A Study on Image Enhancement and Resolution through fused approach of Guided Filter and high-resolution Filter

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Abstract: *In this paper we will present approach or technique for the "Guided Image Filtering and High Resolution filtering". A lot of methods are available for Guided Image Filtering like Edge preserving Filtering, Gradient Preserving Filtering, Extension to color filtering, Structured Transferring Filtering, Median Filtering, Bilateral Filtering etc. The guided filter can perform edge-preserving smoothing operator like the popular bilateral filter. The guided filter generates the filtering output having the content of a guidance image which can be the input image itself or another different image. The guided filter has a fast and non-approximate linear-time algorithm whose computational complexity is independent of the filtering kernel size. This method shows outstanding performance in terms of classification accuracy and computational efficiency. Edge-preserving image smoothing has valuable tool for a variety of application such as denoising, tone mapping, non-photorealistic rendering in computer graphics and image processing. Edge-Preserving filters and guided image filtering algorithms are based in terms of quality measurement parameters like PSNR and SSIM.*

Keywords: Edge preserving Filtering, Gradient Preserving Filtering, Extension to color filtering, Structured Transferring Filtering, Median Filtering, Bilateral Filtering.

1. Introduction

Most application in computer vision and computer graphics involves the concept of image filtering to reduce noise and to extract useful image structures. Simple explicit linear translation-invariant (LTI) filters like Gaussian filter, Laplacian filter and Sobel filter are widely used in image blurring/sharpening, edge detection, and feature extraction. LTI filtering includes the process of solving a Poisson Equation such as in high dynamic range (HDR) compression, image stitching and image matting. Image processing involves many operations such as image enhancement, segmentation, image restoration. To perform these operations, filtering is the most fundamental and important process. A filtering function applied to the values of the input image in a predefined neighborhood of the given location gives the filtered image in the same location. The linear translation invariant (LTI) filters, like the Mean filter, Laplacian filter, Sobel filter are used mostly for blurring, sharpening, noise removal, image enhancement, etc. The LTI filtering methods are applied in the spatial domain. The guided filter has better gradient preserving property than bilateral filter. As the guided filter is local linear function of the guidance image structure transference from the guidance image to the filtering output is also allowed. With these features, the guided filter stands the novel and efficient filtering operation.

Linear translation invariant (LTI) filters have been widely used in image restoration, blurring/sharpening, edge detection, feature extraction, etc. LTI filtering includes the method of solving Poisson's equation such as in HDR compression, image matting and image stitching, These kernels included in LTI filters are spatially invariant and does not depend on the image content.
One way to achieve this purpose is to optimize a quadratic function which enforces some constraints on the unknown output with the help of guidance image where the guidance image may be the filter's input itself or another image. Thus a large sparse matrix encoded with the information involved in the guidance image is solved. Another method is to explicit build the guidance image into the filter kernels. Bilateral filter is the most popular one of such filters. In this paper a novel explicit image filter called Guided filter which overcome the gradient reversal artifacts are used.

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2. Methodologies

In the existing approach the original image is cropped and then segmented into exemplar based approach. The reconstructed image is then formed.

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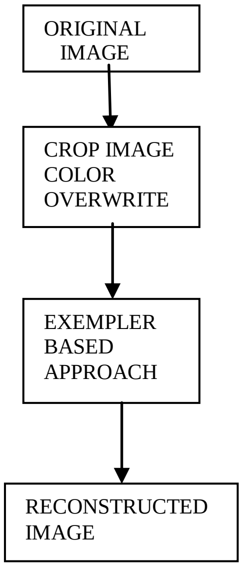


Figure1. Existing Approach

In the proposed approach the original image is cropped and then passed through the guided filter. After then it is passed through the high super resolution filter and then final image is formed.

