The Effect of High-Frequency Spatial Noise from an Image Smoothing Ameliorates

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Abstract-
One of the most significant and challenging methods in image research is picture enhancement. Enhancing a picture's attractiveness visually or offering a "better transform representation for future automated image processing" is the goal of image enhancement. A lot of photos, including real-world photos, satellite photos, aerial photos, and medical photos, include noise and low contrast. To improve the quality of the image, the contrast and noise must be reduced. Image enhancement techniques, which increase the quality (clarity) of pictures for human viewing by reducing noise and blur, boosting contrast, and revealing features, are among the most crucial phases in the identification and interpretation of medical images. The method of augmentation varies depending on the field. The two types of picture enhancement techniques that are now in use are spatial domain enhancement and frequency domain enhancement. An overview of spatial domain picture enhancement processing techniques is presented in this work. To be more precise, we classify processing methods according to representative image enhancing approaches.

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INTRODUCTION

Image enhancement problem can be formulated as follows: given an input low quality image and the output high quality image for specific applications. It is well-known that image enhancement as an active topic in medical imaging has received much attention in recent years. The aim is to improve the visual appearance of the image, or to provide a “better” transform representation for future automated image processing, such as analysis, detection, segmentation and recognition. Moreover, it helps analyses background information that is essential to understand object behaviour without requiring expensive human visual inspection. Carrying out image enhancement understanding under low quality image is a challenging problem because of these reasons. Due to low contrast, we cannot clearly extract objects from the dark background. Most colour based methods will fail on this matter if the colour of the objects and that of the background are similar. The survey of available techniques is based on the existing techniques of image enhancement, which can be classified into two broad categories: Spatial based domain image enhancement and Frequency based domain image enhancement. Spatial based domain image enhancement operates directly on pixels. The main advantage of spatial based domain technique is that they conceptually simple to understand and the complexity of these techniques is low which favours real time implementations. But these techniques generally lacks in providing adequate robustness and imperceptibility requirements. Frequency based domain image enhancement is a term used to describe the analysis of mathematical functions or signals with respect to frequency and operate directly on the transform coefficients of the image, such as Fourier transform, discrete wavelet transform (DWT), and discrete cosine transform (DCT). The basic idea in using this technique is to enhance the image by

manipulating the transform coefficients. The advantage of frequency based image enhancement includes low complexity of computations, ease of viewing and manipulating the frequency composition of the image and the easy applicability of special transformed domain properties. The basic limitations including are it cannot simultaneously enhance all parts of image very well and it is also difficult to automate the image enhancement procedure. In this paper according to if
enhanced image embed high quality background information, the existing techniques of image enhancement like spatial domain methods can again be classified into two broad categories: Point Processing operation and Spatial filter operations. Traditional methods of image enhancement are to enhance the low quality image itself. It doesn't embed any high quality background information. The reason is that in the dark image, some areas are so dark that all the information is already lost in those regions. No matter how much illumination enhancement you apply, it will not be able to bring back lost information. Frequency domain methods can again be classified into three categories: Image Smoothing, Image Sharpening, Periodic Noise reduction by frequency domain filtering. Image enhancement is applied in every field where images are ought to be understood and analysed. For example, medical image analysis, analysis of images from satellites etc.

CLASSIFICATION OF IMAGES

(i) Intensity Images- An intensity image is a data matrix whose values have been scaled to represent intensities. When the elements of an intensity image are of class unit 8, or class unit 16, they have integer values in the range [0, 255] and [0, 65535].respectively. If the image is of class double, the values are floating-point numbers. Values of scaled, class double intensity images are in the range [0, 1] by convention.

(ii) Indexed Images- Array of class logical, unit 8, Unit 16, single, or double whose pixel values are directed indices into a color map. The color map is an m-by-3 array of class double. For single or double arrays, integer values range from [1, p]. For logical, unit8, or unit 16 arrays, values range from [0, p-1]. An indexed image consists of an array and a color map matrix. The pixel values in the array are directed indices into a color map. By convention, this documentation uses the variable name X to refer to the array and map to refer to the color map.

(iii) Binary Images- Binary images have a very specific meaning in MATLAB. In a binary image, each pixel assumes one of only two discrete values: 1 or 0, interpreted as black and white, respectively. A binary image is stored as a logical array.

