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IMAGE PROCESSING USING BILATERAL FILTERING WITH FUTURE SCOPE IN PARELLEL PROCESSING

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ABSTRACT
Bilateral filtering smooths images while maintaining edges, by use of a nonsimilar combination of nearing image values. The method is less time consuming, local, and easy. It clubs together gray levels or colors based on both their geometric closeness and their photometric similarity, and prefers near values to distant values in both domain and range.Also, in contrast withstandard filtering, bilateral filtering generates no phantom colors along edges in color images, and reduces phantom colors where they appear in the original image. After successful processing , this will be implemented on GPGPU for faster implementations.

Keywords: Bilateral Filtering, Denoising, GPGPU (General Purpose Computing for Graphics Processing Unit)

I. INTRODUCTION

There are different types & sources of noise in a digital image. Like, dark current noise generates due to the thermally producedelectrons at sensing sites; it is proportional to the exposure time and highly dependent on the temperature sensor. Shot noise is generated due to the quantum uncertainty in photoelectron production; and it is justified by Poisson distribution. Amplified noise and quantized noise occur during the conversion of the number of electrons produced to pixel intensities. The overall noise characteristics in an image depend on many factors, including pixel dimensions, sensor types, exposure time, ISO speed, and temperature. In this paper, we propose a less time consuming scheme for edge preserving smoothing that is time saving and simple.

Furthermore, our scheme allows explicit enforcement of any desired notion of photometric distance. This is important for color image filtering. The three bands of color images should not be filtered separately from one another, as colors get corrupted close to image edges. In fact, different bands have different contrast level, and are smoothed differently. Separate smoothing disturbs the balance of colors, and undesirable color combinations appear. Bilateral filters has the ability to operate the three bands at once, and can be told explicitly, so to speak, which colors are similar and which are not. Only perceptually same colors are then averaged together, and the artificials mentioned above disappear.

The idea of implementing bilateral filtering is to work in therange of an image what traditional filters do in range of domain. Two pixels are*close* to one another, that is, gaining nearby spatial location, or they can be *same*to one another, that is, have nearby values, possibly same in a perceptually meaningful way. Closeness refers to vicinity in the domain, similarity to vicinity in the range. In old days filtering is domain filtering, and enforces closeness by weighing of the pixel values with coefficients that fall in with distance.
The bilateral filter is defined as:-

$$I^{\text{filtered}}(x) = \sum_{x_i \in \Omega} I(x_i) f_r(\|I(x_i) - I(x)\|) g_s(\|x_i - x\|)$$

I^{filtered} is the filtered image.
$I$is original input image to be filtered.
X are coordinates of current pixel to be filtered.
Ω is window centered in X.
$f_r$is range kernel for smoothing differences in intensities.
$g_r$is spatial kernel for smoothing differences in coordinates.

II. Experiments With Black And White Images

In this section we analyze the performance of bilateral filters on black-and-white images.Figure 1 (a) and 1(b) in the color plates show the potential of bilateral filtering for the removal of texture. Some amount of gray-level quantization can be seen in figure 1 (b), but this is due to the printing process, not by the filter.

Figure 1 (a)

Figure 1 (b)

The picture "simplification" illustrated by figure 5 (b) can be useful for data reduction without loss of overall shape features in applications such as image picture editing, manipulation and transmission, image description for retrieval. Notice that the kitten's whiskers, much thinner than the filter's window, remain crisp after filtering. The intensity values of dark pixels are averaged together from both sides of the whisker, while the bright pixels from the whisker itself are ignored because of the range component of the filter. Conversely, when the filter is centered somewhere on a whisker, only whisker pixel values are averaged together.

Figure 2 shows the effect of different values of the parameter $\sigma_d$and σ_rr on the resulting image. Rows correspond to different amounts of domain filtering, columns to different amounts of range filtering. When the value of the range filtering constant σ_rr is large (100 or 300)with respect to the overall range of values in the image (1 through 254), the range component of the filter has little effect for smallσ_d: all pixel values in any given neighborhood have about the same weight from range filtering, and the domain filter acts as a standard Gaussian filter. This effect can be seen in

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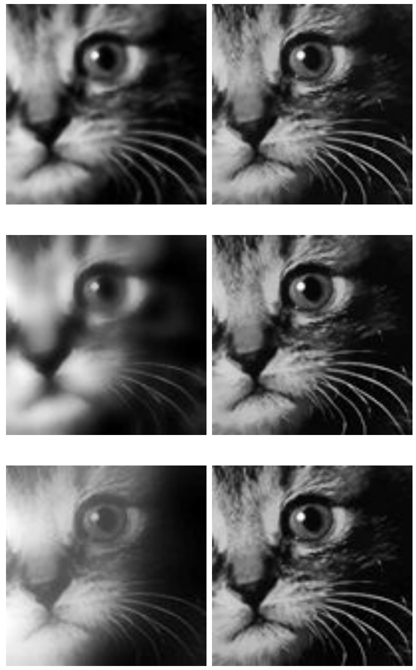
the last two columns of figure (2). For smaller values of the range filter parameterσ_rr (10 or 30), range filtering dominates perceptually because it preserves edges.



