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High Dynamic Range Image Compression Using Hierarchy Approach

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***Abstract*— Digitized photographs are becoming increasingly important in computer graphics.This paper presents high dynamic range image compression using subband architecture. The real world is high dynamic range and most of the images are captured using digital sensors like camera etc. These digital sensors have high dynamic range but there is no easy way to display them. So we have developed the technique to compress the image without loss of image visual information. In this algorithm we have used Analysis-Synthesis filter bank architecture and applying gain control to these sub band without introducing the halos.**

***Keywords*— high dynamic range, range compression, suband, convolution.**

I. Introduction

Natural scenes always contain high dynamic range areas in comparison with the limited dynamic range capabilities of cameras or displays. The dynamic range is defined as the ratio between the maximum and minimum light intensities of the scene. The digital sensor such as digital photography, computer graphics, and medical imaging have limited dynamic range[1-2]. The dynamic range is one of the important criteria for evaluating image quality, especially in devices supporting high resolution images. Images and display devices supporting high dynamic range are attractive to producers and customer of today. Various technique have been proposed for compressing the dynamic range while retaining important visual information[3-5].Some of the display devices has high dynamic range so even if they have high dynamic range they are not able to display the image effectively.So in our project we capture the image in the display system and now we compress the high dynamic range image so that image can be displayed effectively without loss of information.For example a 12-bit image is converted into 8-bit image without loss of information and without introducing the halo artifacts.

II. Related Work

The recent literature on HDR range compression has been extensively reviewed by others[6] and we refer the reader to these sources. The image i(x,y), is simply mapped to a modified image, I'(x,y)=p(I(x,y)), where p() is a compression function such as a power function.The image L(x,y) is a product of two images: an illumination image I(x,y) and a reflectance image, R(x,y).There are various approach to compress the high dynamic range to display the image effectively and one approach is gradient domain high dynamic range. This method is simple,computationally,efficient,robust and easy to use.Observing the drastic changes in luminance across an HDR image give rise to luminance gradients of large magnitude. The method is to manipulate the gradient field of the luminance image by attenuating the magnitudes of large magnitudes. A new low dynamic range is then obtained by solving a poisson equation on the modified gradient field. The one more approach is global edge preserving multiscale decomposition for high dynamic range. In this method image is taken for multiple times and these images are fused to obtain image which has always the dynamic range displays. After that mapping is used to compress the dynamic range[7].The compression is based on the feature of the Human Visual System that is less sensitive to the low frequency components than to the high frequency components.

The low frequency component are compressed while retaining the high frequency component.

III. Proposed Method

Inorder to compress the high dynamic range image without the loss of information we use the method of analysis filter bank and local gain control to the subband.

3.1 Analysis - Synthesis Filter

There are many ways of building subband systems for decomposing and reconstructing images.

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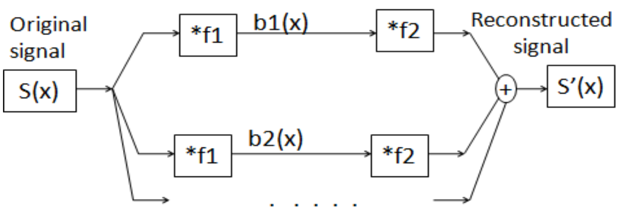
Consider the analysis-synthesis subband system is shown in fig(a). A signal, s(x), is decomposed into a set of bandpass signals, b1(x),b2(x),... with filters f1, f2,... chosen so that the original signal can be reconstructed by directly summing these bandpass signals:

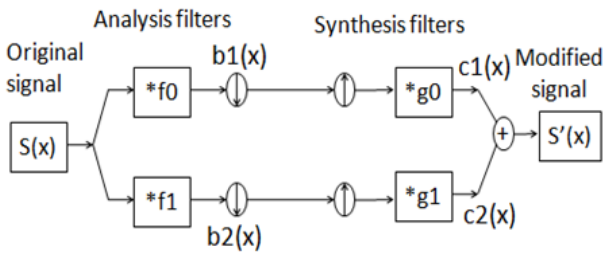
$$S(x)=\Sigma b_n(x)$$

A nonlinearity, labelled "NL", can be imposed on the bandpass signals before summation.



(a) A subband system without synthesis filtering.

An analysis -synthesis subband system with a set of signals is shown in fig(b) in which one set of filters, f1, f2,..., called the analysis filter bank, is used to split the signal s(x) into subbands b1(x),b2(x),... and then another set of filters, g1,g2,..., called the synthesis filter bank.The result from analysis filter is applied to the synthesis filter bank and it produces signals c1(x),c2(x),... These post filtered sub band signals c1(x),c2(x),... are summed to reconstruct the original signal s(x). Nonlinear distortions generally produce frequencies outside the original sub band, and these will tend to be removed by the corresponding synthesis filter. The signal is forced into its proper frequency band before summation, which reduces distortion.