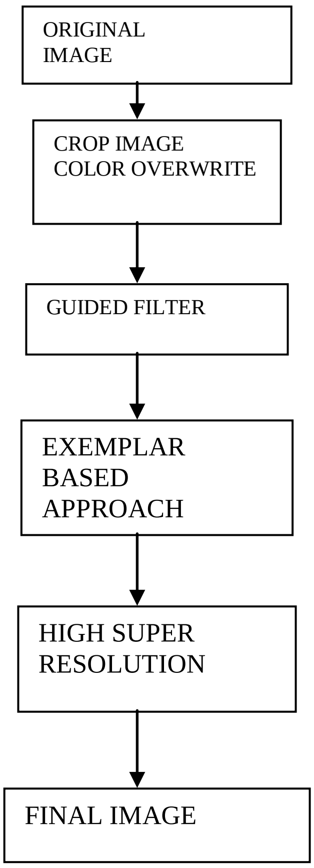


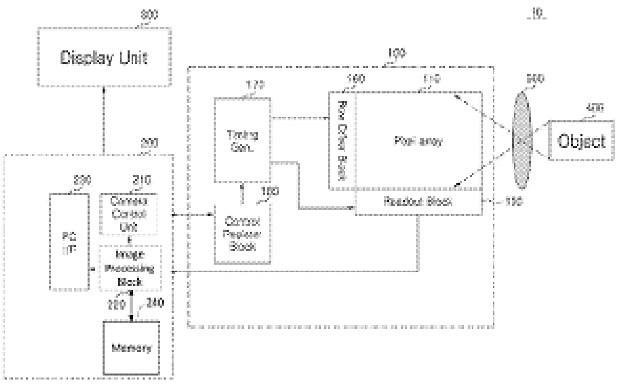
Figure2. Proposed Approach

The various Guided Image Filtering Techniques can be described as follows:

2.1. Edge Preserving Filtering

In image processing, images are often decomposed into a smooth base layer and one or more detail layers. The base layer describes intensity variations of image which is obtained by applying the filter on image. The difference between the original image and the base layer gives the detail layer. According to requirement of application, the layers may be processed with various approaches to get desired result. The base layer output is the blurred input image. Edge preserving decompositions can be used in various image processing such as detail enhancement, HDR compression, details fusion, etc. In image enhancement operation the base layer and the detail layer are processed in various ways and recombined. The quality of images for human viewing is improved by enhancement process. The guided filter has various set of parameters. It has edge smoothing property. The guided filter has various set of parameters.

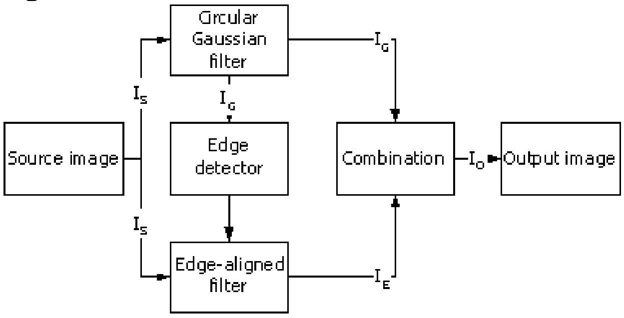
Figure3.



2.2 Gradient-Preserving Filtering

The guided filter has edge-preserving smoothing operator like the bilateral filter. It avoids the gradient reversal artifact that may appear in detail enhancement and HDR compression. A brief introduction to the detail enhancement of the algorithm is as follows. Given the input signal denoted by p, its edge-preserving smoothed output is used as a base layer q. The difference between the input signal and the base layer is described as the detail layer d= p _ q. The enhanced signal is the combination of the boosted detail layer and base layer

Figure4.



