Reconstruction of Missing Texture based on ER Algorithm using DTWT

Chalumuri Indira PG Student, Dpt of Electronics and communication Engineering, Andhra University College of Engineering, Andhra University, Visakhapatnam.
P.V.Sridevi, Professor, Dpt of Electronics and communication Engineering, Andhra University College of Engineering, Andhra University, Visakhapatnam.

Abstract
In image processing there are many applications during the lost image reconstruction, those are image reconstruction at the lost area and for the image enlargement. This project introduces a new method for reconstructing missing textures through the Error Reduction algorithm for phase restoration iterative Fourier transform algorithms are utilized for ER. During this process the image undergoes in the problems like damage and scrapes. To overcome this problem ER algorithm using DTWT estimates the magnitude of FT and to determine the range and to monitor the noise. A new method of minimum error estimate is created and modified during the texture image renovation. The performance metrics (SSIM, MSE and PSNR) were used to evaluate the ER algorithm using dual tree wavelet transform. The experimental results were evaluated using the MATLAB tool.

Keywords: Fourier Transform, Image reconstruction, Image retrieval, Dual tree wavelet transform

1. Introduction

Digital images are needed to learn basic processing of an image in different applications.
These are damaged by nature and by some environmental factors. Those can degrade the quality of image and increase the noise (font size,text,logos). For human eye it is difficult to detect the areas which are missed and also it is difficult to find. Intermediate or high-level processing techniques that can produce erroneous results when given a degraded image as input. Reconstruction is a low-level image processing, usually characterized by image input as well as image output. For high level and medium preprocessing recovery is an important step. The process of restoration eliminates object and noise in the image which is not needed and extract the missed areas in an image. The comparison takes place in between known image areas and missed areas. The object of the process of restoration is to transform the meaning less image into a meaning full
Image, from this the missing areas are easy to identify
The textures which are missed have similar patters in the image that have been degrade by noise masking in the process of reconstruction the missed texture is removed and replaced in a meaning full way. It is an important step for processing a document and to find the information which is useful from the past. Several methods have been interduce to restore the missing texture and to relegation this application. Specifically, the procedure is segregated into reconstruction in accordance with structure and reconstruction based on texture. The method of reconstruction based on texture is limited to gray scale.
The CWT is an improvement to DWT because of the properties like invariant, selective diction in 2D. In this case, CWT offers an improvement in performance over DWT.

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2. **Reconstruction of texture by ER algorithm**

ER algorithm is coming under the algorithms of iterative Fourier transform, those are used for extraction of phase, reconstruction of the image which is applied by Fourier constraints in the method of ER algorithm using DTWT, a group of pixels are cropped from the image which is under target and the missed textures are evaluated from the recognized region. For the below explanation, the areas of unrecognized and recognized intensity in the focus area f are denoted as **Ω** and **Ω**`, respectively. The ER algorithm by DTWT uses areas of known f^i(i=1,2,...,N) cropped from the focus image at regular intervals, where N is the number of areas trimmed.

3. Proposed Methodology

Digital images are needed to learn basic processing of image applications, research too. Images in digital format are damaged due to nature, made by man (eg text writing on images, placing logos and images, etc.) or environmental factors. Lossy region studied reconstruction extensively in image processing field because, number of fundamental applications can be offered by it. Multiple methods have been proposed which focus on important visual features reconstruction like target images of structure as well as texture. Most of the methods fall into two categories roughly: reconstruction of structures missing and reconstruction of textures missing.

Note that you can easily crop the training patches from the top left corner in the grid order of the focus image. In the procedure that proposed, have to estimate the magnitude of the focus point f in Fourier Transform depends on the convergence error in the ER algorithm. There target point f is then reconstructed using ER algorithm with fourier transform variable for evaluation. It reduces the error size of FT under the limit of image area, this is named as sharpest decay algorithm. So, the error can be considered by him as e^i (i = 1, 2, ..., N) found in as the minimum distance 2 in the ER algorithm of the magnitude of the Fourier transform in the two plots f and f^i. Then the M patches are selected that which criterion e^i is smaller than in other known patches.