(b) A two-subband system with subsampling

The analysis-synthesis filter bank is said to be symmetrical because the synthesis filter are tuned to the same frequency band as analysis filter.Hence it will be effective in controlling the nonlinear distortion.This analysis -synthesis sub band are often implemented with hierarchical sub sampling leading to pyramid and In this sub band architecture we use filter which consists of a lowpass filter f0 = [1,1] and a high pass filter f1 = [−1,1]. An input signal s(x) is split into a low band and a high band by convolution with f0 and f1. The filter outputs are subsampled by a factor of two, meaning that every other sample is dropped and we use qmf filter. For example if the input has N samples each sub band will have N/2 samples. The sub bands are now up sampled by a factor of two by padding a zero between each sample. Each of these zero-padded subband signals is convolved with a second filter, which is g0 = [1,1] for the low band and g1 = [1,−1] for the high band. . These signals are summed, and the original signal is reconstructed exactly.The process is iterated with with band sampling, up sampling, down sampling leading to construction of the qmf pyramid so, in each stage the number of samples reduces to half.The effective spatial scale of the corresponding high pass filter doubles, and the effective peak spatial frequency halves. This process can be applied separably in the x and y directions in 2-D leading to three high pass filters and one low pass filter at each stage, with a subsampling by a factor of 2 in each dimension.Since the number of samples falls by half in each dimension at each level the sub sampled pyramids are highly efficient in terms of computation and representation, The sub sampling can lead to problems with aliasing. To avoid aliasing we apply gain control to the sub sampled pyramid which will give better results. The distortion can be reduced by modifying the way that signal strength is reduced.

3.2 Smooth Gain Control

It is the method used to reduce the distortion which has produced in the subband architecture by varying the gain of the signal. The gain is high for low values and gain is low for high values.

The gain can be expressed as:

$$G(x)=b'(x)/b(x)$$

where,

G(x)=gain of the signal,
b'(x)=compressed signal,
b(x)=original signal.

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To prevent the rapid variation in gain, we can simply compute a new gain signal and forces it to be smooth.If the gain varies more slowly than the subband signal itself, then there will be reduced distortion hence the use of smooth gain map leads to a major reduction in artifacts.

IV. RESULT ON RANGE COMPRESSION

We have successfully applied this algorithm to a number of high dynamic range images by compressing the high dynamic range images without introducing the halo artifacts and without loosing visual information. Initially we capture images with high dynamic range but there is loss of visual information in these images so by applying our algorithm to these images we have obtained the compressed images with good quality of image. We have shown the obtained results and the fig1(a) is the input HDR image and fig1(b) is the compressed output image .The another example is shown in fig2(a) the input image and fig2(b) is the output image.

fig2(a) the input HDR image

fig1(a) the input HDR image

fig1(b) the compressed output image

fig2(b) the compressed output image

V. CONCLUSION

This paper has focused on the subband architecture based on the analysis-synthesis subband architectures and smooth gain control ,gives good range of compression without disturbing halos.By using these method we compressed the image without loss of information.Multiscale techniques sometimes have the reputation of causing the halos so,we have overcome the reputation of halos in this method and it has been successfully implemented.

REFERENCES

[1] Mitsunaga, t., and Nayar, s. k., 2000. high dynamic range imaging: spatially varying pixel exposures. in ieee cvpr, 472-479.

[2] Ward, g., and Simmons, m. 2004. Subband encoding of high dynamic range imagery. In APGV ’04: Proceedings of the 1st Symposium on Applied perception in graphics and visualization, ACM Press, 83–90.

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[3] P. Debevec and J. Malik, "Recovering high dynamic range radiance maps from photographs", Proc. SIGGRAPH, Los Angeles, CA, Aug. 1997, pp. 369–378.

[4] E. Reinhard, G. Ward, P. Debevec, and S. Pattanaik, High Dynamic Range Imaging: Acquisition, Display, and Image Based Lighting, Morgan Kaufmann, San Francisco, CA, 2006.

[5] K. Jacobs, C. Loscos, and G. Ward, "Automatic high dynamic range image generation for dynamic scenes", IEEE Computer Graphics and Applications, Vol. 28, No. 2, Mar. 2008, pp. 84–93.

[6] DiCarlo, J.M. and Wandell, B.A., May (2000) "Rendering high dynamic range images," Proc. SPIE, Vol. 3965, Pp. 392– 401.

[7] Tumblin, j., and Turk, G. 1999. Lcis: A boundary hierarchy for detail-preserving contrast reduction. In Proceedings of SIGGRAPH 99, Computer Graphics Proceedings, Annual Conference Series, 83–90.

[8] Reinhard, E. Stark, M.M. Shirley, P. and Ferwerda, J.A., "Photographic tone reproduction for digital images," in Proc. SIGGRAPH, 2002, Pp. 267–276.

[9] Larson, g. w., Rushmeier, h., and Piatko, c. 1997. A visibility matching tone reproduction operator for high dynamic range scenes. IEEE Transactions on Visualization and Computer Graphics 3, 4, 291–306.

[10] Mallat, S. 1998. A Wavelet Tour of Signal Processing. New York: Academic.

[11] Mann, s., and Picard, R. 1995. Being 'undigital' with digital cameras: Extending dynamic range by combining differently exposed pictures. In IS&T's 48th annual conference, 422–428.

[12] Nakazawa, Masayuki, Tsuchino, and Hisanori, 1995. Method of compress- ing a dynamic range for a radiation image. United States Patent 5,471,987.

[13] Pattanaik, s. n., Ferwerda, j. a., Fairchild, m. d., and Greenberg, d. p. 1998. A multiscale model of adaptation and spatial vision for realistic image dis- play. In Proceedings of SIGGRAPH 98, Computer Graphics Proceedings, Annual Conference Series, 287–298.