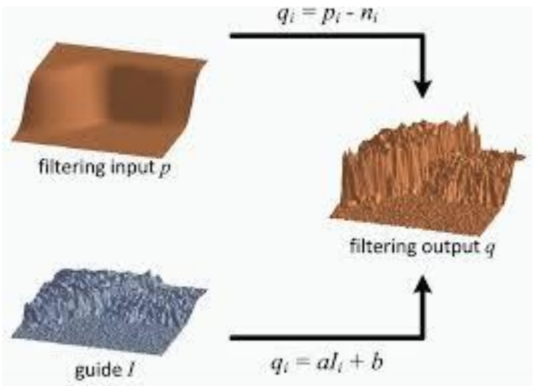
2.3 Extension to Color Filtering

The guided filter can easily be used to color images. In case when the filtering input p is multichannel, it can be applied to the filter of each channel independently. A color guidance image helps in preserving the edges that cannot be used in gray-scale bilateral filtering. A color guidance images are essential in the matting/feathering and dehazing applications, as we show later the local linear model is more likely valid in the RGB color space than in gray-scale.

2.4 Structure-Transferring Filtering

The guided filter is not simply a smoothing filter but it be used as the local linear model, the output q is used as scaling of the guidance I. This makes possible to transfer structure from the guidance I to the output q even if the filtering input p is smooth. The binary mask can be obtained from graph-cut or other segmentation methods and are used as the filter input p. The guidance I is the color image. The behaviors of three filters: guided filter (joint bilateral filter, and a recent domain transform filter. The bilateral filter may lose some thin structures (see zoom-in). This is because the bilateral filters are guided by pixel-wise color difference, whereas the guided filter has a patch-wise model.

Figure5.



2.5 Median Filtering

The median filter is another popular edge aware filter, which can be considered as a special case of local histogram filters. The median is the statistical concept which means the center value of the provided list. The pixel under consideration is replaced with the median magnitude. It also shows property of noise reduction, while preserving edges more effectively as compared to a linear smoothing filter. Rank order and morphological processing are proposed variations for the basic median concept.

2.6 Bilateral Filtering

The bilateral filter is another non iterative strong approach to preserve edges in images. It produces filter output at the considered pixel as an average of neighboring pixels. But the bilateral filter has disadvantage of gradient reversal artifact. For a pixel on an edge which has few similar pixels in the neighborhood, the weighted average becomes unstable. The result is that the smoothed output is not consistent with the input at the edges. So detail enhancement like operations which requires the consistency of input signal and output signal has to be performed with better gradient preserving filter.

3. Result and Discussion

3.1 Experimental Setting

All the 9 record from different images their PSNR, SSMI AND MSE using the proposed algorithm is calculated.

3.2 Performance Evaluation

The PSNR and SSIM parameter are used to measure the quality of reconstructions of images and lossy compression codecs. Higher PSNR indicates that reconstruction is of higher quality and lower PSNR indicates that reconstruction is of lower quality.
PSNR=10log10 (R2/MSE)

SSIM is used for measuring the similarity between the two images. SSIM is the measurement or prediction of image quality. It is designed to improve the traditional methods such as Peak Signal to Noise Ratio (PSNR) and Mean Squared Error (MSE).
MSE=ΞM,N [I1(m,n)−I2(m,n)]2/M∗N

3.3 RESULTS

All the 9 record from different images their PSNR, SSMI AND MSE using the proposed algorithm is calculated which is shown in the table-1.

Figure6. IMAGE 1

Figure7. IMAGE 2

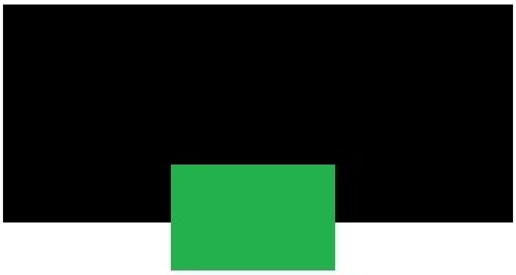


Figure8. IMAGE 3

Table-1: Performance of proposed algorithm on the basis of MSE, PSNR, AND SSMI.