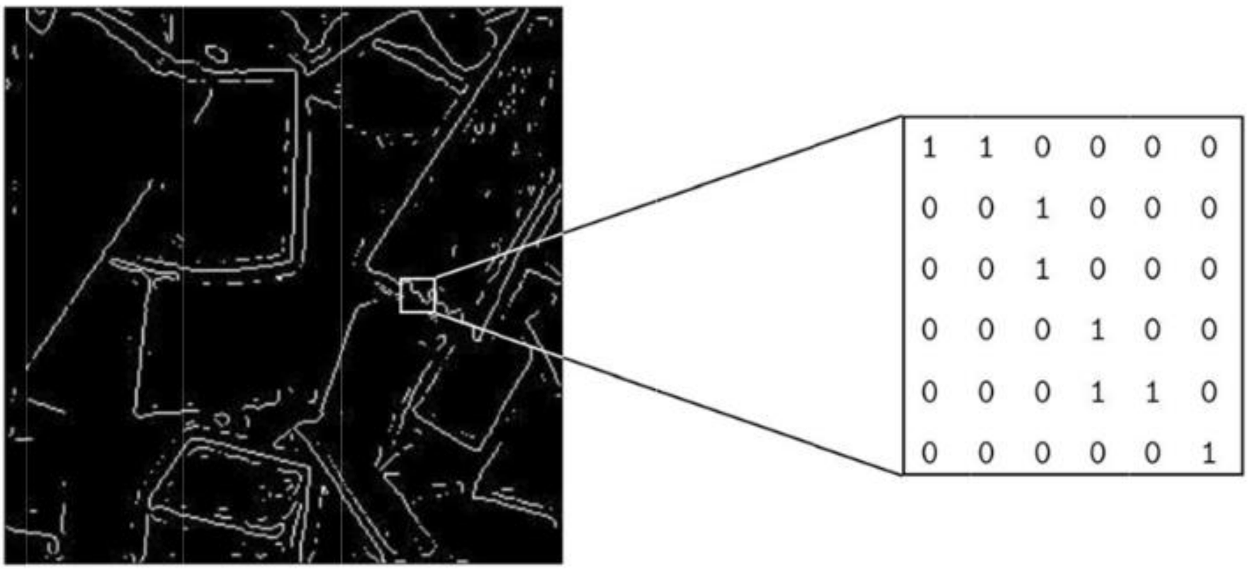

Figure 1- Binary Images

IMAGE ENHANCEMENT TECHNIQUES

The main definition of enhancing is to make something greater in value, desirability or attractiveness. The term of enhancement implies a process to improve the visual quality of the image. Image Enhancement transforms images to provide better representation of the subtle details. The principal objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application. Image enhancement processes consist of a collection of techniques that seek to improve the visual appearance of an image or to convert the image to a form better suited for analysis by a human or a machine. In an image enhancement system, there is no conscious effort to improve the fidelity of a reproduced image with regard to some ideal form of the image, as is done in image restoration. Actually, there is some evidence to indicate that often a distorted image, for example, an image with amplitude overshoot and undershoot about its object edges, is more subjectively pleasing than a perfectly reproduced original. Enhancement of an image is necessary to improve appearance or to highlight some aspect of the image is converted from one into another acquired, scanned, transmitted, copied or printed many types of noise can be present in the image. Image enhancement has come to specifically mean a process of smothering irregularities or noise that has somehow corrupted the image. The term “image enhancement” has been widely used in the past to describe any operation that improves image quality by some criteria. However, in the recent years the meaning of the term has evolved to denote image-preserving noise smoothing. This primarily serves to distinguish it from similar-sounding terms, such as image restoration and image reconstruction, which also taking specific meaning. Image enhancement has played and will continue to play an important role into different fields such as medical, industrial, military and scientific applications. In addition to these applications, image enhancement is increasingly being used in consumer electronics. Internet Web users, for instance, not only rely on built-in image processing protocols such as JPEG (Joint Photographic Expert Group) and interpolation, but they also have become image processing users equipped with powerful yet inexpensive software such as Photoshop. Users not only retrieve digital images from the Web but they are now able to acquire their own by use of digital cameras or through digitization services.