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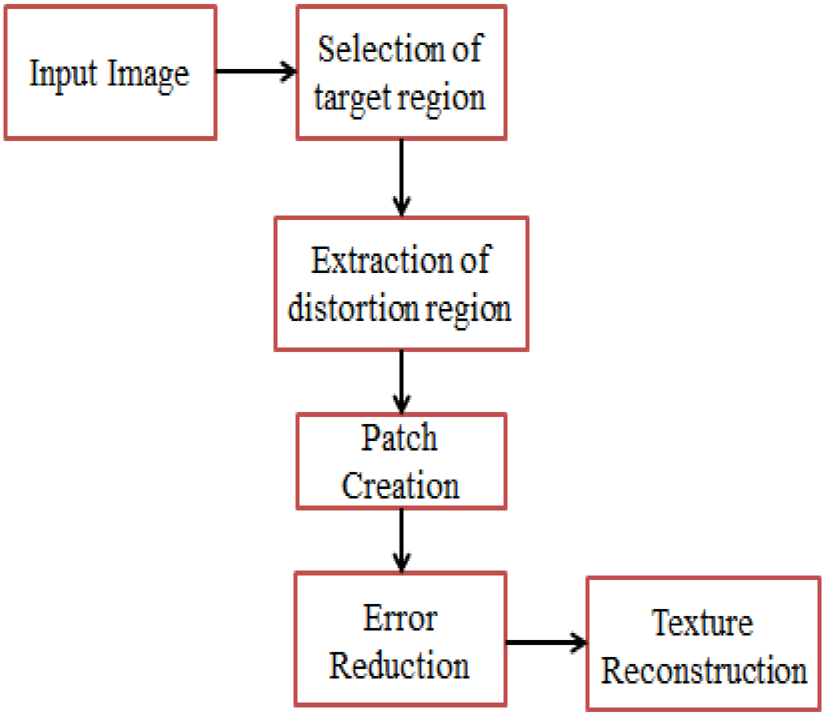

Fig1. Block Diagram of reconstruction of missing texture

Algorithm steps:

Step 1

To select a target area to delete and fill the input image is applied. The area for the source is the differences between original image and target image area, the band surround the target area, or by user

Step 2

For reconstruction of the image to select manually. The area of distortion is the difference between total image and known image. The range of distortion is patched with the same block size as known range

step 3

For reconstruction of missed texture, an ER algorithm is applied. which belongs to the iterative transformation algorithm and is mainly used for extracting phases and determine the patch with minimum errors as well as an error between patches.

Step 4

Form the equation of ER the error is determine and next task is to discover the block with its locations and less error. From this, minimized error and its position determined. The new estimation is for location finding and to reduce error as well as to restore the texture in the image with is missed.

A. Fourier Transform

Fourier transform (FT) is a mathematical transformation that breaks down a function that depends on space or time into a function that depends on space or time. The word Fourier transform suggest that frequency domain representation and the mathematical operations that relate the frequency domain representation to a function of space or time. FT divides each input into parts of frequency components.

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$$\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x) e^{-i2\pi\xi x}\, dx, \forall \xi \epsilon \mathbb{R} \qquad (1)$$

The transform of function $f(x)$ at a frequency $\boldsymbol{\xi}$ is given by a complex number $\hat{f}(\boldsymbol{\xi})$

B. Dual Tree Complex Wavelet Transform

The problem of offset spreading and low directional selectivity in 2D and those commonly encountered in DWT are solved by DTCWT. For texture sorting and content-based image capture are the applications which are used by the proposed method. By using 2 different DWT decompositions computes the complex transformation by using DTCWT. In DWT, the real and imaginary coefficient will produce when the filter is specially designed.

The Fourier transform of the focus region or deform region is given as,

$$G_m(u,v) = R\{G(u,v)\} + jI\{G(u,v)\} = F\{g(x,y)\} \qquad (2)$$

In polar co-ordinates the above mention equation can be represented as,

$$G_m(u,v) = |G_m(u,v)| e^{j\emptyset_d(u,v)} \qquad (3)$$

Where, $|G_m(u,v)|$ and $\emptyset_m(u,v)$ are the magnitude and phase of fourier transform of the target region respectively.

The magnitude of the Fourier transform of recognized region is given by,

$$|F(u,v)| = \sqrt{R^2[F(u,v)] + I^2[F(u,v)]} \qquad (4)$$

Where, $(u,)$ is Fourier transform of known region, R[F(u,v)] is real part of the Fourier transform of recognized region and I[F(u,v)] is Imaginary part of the Fourier transform of recognized region.

