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A Novel Image Denoising Based On Local Geometry Encoding

Y K Mounika[1], M Venkata Dasu[2]

M.Tech (DECS), Annamacharya Institute of Technology & Sciences, Rajampet, India[1]

Assistant Professor, Department of ECE, Annamacharya Institute of Technology & Sciences, Rajampet, India[2]

ABSTRACT: Denoising an image is a fundamental task for correcting defects produced during the acquisition process of a real world scene and its reproduction on a display, due to physical and technological limitations. It can also be useful as a pre-processing stage in order to improve the results of higher level applications. In this project, we consider an image decomposition model that provides a novel framework for image denoising. The model computes the components of the image to be processed in a moving frame that encodes its local geometry (directions of gradients and level lines). Then, the strategy we develop is to denoise the components of the image in the moving frame in order to preserve its local geometry, which would have been more affected if processing the image directly. This project is developed in three stages 1) Process with an image denoising technique F and call the output image. 2) Apply the same image denoising technique to the components in some moving frame related to the channels of the image or the full image itself. Then apply the inverse frame change matrix field to the processed components, from which a color image is reconstructed. 3) Compare direct method and Channel estimation with the metrics PSNR and SSIM. Note that SSIM has been originally designed for gray-level images, and we define the SSIM Index for color images as the mean of the SSIM Index of each color channel. Experiments on a whole image database tested with several denoising methods show that this framework can provide better results than denoising the image directly, both in terms of Peak signal-to-noise ratio and Structural similarity index metrics.

KEYWORDS: PSNR,SSIM, Denoise, local image geometry.

I.INTRODUCTION

Image processing has got wide varieties of applications in computer vision, multimedia communication, television broadcasting, etc. that demand very good quality of images. The quality of an image degrades due to introduction of additive white Gaussian noise (AWGN) during acquisition, transmission/ reception and storage/ retrieval processes. It is very much essential to suppress the noise in an image and to preserve the edges and fine details as far as possible. In the present research work, efforts are made to develop efficient spatial-domain and transformdomain image filters that suppress noise quite effectively. Digital Image Processing usually refers to the processing of a 2-dimensional (2-D)picture signal by a digital hardware. The 2-D image signal might be a photographic image, text image, graphic image (including synthetic image), biomedical image (X-ray, ultrasound, etc.), satellite image, etc. In a broader context, it implies processing of any 2-D signal using a dedicated hardware, e.g. an application specific integrated circuit (ASIC) or using a general-purpose computer implementing some algorithms developed for the purpose. An image is a 2-D function (signal), f (x ,y) where x and y are the spatial (plane) coordinates. The magnitude of f at any pair of coordinates f(x,y) is the intensity or gray level of the image at that point. In a digital image, f(x,y), and the magnitude of f are all finite and discrete quantities. Each element of this matrix (2-D array) is called a picture element or pixel.

Image processing refers to some algorithms for processing a 2-D image signal, i.e. to operate on the pixels directly (spatial domain processing) or indirectly (transformdomain processing). Such a processing may yield another image or some attributes of the input image at the output. It is a hard task to distinguish between the domains of image processing and any other related areas such as computer vision. Though, essentially not correct, image processing may be defined as a process where both input and output are images. At the high level of processing and after some preliminary processing, it is very common to perform some analysis, judgment or decision making or perform some mechanical operation (robot motion). These areas are the domains of artificial intelligence (AI), computer vision,

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robotics, etc. Digital image processing has a broad spectrum of applications, such as digital television, photo-phone, remote sensing, image transmission, and storage for business applications, medical processing, radar, sonar, and acoustic image processing.