DIFFERENT IMAGES	PSNR	SSMI	MSE
IMAGE 1 RED-255 GREEN-0 BLUE-0	31.74	0.973400	0.005393
IMAGE 1 RED-0 GREEN-255 BLUE-0	33.20	0.979840	0.005304
IMAGE 1 RED-0 GREEN-0 BLUE-255	31.94	0.976744	0.005393
IMAGE 2 RED-255 GREEN-0 BLUE-0	32.97	0.979351	0.0066615
IMAGE 2 RED-0 GREEN-255 BLUE-0	30.94	0.970810	0.0063617
IMAGE 2 RED-0 GREEN-0 BLUE-255	32.07	0.977998	0.0066615
IMAGE 3 RED-255 GREEN-0 BLUE-0	28.49	0.877515	0.069413
IMAGE 3 RED-0 GREEN-255 BLUE-0	28.60	0.878309	0.694770
IMAGE 3 RED-0 GREEN-0 BLUE-255	28.35	0.876399	0.069413

Conclusion

In this paper a novel filter is widely applicable in computer vision and graphics. Different from the recent trends we design a new filter that exhibit the nice property of edge-preserving smoothing. It can be computed efficiently and non approximately. This filter is more generic than "smoothing" and is applicable for structure-transferring, enabling novel applications of filtering-based feathering/matting and dehazing applications.

The novel explicit image filter can be used in various image processing applications. Guided filter is generic concept for edge preserving smoothing and structure transferring filtering. It is more effective as compared to other existing approaches in aspects such as detail enhancement, denoising, etc. With proper selection of parameter values depending upon the area of application desired results can be obtained.

References

[1] Neelima Rajput and Ms D.S Gaul, "Guided Filter Technique: Various Aspects In Image Processing", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 28, no. 11, pp. 1768- 1783, 2013.

[2] Shyno.K.G. and Sarika.S, "Feature Extraction of Hyperspectral Images Using Image Guided Filter" International Conference on Explorations and Innovations in Engineering & Technology (ICEIET – 2016).

[3] Kaiming He, Member, IEEE, Jian Sun, Member, IEEE, and Xiaoou Tang, Fellow, IEEE, " A technique for Guided Image Filtering" IEEE Transactions on Pattern Analysis and Machine Intelligence, VOL. 35, NO. 2013

[4] Takahiro Hasegawa, Ryoji Tomizawa, Yuji Yamauchi, "Guided Filtering Using Reflected IR Image for Improving Quality of Depth Image" IEEE Transactions on Pattern Analysis and Machine Intelligence, 35(6):1397–1409,2014

[5] Wei Gan, Chao Ren, Xiaofei Wang, Xiaohai He, "An Improving Infrared Image Resolution Method via Guided Image Filtering" IEEE transactions on Image filtering , VOL. 9, NO. 10, OCTOBER 2014.

[6] V.Venkateswara Reddy, S.Ravi Kumar, G.Hari Krishna "Guided Image Filtering for Image Enhancement" International Journal of Research Studies in Science, Engineering and Technology Volume 1, Issue 9, December 2014, PP 134-138.

[7] Vrushali Patil, Dr. P. Malathi, Dr. Manish Sharma "Edge Preservation using Guided Image Filter Technique" International Journal of Engineering Research and General Science Volume 3, Issue 4, July-August, 2015

[8] Shivaprasad.B.M , Sujatha.S "Enhancement of Debased Images Using Guided Bilateral Filter" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 5, Issue 5, May 2016

[9] Devi.S, Jini Cheriyan "Integrating the Concept of Guided Image Filter and Coefficient Thresholding for Image Denoising" International Journal of Engineering Research and Development Volume 9, Issue 4 (December 2013), PP. 43-50

[10] Giovanni Chierchiay, Davide Cozzolino ," Guided Filetering for PRNU-based localization of small-size image forgeries IEEE Transactions on Signal Processing, vol. 53, no. 10, pp. 3948–3959, Oct. 2013

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