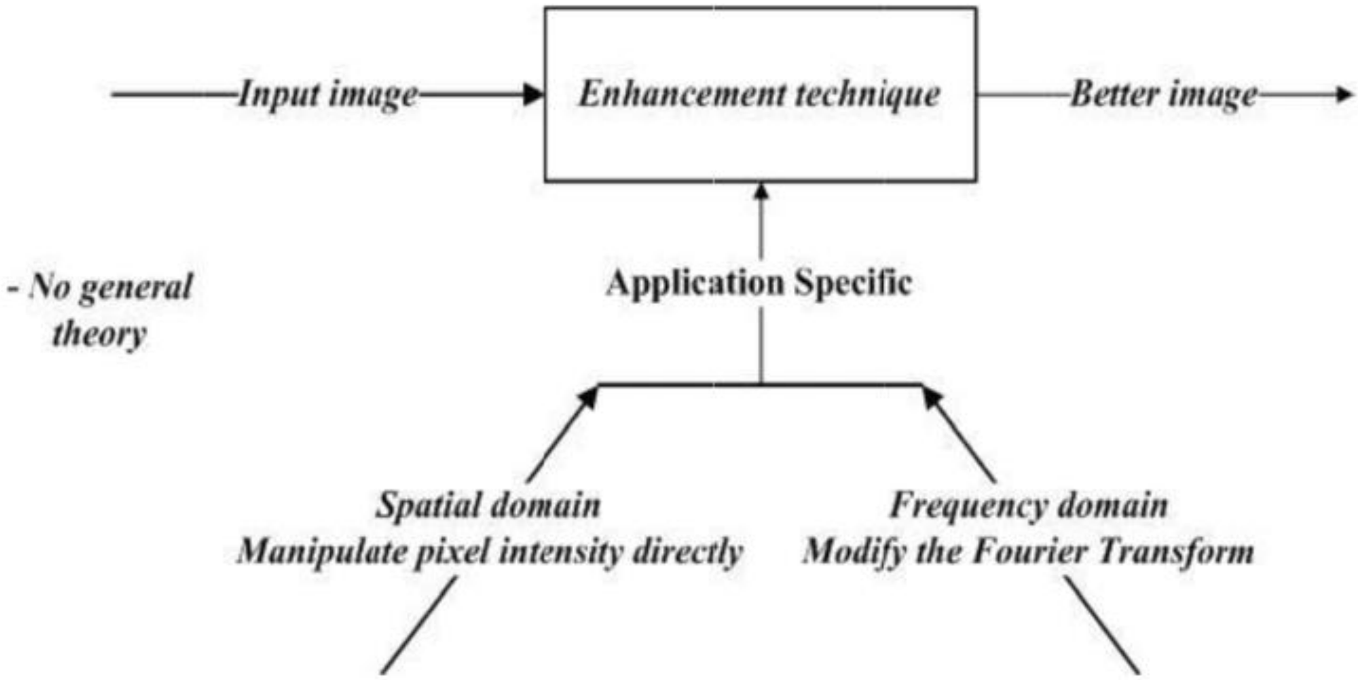

Figure 2- Image Enhancement Techniques

SMOOTHING ALGORITHMS

The inexpensiveness and simplicity of point-and-shoot cameras, combined with the speed at which budding photographers can send their photos over the Internet to be viewed by the world, makes digital photography a popular hobby. With each snap of a digital photograph, a signal is transmitted from a photon sensor to a memory chip embedded inside a camera. Transmission technology is prone to a degree of error, and noise is added to each photograph. Significant work has been done in both hardware and software to improve the signal-to-noise ratio in digital photography. In software, a smoothing filter is used to remove noise from an image. Each pixel is represented by three scalar values representing the red, green, and blue chromatic intensities. At a pixel studied, a smoothing filter takes into account the pixels surrounding it in order to make a determination of a more accurate version of this pixel. By taking neighboring pixels into consideration, extreme "noisy" pixels can be filtered out. Unfortunately, extreme pixels can also represent original fine details, which can also be lost due to the smoothing process. This paper will examine four common smoothing algorithms and introduce a new smoothing algorithm. Each of the algorithms covered can be applied to one dimensional as well as two dimensional signals. Figure 3 demonstrates five common filtering algorithms applied to an original image. The simplest of smoothing algorithms is the Mean Filter as defined. The Mean Filter is a linear filter which uses a mask over each pixel in the signal. Each of the components of the pixels which fall under the mask are averaged together to form a single pixel. This new pixel is then used to replace the pixel in the signal studied. The Mean Filter is poor at maintaining edges within the image.