C. Estimation of DTWT

A dual-tree CWT uses two real DWTs; The first DWT shows the real part of the transformation while the second DWT shows the imaginary part. Two true wavelet transforms use two different filter sets, each of which satisfies the perfect reconstruction (PR) condition for missing texture analysis. The two filter sets are designed together so that the overall transformation is close to analytic. Let *h0(n), h1(n)* be the low pass/high pass filter pair for the top filter set (FB) and *g0(n), g1(n)* be the low pass/high pass filter pair for the bottom FB. We will express the two real wavelets linked with each of the two real wavelet transforms as *h(t)* and *g(t).* In addition to satisfying the PR condition, the filter is designed in such a way that the complex wavelet *(t) := h(t) + jψg(t)* is approximated analytically. Thus, they are designed so that g(t) approximates the Hilbert transformation of *h(t)* [denoted as *g(t) H{ψh(t)}].*

If two real DWTs are represented by square matrices F_h and F_g,, the CWT multiple trees can be written by a rectangular matrix,

$$F = \begin{bmatrix} F_h \\ F_g \end{bmatrix} \qquad (5)$$

If the vector **x** represents a real signal, then $w_h = F_h x$ represents the real part and $w_g = F_g x$ represents the imaginary part of the dual-tree CWT.

D. Pixel-wise comparison or image constraint

The New rankings will be found in two ways. They are pixel-by-pixel comparisons and image constraints. They will be as follows: Pixel-by-pixel comparison: This approach calculates the average for the inverse Fourier transform estimate of the combined block, denoted $g''_m(\mathrm{x,y})$.The new calculated image $g_{m+1}$is given by

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$$g_{m+1}(x,y) = \begin{cases} g''_m(x,y); & if\ g_m(x,y) > thrld \\ g_m(x,y); & otherwise \end{cases} \quad (6)$$

Image constraint: In this approach, a new evaluation image g_{m+1} is given by

$$g_{m+1}(x,y) = \begin{cases} g'_m(x,y); & (x,y) \in D \\ g_m(x,y); & (x,y) \notin D \end{cases} \quad (7)$$

Where D is the set of pixels (x,y) present in the measured area of the focus image.
New estimates are formed based on the recognized and unrecognized areas of the focus image. This is given as follows:

$$g_{m+1}(x,y) = \begin{cases} g'_m(x,y); & (x,y) \in \Omega \\ g_m(x,y); & (x,y) \in \bar{\Omega} \end{cases} \quad (8)$$

Where and are respectively the missing area and the other areas that have the initial missing intensity. The error reduction algorithm is used to reconstruction the focus image by iteratively processing the above steps.

E. Error Reduction

After finding the estimation, the next step will be the ER equation. The errors between the evaluation in the error reduction algorithm will be found using this ER equation and is calculated as follows:

$$E_m^i = \sum_{x=1}^{w} \sum_{y=1}^{h} \{g_{m+1}(x,y) - g''_m(x,y)\}^2 \quad (9)$$

Also, we declare E_{T1}^i obtained after iteration T1 as E^i. It is shown that $E^i (= E_{T1}^i)$, which converges after 1 iteration, is the smallest sum of the squared errors of intensity between the image that satisfies the Fourier constraint and the image satisfies the image constraint. This algorithm was developed by Ogawa in 2012.

F. Texture Reconstruction

$$\hat{F}_{m+1}(u,v) = |\hat{F}_m(u,v)| + \beta\{|F_m(u,v)| - |\hat{F}_m(u,v| \quad (10)$$

After getting the error from the ER equation, the next step is to find the block with the minimal error and its position. This function is used to find the minimal error and its position is min(E). This is denoted as $\bar{F}_m(u,v)$. The recently developed estimation is formed after finding the position that has the minimal error to restore the misplaced texture in the image. This is calculated as follows:
The image format can be formed by using blocks, which are estimated and in the original image the deform patch is reconstructed.

4. Results and discussion

This section describes the experimental results of the test images. Three types of bugs with changing complication based on warp block dimensions. If the warp block dimensions vary from 10 to 17, this is

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considered a minor bug. If the amount of distortion varies between 18 and 25, it is considered a mild error. If the warp block dimensions vary between 26 and 40, it is considered a major bug.

For showing the experimental results here 3 cases are considered.