II. LITERATURE SURVEY

Noise introduced in an image is usually classified as substitutive (impulsive noise: e.g., salt & pepper noise, random-valued impulse noise, etc.) and additive (e.g., additive white Gaussian noise) noise. The impulsive noise of low and moderate noise densities can be removed easily by simple denoising schemes available in the literature. The simple median filter works very nicely for suppressing impulsive noise of low density. However, many efficient filters have been developed for removal of impulsive noise of moderate and high noise densities. Chen et al. have developed a nonlinear filter, called tri-state median filter, for preserving image details while effectively suppressing impulsive noise. The standard median filter and the centre weighted median (CWM) filter are incorporated into noise detection framework to determine whether a pixel is corrupted before applying the filtering operation. A nonlinear non iterative multidimensional filter, the peak-and-valley filter, is developed for impulsive noise reduction. The filter consists of a couple of conditional rules that identify the noisy pixels and replace their gray level values in a single step. F. Russo has developed an evolutionary neural fuzzy system for noise cancellation in image data .
The proposed approach combines the advantages of the fuzzy and neural paradigms. The network structure is designed to exploit the effectiveness of fuzzy reasoning in removing noise without destroying the useful information in input data. Farbiz et al. have proposed a fuzzy logic filter for image enhancement. It is able to remove impulsive noise and smooth Gaussian noise. Also, it preserves edges and image details. H-L Eng and K-K Ma have proposed a noise adaptive soft-switching (NASM) filter . A soft-switching noise-detection scheme is developed to classify each pixel to be uncorrupted pixel, isolated impulsive noise, nonisolated impulsive noise or image object's edge pixel. 'No filtering', a standard median filter or the proposed fuzzy weighted median filter is then employed according to respective characteristic type identified. T. Chen and H.R. Wu have developed a scheme for adaptive impulse detection using CWM filters. In addition to the removal of noise from gray images, some color image denoising filters are also developed for efficient removal of impulsive noise from color images. Fuzzy techniques can be applied to develop filters for suppression of additive noise. Ville et al. proposed a fuzzy filter for suppression of AWGN. The filter consists of two stages. The first stage computes a fuzzy derivative for eight different directions. The second stage uses these fuzzy derivatives to perform fuzzy smoothing by weighting the contributions of neighboring pixel values. The filter can be applied iteratively to effectively reduce high noise.

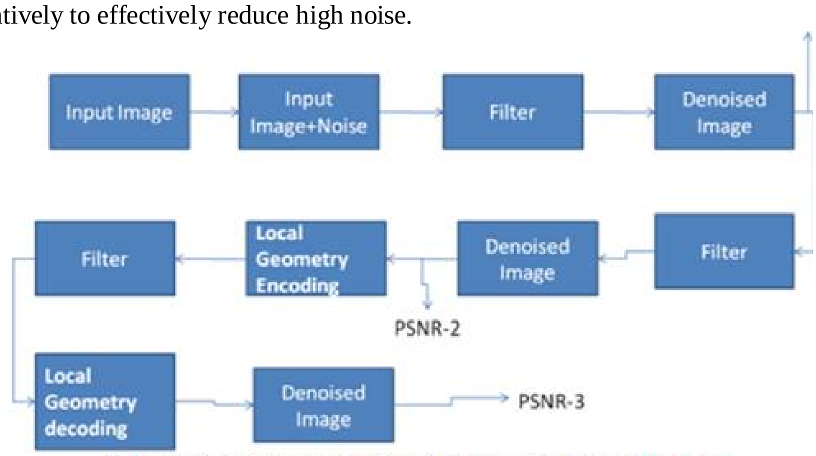

Figure 1. Image Denoising Based on Local Geometry Encoding

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Figure 2. Parameters of the noisy image

