	69.2836	0.0077
Fan Beam	DCT	65.9825	0.0164

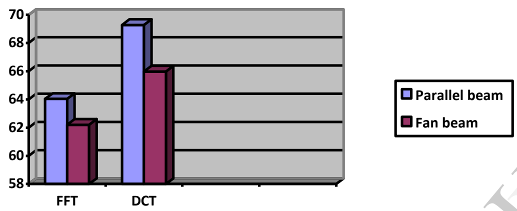

Fig. 6 Comparison of PSNR values.

VI CONCLUSION

In this paper we have studied and discussed about ghost or low visibility objects. In paper [1] author has shown ghost convolution using fourier we have discussed it using cosine transform also. We have found the topic of great importance as studied from all the eminent papers shown in refrences.

REFERENCES

[1]S.Chandra, Imants Syallbe, Jeanpierre Guedon, Andrew Kingston and N. Normand, " Recovering missing slices of the DFT using Ghosts". IEEE transactions on Image Processing, Vol. 21, No. 10, 4431-4441, 2012.

[2] Syallbe I., Chandra S. , Debled Renneson et. al (Eds.) , "Growth of Discrete Projection Ghosts created by iteration", DGCI 2011, LNCS 6607, 406-416.

[3]Shekhar Chandra, I. Svalbe and Jeanpierre Guédon, "An exact, non-iterative Mojette inversion technique utilising ghosts", Discrete Geometry for Computer Imagery, Lyon, April, 2008, Springer, LNCS volume 4992, pp. 401-412.

[4] Svalbe, I., Normand, N., Nazareth N., Chandra, S., "On constructing minimal ghosts". APRS Conference, DICTA 2010, Sydney, Australia,1-3, 2010.

[5] Svalbe, I., Normand, N., Debled-Renesson et al., "Properties of minimal ghosts" DGCI 2011, LNCS 6607, 417-428.

[6] K.R.Rao and R.Yip, "Discrete Cosine Transform-Algorithm, Advantages and Applications". Published by New York Academic Press, Edition 1990.