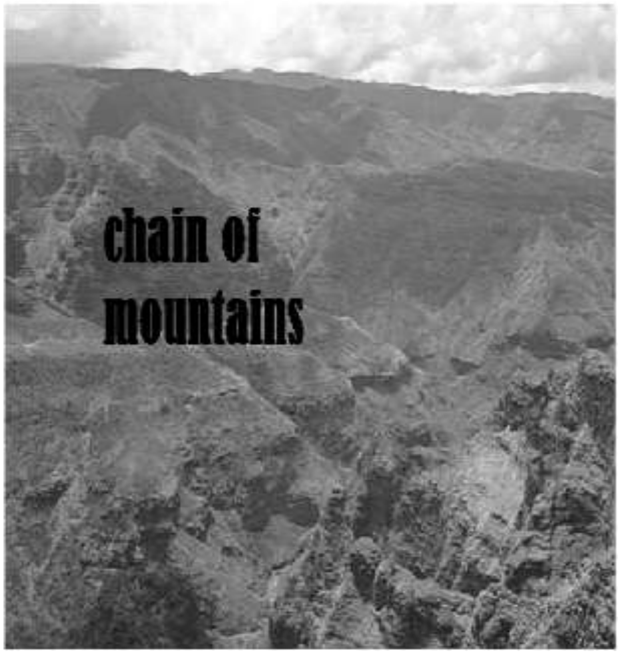

Fig 1: Input masked Image

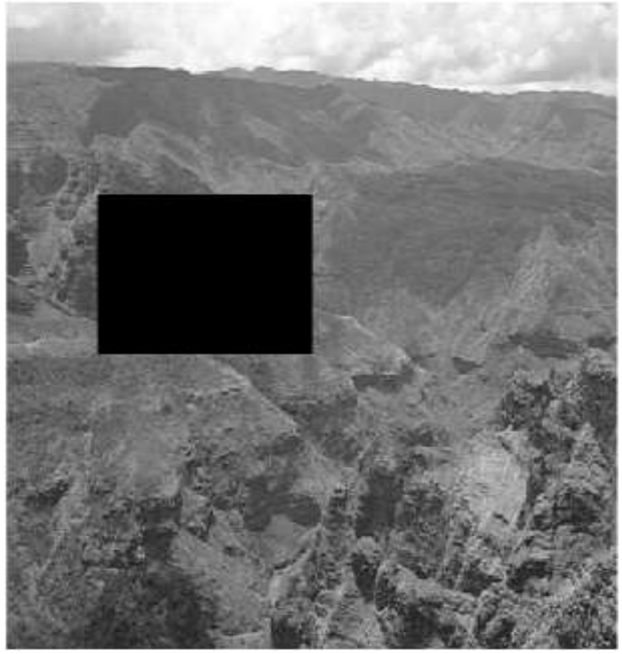

Fig 2: Distorted Image

For the given input image, the reconstructed images using two techniques one is DFT and other is DTWT is shown on fig 3 and fig 4.

Fig 3 Reconstructed Image using DFT

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Fig 4 Reconstructed image using DTWT

Performance evaluation

The performance metric calculation for the image augmentation is done based on MSE, PSNR, and SSIM. MSE is nothing but mean square error, it is the comparison between the original and estimated values.

MSE = 1/N $\sum_{i=1}^{N}(y1 - y2)$ ^2

PSNR is nothing but a top most signal to noise, it is the ratio of signal to noise

The Structural Similarity Index (SSIM) is a metric, it measures the quality degradation of an image

Table1. Comparison of performance metrics

Parameter	SSIM		MSE		PSNR	
	DFT	**Proposed DTWT**	DFT	**Proposed DTWT**	DFT	**Proposed DTWT**
Case1	0.984212	**0.991837**	5.503181	**3.839571**	35.673396	**39.607105**
Case2	0.989439	**0.993317**	2.177456	**0.566024**	41.563822	**47.267546**
Case3	0.990358	**0.991196**	2.456467	**1.580240**	41.080759	**42.258542**

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5. Conclusion

In this summary, based on the Error Reduction algorithm the missed texture is reconstructed and incorporating a multiple tree wavelet transform is estimated and presented. The misplaced texture reconstruction method based on ER algorithm uses the number of multiple tree wavelet transforms as texture features and allows the missing textures to be reconstructed by extracting some phases using ER algorithm. From this ER algorithm, the collected errors are used to reintroduce the DTWT magnitude. This process is used for the reconstruction of missing areas by to estimating the accurate feature of the texture and it is better than Fourier transform. Reconstruction of new missing textures using the ER algorithm in conjunction with DTWT was designed. The images which are tested are reconstructed with different complexity levels. The parameters such as SSIM, MSE and PSNR are used to measure the operation of the reconstructed image.

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