Bilateral filtering with parameters σ_d= 3pixels and σ_r=50=intensity values is applied to the image in figure 3 (a) to yield the image in figure 3 (b). We must note that most of the fine texture has been removed, and still all contours are as crisp as in the original one.

Figure 3 (a)

Figure 3 (b)

In terms of computational cost,the bilateral filter is twice as expensive as a nonseparable domain filter of the same size. The range component depends nonlinearly on the image, and is nonseparable. A simple trick that decreases computation cost considerably is to precompute all values for the similarity functions.

III. Experiments With Color Images

For black-and-white images, intensities between any two grey levels are still grey levels. As a consequence, when smoothing black-and-white images with a standard low-pass filter, certain intermediate levels of gray are generated across edges, leading to production of blurred images. With color images, an additional problem arises from the fact that between any two colors there are other, often rather different colors. For example, between blue and red there are various shades of pink and purple. Thus, disturbing color bandsmay be produced when smoothing across color edges. The filtered image does not just look blurred, it also consists of odd-looking, colored auras around objects. Figure 4 (a) in the color plates shows a detail from a picture with a red jacket in front of a blue sky. Even in this clear picture, a thin pink-purple line is visible, and is due to a combination of pixel averaging and lens blurring. In fact, pixels along the boundary, when projected back into the scene, intersect both blue sky and red jacket, and the resulting color is the average of red and blue i.e. pink. When smoothing, this effect is emphasized, as the broad, blurred purple-pink area in figure 4 (b) shows.

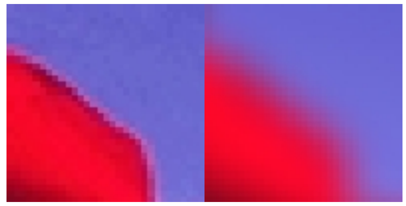


Figure 4 (a) ***Figure 4(b)***

To address this difficulty, edge-preserving smoothing could be applied to the RGB components of the image separately. However, the intensity profiles across the edge in the three color bands are in general different. Separate smoothing results in an even more pronounced pink-purple band than in the original image, as shown in figure 4 (c). The pink-purple band, however, is not widened as it is in the standard-blurred version of figure 4 (b).

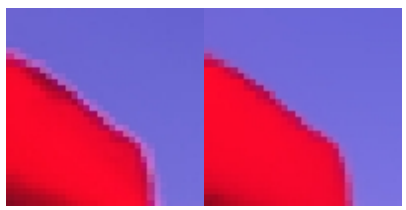


Figure 4 (c) ***Figure (d)***

A much better output can be obtained with bilateral filtering. In fact, a bilateral filter allows mixing the three color bands appropriately, and measuring photometric distances between pixels in the combined space. Also this combined distance can be made to correspond closely to perceived dissimilarity by using Euclidean distance in the CIE-Lab color space .

Figure 4 (d) shows the output image from bilateral smoothing of the image in figure 4 (a). The pink band has shrunk considerably, and no extraneous colors appear.

Figure 5 (c) in the color plates shows the result of five iterations of bilateral filtering of the image in figure 5 (a).

While a single iteration produces a much cleaner image (figure 5 (b)) than the original image, and is likely to be sufficient for most image filtering needs, multiple iterations have the effect of flattening the colors in an image considerably, butwithout blurring edges. The output image has a much reduced color map, and the effects of bilateral filtering are simpler to see when printout is taken out. Note that the cartoon-like appearance of figure 5 (c). All edges and shadows are preserved, but most of the shading is gone, and no "new" colors are introduced by filtering procerss.

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Figure 5 (a)

Figure 5 (b)

Figure 5 (c)

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IV. CONCLUSION

In this paper we have introduced the concept of bilateral filtering for edge-preserving smoothing. The liability of bilateral filtering is analogous to that of old filtering techniques, which we called domain filtering in this paper. The explicit enforcement of a photometric distance in the range component of a bilateral filter makes it possible to filter color images in a perceptually appropriate manner. The parameters used for bilateral filtering in our illustrative examples were to some extent arbitrary.

This is however a consequence of the generality of this technique. In fact, just as the parameters of domain filters depend on image properties and on the intended result, so do those of bilateral filters. Given a specific application, techniques for the automatic design of filter profiles and parameter values may be possible.

V. FUTURE SCOPE

The bilateral filtering for image processing takes a considerable amount of time to process an image with lots of information, to reduce this computation time this technique will be implemented on GPU's . GPGPU leads to a huge amount of reduction in computation/processing time.

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