

Image Zooming Using Wavelet Transform

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Abstract: Enlargement and reduction of images is very important application. The proposed idea in this article to image zoom is depend on merging between traditional method (insert zeros) and wavelet transform. Using wavelet transform in image zooming give satisfactory results because it is preserving the edge information that always important for human vision.

Keywords: Zoom, Wavelet transform, Interpolation, DWT, noise, Daubechies family

1 Introduction

image over-sampling/sub-sampling is often required in applications such as satellite imaging, medical imaging, digital photography, multimedia etc. Over-sampling facilitates image interpretation, better visualization, etc. whereas sub-sampling facilitates fitting of large images into smaller display area, creating icons etc.

Zooming of images can be accomplished with interpolation where the procedure is to fit the image data with a continuous model and then re-sample the function on the grid appropriate to the scaling desired.[2]

Interpolation is the process of estimating the values of a continuous function from discrete samples. Interpolation is used extensively in digital image processing to magnify images and correct spatial distortions. Tows of the simplest approximations of the ideal interpolation function are related to the nearest-neighbor interpolation and the bilinear interpolation.

Both methods provide the interpolation function with a very small computation time, but they will cause conspicuous blocking artifacts.

The cubic interpolation algorithms can reduce the blocking effects, but it always blurred the reconstructed image and produced some ringing effects in the edge regions [1]. Zooming with interpolation results in information loss especially in sub-

sampling. Usually information loss is minimized by performing low pass filtering prior to resampling[2]. With the rapid increase in available computing power, the nonlinear techniques for image interpolation have received increasing attention recently. Because the characteristics of the edges in a digital image can be reserved for many scales of resolution and the edges are always important for human vision, most of the nonlinear interpolation algorithms tend to focus on the edge information[1].

Our interest is the zooming of image using wavelet[3]. Transformations such as DCT and wavelets, which are widely used for image compression, can also be used for zooming [2].

2 Wavelet transformation

The wavelet transform has been identified as an effective tool for time-frequency representation of signals. It can decompose a digital image into some frequency sub-images, each represented with proportional frequency resolution. The resulting band-pass representation provides that the solution space of many image-processing problems can be decomposed into its lower frequency subspace and higher frequency subspaces[1]. Each stage of the discrete wavelet transform (DWT) procedure, the image is decomposed into four quarter-sized images (by applying filter). The first quarter contains average information of the image

(low frequency sub-band) and the other three quarters details (high frequency subbands).

The first quarter is again decomposed into four and so on. The scheme is shown in Fig. 1.[2]

The four sub-image in first scale represented by the approximation coefficients(CA1),the horizontal detail coefficients (CH1),the vertical detail coefficients(CD1)and the diagonal detail efficients(CV1).The second and next scale of WT decomposition is available from the approximation coefficients CA1 and from the next CAi. The approximation coefficients contain information about lower frequency components of the image while the detail coefficients represent information about high frequency components in three directions at one scale [3].

Ca1	Ch1	Cd1	Cv1
ca1	ch1		
Cd1		Cv1	

Fig.1
The wavelet coefficients at three scales

3 The method

We selected daub4 (moment = 4), an orthonormal wavelet from Daubechies family having compact support, for wavelet transformation.

Wavelet zooming is based on the fact that 3/4th of a transformed matrix contains details and an image can be reconstructed using 1/4th of the matrix (average) ignoring details.

In this article we proposed two methods to image zoom the first one is by combining the traditional method (insert zeros) and wavelet transform. Inserting a rows and columns of zeros between a rows and columns of original image can be enlarging the image. But the resulted image suffer from blurring because of the inserted zeros Fig. 2 (a,b)(256 color Bitmap)show that. So,

the role of wavelet is the noise removal that caused by inserted zeros.

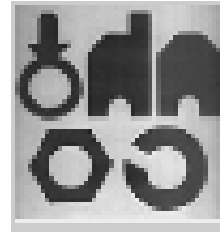


Fig.2 a
Original image(50*50)



Fig.2 b
Resize image (100*100)

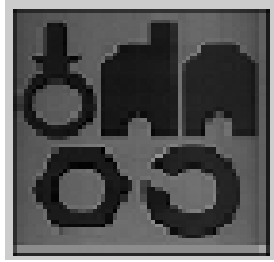
Because the noise is small values is dominant for high frequencies and its effects can be reduced using some kind of low pass filter. Therefore the noise is can be in the details bands of image.

One step in the wavelet transform calculates a low pass (scaling function) result and a high pass (wavelet function) result. The low pass result is a smoother version of the original signal (the average, in the case of the Haar wavelet). The low pass result recursively becomes the input to the next wavelet step.The wavelet packet transform(DWPT) applies the transform step to both the low pass and the high pass result. The wavelet transform is a good tool to separate the low frequencies from high frequencies which is can be in it noise.

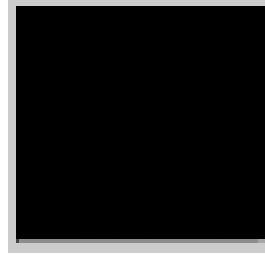
In this paper DWT has been used instead of DWPT because it no benefit of transform the high frequencies that contain the a noise. The following figure show the DWT of resize image (Fig 1)for one level.

When cancel the details of sub images (Ch1,Cd1,Cv1) and take inverse discrete wavelet transform (*IDWT*) for only ca1 and by proceeding enhancements (increase the intensity) on image can be the resulted image as Fig 4. The second method is by coping

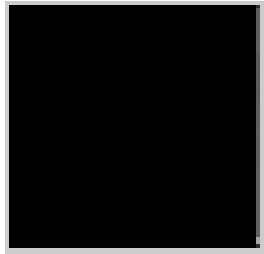
the original image in top left corner of sub images of Fig1 (Ca1) and full the remaining of sub images (Ch1,Cd1,Cv1) with zeros. Then take the (*IDWT*) for these sub images to get Fig 5.



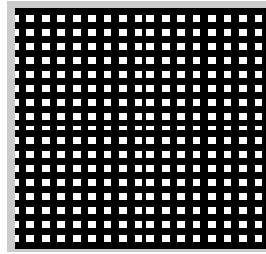
Ca1



Ch1



Cd1



Cv1

Fig 3



Fig. 4



Fig.5

References

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