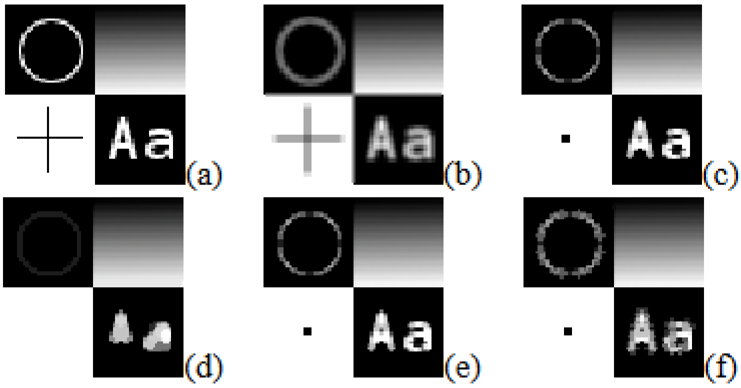

Figure 3- Examples of common filtering approaches. (a) Original Image (b) Mean Filtering (c) Median Filtering (d) Root signal of Median Filtering (e) Component-wise Median Filtering (f) Vector Median Filtering

SPATIAL MEDIAN FILTER FOR SMOOTHING IMAGES

When transferring an image, sometimes transmission problems cause a signal to spike, resulting in one of the three point scalars transmitting a incorrect value. This type of transmission error is called "salt and pep-per" noise due to the bright and dark spots that appear on the image as a result of the noise. The ratio of incorrectly transmitted points to the total number of points is referred to as the noise composition of the image. The goal of a noise removal filter is to take a corrupted image as input and produce an estimation of the original with no foreknowledge of the characteristics of the noise nor the noise composition of the image. In images containing noise, there are two challenges. The first challenge is determining noisy points. The second challenge is to determine how to adjust these points. In the Vector Median Filter (VMF), a point in the signal is compared with the points surrounding it as defined by a filter mask. Each point in the mask filter is treated as a vector representing a point in a three-dimensional space. Among these points, the summed vector distance from each point to every other point within the filter is computed. The point in the signal with the smallest vector distance amongst those points in the filter is the minimum vector median. The point in space that has the smallest distance to every other point is considered to be the best representative among the set. In the basic implementation of the Vector Median Filter, the vector median replaces the point in the signal currently studied. The original VMF approach does not consider if the current point is original data or not. If a point has a small summed vector distance, yet is not the minimum vector median, it is replaced anyway. The advantage of replacing every point achieves a uniform smoothing across the image. The disadvantage to replacing every point is that original data is sometimes overwritten. A good smoothing filter should simplify the image while retaining most of the original image shape and retain the edges. A benefit of a smoothed image is a better size ratio when the image needs to be compressed. The Spatial Median Filter is a new noise removal filter. The Spatial Median Filter and the Vector Median Filter follow a similar algorithm and it will be shown that they have comparable results. To improve the quality of the results of the Spatial Median Filter, a new parameter will be introduced and experimental data is shown demonstrating the amount of improvement. The Spatial Median Filter is a uniform smoothing algorithm with the purpose of removing noise and fine points of image data while maintaining edges around larger shapes. The Spatial Median Filter is based on the spatial median quantile function developed by P. Chaudhuri in 1996, which is a L1 norm metric that measures the difference between two vectors. R. Serfling noticed a spatial depth could be derived by taking an invariant of the spatial median. The Serfling paper first gave the notion that any two vectors of a set could be compared based on their "centrality" using the Spatial Median. Y. Vardi and C. Zhang have improved the spatial median by deriving a faster estimation formula.