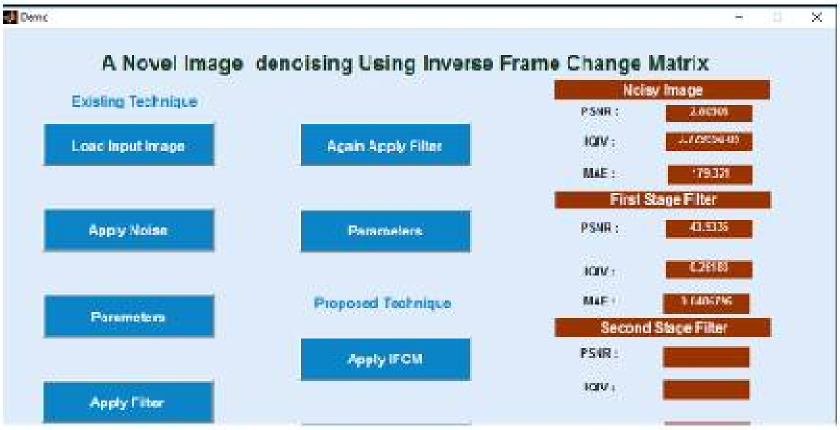

Figure 3. Parameters of the first stage filter

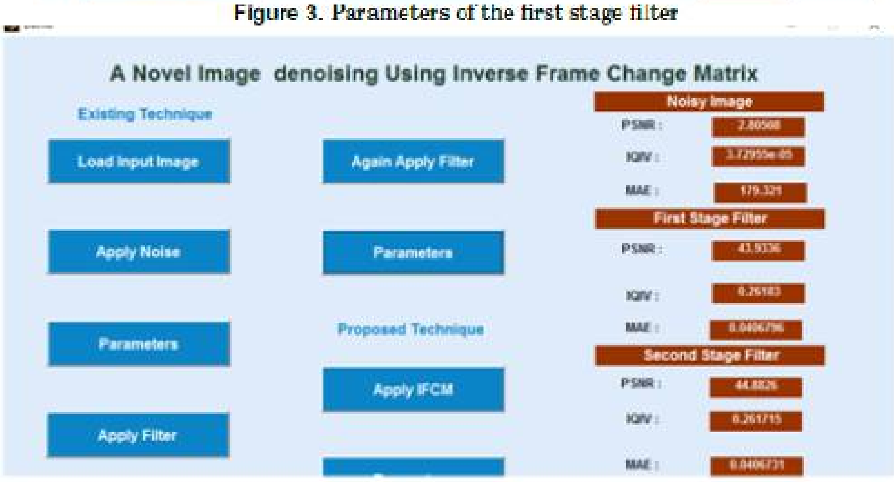

Figure 4. Parameters of the second stage filter

Kervrann et al. developed a novel adaptive and patch-based approach for image denoising and representation. The method is based on a pointwise selection of small image patches of fixed size in the variable neighborhood of each pixel. This method is general and can be applied under the assumption that there exist repetitive patterns in a local neighborhood of a point. A novel method using adaptive principal components is proposed by Mureson and Parks for

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suppression of AWGN. The method uses principal components on a local image patches to derive a 2-D, locally adaptive basis set. The local principal components provide the best local basis set and the largest eigenvector is in the direction of the local image edge. Hirakawa et al. proposed an image denoising scheme using total least squares (TLS) where an ideal image patch is modeled as a linear combination of vectors cropped from the noisy image. The model is fitted to the real image data by allowing a small perturbation in the TLS sense.
Shen et al. designed non separable Parseval frames from separable (tensor) products of a piecewise linear spline tight frame. These non separable framelets are capable of detecting first and second order singularities in directions that are integral multiples of 450. Using these framelets, two image denoising algorithms are proposed for suppression of AWGN. A new class of fractionalorder anisotropic diffusion equations for image denoising is proposed in for noise removal. These equations are Euler-Lagrange equations of a cost functional which is an increasing function of the absolute value of the fractional derivative of the image intensity function, so the proposed equations can be seen as generalization of second-order and fourth-order anisotropic diffusion equations. Now-adays, wavelet transform is employed as a powerful tool for image denoising . Image denoising using wavelet techniques is effective because of its ability to capture most of the energy of a signal in a few significant transform coefficients, when natural image is corrupted with Gaussian noise. Another reason of using wavelet transform is due to development of efficient algorithms for signal decomposition and reconstruction [for image processing applications such as denoising and compression. Many wavelet-domain techniques are already available in the literature. Out of various techniques soft-thresholding proposed by Donoho and Johnstone is most popular. The use of universal threshold to denoise images in wavelet domain is known as VisuShrink . In addition, subband adaptive systems.

