

Image Mapping and Object Removal Using Haar Wavelet Transform in Image Inpainting

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Abstract: Image inpainting or restoration is one of the techniques which are being used from medieval times. Wavelets have shown significant performance in the process of image inpainting. But there are many wavelets available which can be used. In this paper we will evaluate the performance of Haar wavelet in image inpainting. Its performance will also be compared with some other wavelets using different cracked images.

Keywords: Haar, Image inpainting, Multiresolution, Texture, Wavelet

1. Introduction

The aim of image inpainting is to restore an image such that a viewer cannot detect the restored parts. One application of image inpainting is to retouch damaged parts of a digital picture. Nowadays, the image Inpainting technology is a hotspot in computer graphics. It has important value in edge preservation, film restoration and to add special effects in movies, removing redundant objects etc. In the fine art museums, this Inpainting concept is used for degraded paintings. Conventionally Inpainting is carried out by professional artist and usually its very time consuming process because it was the manual process. The main goal of this process is to reconstruct damaged parts or missing parts of image. And this process reconstructs image in such a way that the inpainted region cannot be detected by a casual observer. The filling-in of missing region in an image is known as Image Inpainting. Inpainting is the art of modifying an image or video in a form that is not easily detectable by an ordinary observer. Image Inpainting has become a fundamental area of research in image processing. The reconstruction of images in a way that is non-detectable for an observer who does not know the original image is a practice as old as artistic creation itself. This practice is called 'retouching' or 'Inpainting'. Also image Inpainting has been widely investigated in the applications of digital effect (i.e. object removal, image editing, image resizing), image restoration (e.g. Scratch or text removal in photograph), image coding and transmission (e.g. recovery of missing blocks) etc.



Figure 1: Removing large objects from image

Fig. 1 shows an example of this task, where the foreground person (manually selected as the target region) is automatically replaced by data sampled from remainder of the image. The process of Inpainting can be graphically represented as shown in fig.2. The input to the algorithm is

an image to be inpainted i.e. original image. The user selects the region to be inpainted i.e. the target region. Then the algorithm proceeds filling the target region. The output is an reconstructed or inpainted image. The conventional techniques that are proposed for image inpainting can be divided into two categories:

1) Texture oriented 2) Structure oriented.

These two techniques are used to inpaint different Damaged images. But the results were not satisfactory. Though the techniques of texture synthesis are effective, they have difficulty in filling holes in photographs of real world scenes consisting of composite textures. On the other hand structure based technique had the drawback that they introduce some blur, which becomes noticeable when filling larger regions. Thus Marcelo Bertalimo[4,5] introduced implementation of wavelet transform for the image inpainting process. Wavelet transform has been used for various image analysis problems due to its nice multi-resolution properties and decoupling characteristics.

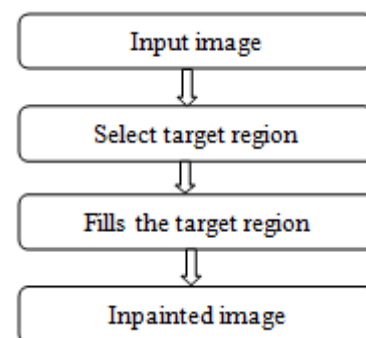


Figure 2: basic block diagram of inpainting process

For the wavelet transform, the coefficients at the coarse level i.e., approximate coefficients represent a larger time interval but a narrower band of frequencies. This feature of the wavelet transform is very important for image coding. The target region (damaged or lost data or object to be removed) information of the image can be divided into two kinds of regions. The first region, the distribution of the target information of the image is the local and concentration. So the decision method of the image repair can depend on the characteristic and direction of the neighbouring textures to decide. The second regions, the distribute of the image target part is global and dispersion.

Therefore when the data a great deal of creation lost, we can't clearly repair the repair image through the consult data of the neighbouring district. To solve the problem, we use the human vision characteristic which makes the basis of the repair. When the reference data is very minimum to repair the image, we zooming out the distorted image and then observe the image shape. In image processing , down-sampling method is used to reach the visual effect. Wavelet transform has been used for various image analysis problems due to its nice multi-resolution properties and decoupling characteristics. The proposed algorithm uses the plus points of wavelet transforms for image inpainting. Wavelet transform has been used as a good image representation and analysis tool mainly due to its multiresolution analysis, data reparability, compaction and sparsity features in addition to statistical properties [12]. A wavelet is a small wave like oscillations which begins with zero, increasing and then decreases back to zero. The wavelet contains both the irregular shape and the compactly supported.

2. Haar Wavelet

The Haar wavelet transform is a type of discrete wavelet transform. In mathematics, the Haar wavelet is a sequence of rescaled "square-shaped" functions which together form a wavelet family or basis. Wavelet analysis is similar to Fourier analysis in that it allows a target function over an interval to be represented in terms of an orthonormal function basis. The Haar sequence was proposed in 1909 by Alfrd Haar. The haar transform can be expressed in the following matrix form

T=HFH

Where F is the n*n image matrix, H is the Haar transformation matrix and T is the n*n resulting matrix. This is equation for symmetric and separable form of matrix.

The Haar wavelet's mother wavelet function $\psi(t)$ can be described as

$$\psi(t) = \begin{cases} 1 & 0 \leq t < 1/2, \\ -1 & 1/2 \leq t < 1, \\ 0 & \text{otherwise.} \end{cases}$$

Its scaling function $\phi(t)$ can be described as

$$\phi(t) = \begin{cases} 1 & 0 \leq t < 1, \\ 0 & \text{otherwise.} \end{cases}$$

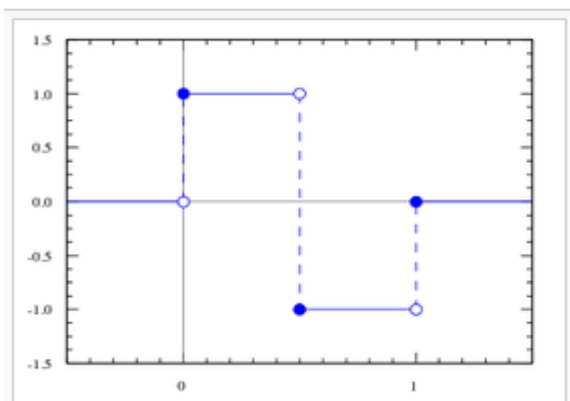


Figure 3: Haar Wavelet

3. Simulation Result

In simulation result we have performed image inpainting on various images. We have used different wavelets for the image decomposition. Some of the wavelets used are Haar, Coiflet, Bior4, Bior2, Db4, Db2 etc. Different wavelets have shown variation in the parameters of image inpainting.



Figure 4: Distorted Images on the left side along with Inpainted Images on the right side



Figure 5: Distorted Images on the left side along with Inpainted Images on the right side



Figure 6: Distorted Images on the left side along with Inpainted Images on the right side



Figure 7: Distorted Images on the left side along with Inpainted Images on the right side

4. Conclusion

The filling-in method is applied to several different types of datasets of missing blocks images. In this paper we have analysed discrete wavelet transforms for image inpainting. Different distorted images were taken and each image was inpainted using Haar wavelet. Thus we can conclude that Haar wavelet has performed better, for image inpainting, then other wavelets. the results generated by our proposed

method clearly illustrates superior image inpainting that other present image inpainting methods

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