CONCLUSION

The uses for picture enhancement are as varied as the sources of images themselves. Naturally, different applications benefit from enhancement techniques that are adjusted to account for the noise present and the statistics of the physical processes that underlie the picture capture stage. Häder (21) provides an excellent summary of image processing for biological applications.The improvement of picture time sequences is becoming more and more popular as cheap computer engines capable of online video processing become available. I(i, j, k) can be used to represent a video data collection, where k stands for time samples. With the use of three-dimensional FFTs, three-dimensional convolution, three-dimensional windows, and three-dimensional wavelet transforms, many of the previously covered approaches may be easily extended to video processing. Nonetheless, one unique characteristic of video sequences is that they typically have visual motion, which is projected from the motion of scene objects. The moving elements of the scene may time-alias because of the frequently fast motion. When this occurs, attempting to directly extend many of the previously stated non-point operation methods into three dimensions will typically not work well since the processed video will frequently display ghosting artefacts that result from improper treatment of the aliasing data. Motion-compensated augmentation methods can help with this. This usually entails two steps: motion estimation, which estimates the motion of an item locally across the picture (using a matching algorithm); and compensation, which corrects for object shifts before completing further processing.

REFERENCES

[1] R. C. Gonzales, R. E. Woods, Digital Image Processing, Reading, MA: Addison-Wesley, 1995.
[2] A. Antoniou, Digital Filters: Analysis and Design, New York: McGraw-Hill, 1979.
[3] J. C. Russ, The Image Processing Handbook, Boca Raton, FL: CRC Press, 1995.
[4] A. C. Bovik, S. T. Acton, The impact of order statistics on signal processing, In H. N. Nagaraja, P. K. Sen, and D. F. Morrison (eds.), Statistical Theory and Applications, New York: Springer-Verlag, 1996, pp. 153-176.
[5] J. W. Tukey, Exploratory Data Analysis, Reading, MA: Addison-Wesley, 1971.
[6] A. C. Bovik, T. S. Huang, D. C. Munson, Jr., A generalization of median filtering using linear combinations of order statistics, IEEE Trans. Acoust. Speech Signal Process., ASSP-31: 1342-1350, 1983.
[7] A. C. Bovik, Streaking in Median Filtered Images, IEEE Trans. Acoust. Speech Signal Process., ASSP-35: 493-503, 1987.
[8] O. Yli-Harja, J. Astola, Y. Neuvo, Analysis of the properties of median and weighted median filters using threshold logic and stack filter representation. IEEE Trans. Acoust. Speech Signal Process., ASSP-39: 395-410, 1991.
[9] P.-T. Yu, W.-H. Liao, Weighted order statistic filters - their classification, some properties and conversion algorithm. IEEE Trans. Signal Process., 42: 2678-2691, 1994.
[10] J. Serra, Image Analysis and Morphology: Vol. 2: The Theoretical Advances. London: Academic Press, 1988.
[11] H. G. Longbotham, D. Eberly, The WMMR filters: A class of robust edge enhancers, IEEE Trans. Signal Process., 41: 1680-1684, 1993.
[12] P. D. Wendt, E. J. Coyle, N. C. Gallagher, Jr., Stack filters, IEEE Trans. Acoust. Speech Signal Process., ASSP-34: 898-911, 1986.

[13] K. E. Barner, G. R. Arce, Permutation filters: A class of nonlinear filters based on set permutations. IEEE Trans. Signal Process., 42: 782-798, 1994.
[14] P. Perona, J. Malik, Scale-space and edge detection using anisotropic diffusion, IEEE Trans. Pattern Anal. Mach. Intell., PAMI-12: 629-639, 1990.
[15] F. Catte et al., Image selective smoothing and edge detection by nonlinear diffusion, SIAM J. Numer. Anal., 29: 182-193, 1992.
[16] D. L. Donoho, De-noising by soft-thresholding. IEEE Trans. Inf. Theory, 41: 613-627, 1995.
[17] G. Strang, T. Nguyen, Wavelets and Filter Banks, Wellesley, MA: Wellesley-Cambridge Press, 1996.
[18] D. Wei, C. S. Burrus, Optimal wavelet thresholding for various coding schemes, Proc. IEEE Int. Conf. Image Process., I: 610-613, 1995.
[19] D. Wei, A. C. Bovik, Enhancement of compressed images by optimal shift-invariant wavelet packet basis. J. Visual Commun. Image Represent. in press.
[20] W. B. Pennebaker, J. L. Mitchell, JPEG - Still Image Data Compression Standard, New York: Van Nostrand Reinhold, 1993.
[21] D. P. Häder (ed.), Image Analysis in Biology, Boca Raton, FL: CRC Press, pp. 29-53, 1991.

[22] A. M. Tekalp, Digital Video Processing, Upper Saddle River, NJ: Prentice-Hall, 1995.