III. IMAGE DENOISING BASED ON LOCALGEOMETRY ENCODING

The framework we propose for denoising an image while systematically taking into account its local geometry is based on applying image denoising techniques to the components of the image in the moving frame constructed above instead of applying the technique to the image itself. This methodology has already been used in [2]–[4] with local regularization/ denoising methods, but it can actually be extended to any denoising technique. In this section, we give more details about our approach dealing with gray-level and color images. The framework we propose for denoising an image while systematically taking into account its local geometry is based on applying image denoising techniques to the components of the image in the moving frame constructed above instead of applying the technique to the image itself.

IV. SIMULATION RESULTS

Figure 5. Input image

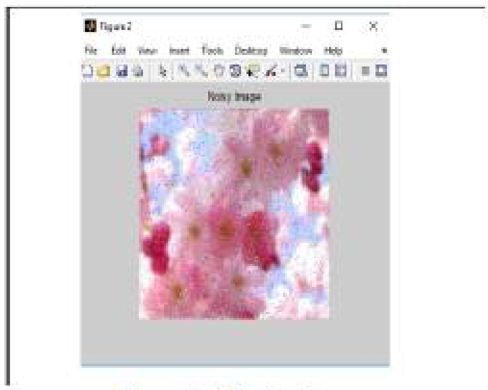

Figure 6. Noisy image

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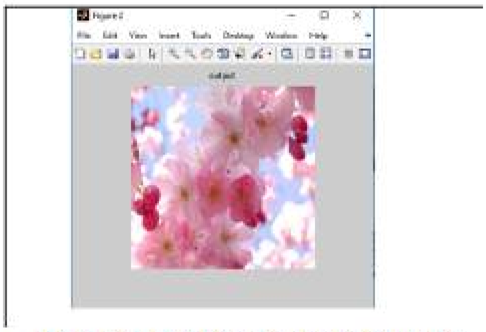

Figure 7. First stage filtered image

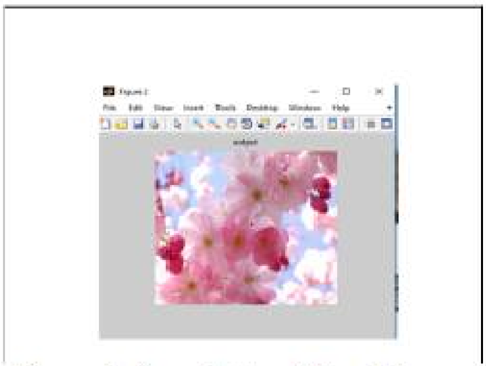

Figure 8. Second stage filtered image

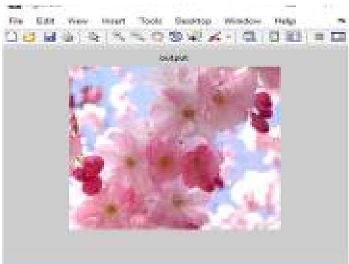

Figure 9. output image

Figure 10. Parameters of the output image

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V.CONCLUSION

The human eye is the only one able to decide if the quality of the image has been improved by the denoising method. We display some denoising experiences comparing the NL-means algorithm with local smoothing filters. All experiments have been simulated by adding a Gaussian white noise of standard deviation to the true image. The objective is to compare the visual quality of the restored images, the non presence of artifacts and the correct reconstruction of edges, texture and details. the experimental results shows that to stage wiener filter gives same psnr further psnr is improved by local geometry encoding.

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