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Improve Image-Denoising by using Weight based Sparse Matrix in Term of MSE & PSNR

Er. Sonvir Kaur Bath
M.Tech Scholar Dept of Computer Science & Engineering
St. Soldier Institute of Engineering & Technology, Jalandhar

Er. Harjeet Singh
Assistant Professor, Dept of Computer Science & Engineering
St. Soldier Institute of Engineering & Technology Jalandhar

Dr. Gurpreet Singh
Professor, Dept of Computer Science & Engineering
St. Soldier Institute of Engineering & Technology, Jalandhar

Abstract:- Joint sparse representation(JSR) has shown great potential in various image processing and computer vision tasks. Nevertheless, the conventional JSR is fragile to outliers. In this paper, we propose a weighted JSR(WJSR) model to simultaneously encode a set of data samples that are drawn from the same subspace but corrupted with noise and outliers. Our model is desirable to exploit the common information shared by these data samples while reducing the influence of outliers. To solve the WJSR model, we further introduce a greedy algorithm called weighted simultaneous orthogonal matching pursuit to efficiently approximate the global optimal solution. Then, we apply the WJSR for mixed noise removal by jointly coding the grouped nonlocal similar image patches. The denoising performance is further improved by incorporating it with the global prior and the sparse errors into a unified framework. Experimental results show that our denoising method is superior to several state-of-the-art mixed noise removal methods.

Keywords– Greedy algorithm, image denoising, joint sparse representation (JSR), nonlocal similarity, weighted sparse coding.

I. INTRODUCTION

A method which is used to transform an image into digital form and applied some operations on it is called an image processing. Image denoising is an important image processing task, both as a process itself, and as a component in other processes, very many ways to denoise an image or set of data exists. The main properties of a good image denoising model are that it will remove noise while preserving edges is known as image denoising.

Techniques of image noising and denoising:-

A. Noise Models: Unwanted information in an image is known as noise. Noise produces undesirable effects such as artifacts, unrealistic edges, unseen lines, corners, blurred objects and disturbs background scenes. Prior learning of image is required to reduce effects of the noise. Here we will discuss few noise models, their types and categories in digital images:

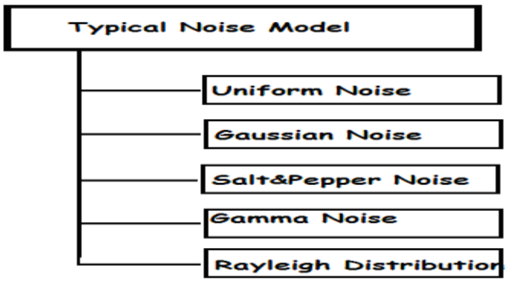

Figure 1: Noise Model

1) *Gaussian Noise or Amplifier Noise:* Probability density function [PDF] of the normal distribution is present in a noise. It is also known as Gaussian distribution. This part of image is present in dark area of noise with constant level of noise signal.
2) *Uniform Noise:* The uniform noise cause by quantizing the pixels of image to a number of distinct levels is known as quantization noise. Uniform noise can be used to generate any different type of noise distribution.
3) *Salt and Pepper Noise:* The salt and pepper noise are also called impulse noise, spike noise, shot noise caused by the malfunctioning pixel elements, faulty memory location in the camera sensors and timing error in the digitization process. There are only two possible values exists that is a and b in salt and pepper and the probability of each is less than 0.2. If the numbers greater than this numbers the noise will swamp out image. For 8-bit image the typical value for 255 for salt-noise and pepper noise is 0.

   Reasons for Salt and Pepper Noise:
   a) Failure of cell memory
   b) Camera's cell sensor malfunctioning
   c) Synchronization error in data transmission
4) *Gamma Noise:* The noise can be obtain by the low-pass filtering of laser based images.
5) *Rayleigh Noise:* Radar range and velocity images typically contain noise that can be modeled by the Rayleigh distribution.

II. FILTERS

To achieve number of tasks such as reduction of noise and re-sampling basic function of image processing is applied known as filtering. In the entire image processing, filtering is used as a basic process. The behavior of data and task performed by the each filter is determined by the filtering. By preserving important and useful information, filtering is used to remove noise of the image [7]. Filters can be described by different categories:-

g(x, y)=Corrupted image f(x ,y)=Filtered image

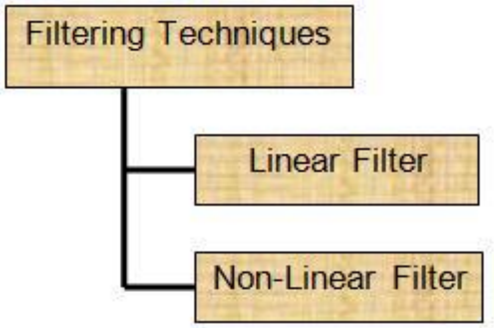

Figure 2. Filtering Techniques:

A. *Linear Filters:* To remove particular type of noise, linear function is used. Averaging filters or Gaussian are suitable for this purpose. These filters are used to blur the sharp edges, destroy the lines and other fine details of image, and perform badly in the presence of signal dependent noise [6].
B. *Non-Linear Filters:* Weighted median, rank conditioned, relaxed median, rank selection is types of non-linear median filter which are developed to overcome the shortcoming of linear filter.

Different Type of Linear and Non-Linear Filters:

Mean Filter: The mean filter is a type of simple spatial filter. It is a sliding-window filter. It replaces the center value in the window. It also replaces with the average mean of all the pixel values in the kernel or window. The window is usually square but it can be of any shape.

III PERFORMANCE PARAMETERS

For comparing original image and uncompressed image, we calculate following parameters:

A. *Mean Square Error (MSE):* The MSE is the cumulative square error between the encoded and the original image defined by:

$$MSE = \frac{1}{mn}\sum_{0}^{m-1}\sum_{0}^{n-1}\|f(i,j) - g(i,j)\|^2$$

Where, f is the original image and g is the uncompressed image. The dimension of the images is m x n. Thus MSE should be as low as possible for effective compression [4].

B. *Peak signal to Noise ratio (PSNR):* PSNR is the ratio between maximum possible power of a signal and the power of distorting noise which affects the quality of its representation. It is defined by:

$$PSNR = 20\log_{10}\left(\frac{MAX_f}{\sqrt{MSE}}\right)$$

where MAX f is the maximum signal value that exists in our original “known to be good” image.

C. *JSR method for removing mixed noise:* Image denoising is a vital inverse issue that plans to recover the original image however much as could reasonably be expected from its noisy form. Joint sparse representation (JSR) has demonstrated extraordinary potential in different image processing and PC vision tasks. Weighted joint SR (WJSR) model for coding a group of comparable signals (e.g., image patches) corrupted by clamor and anomalies. These comparable signals are coded by the same dictionary atoms however with various weights to endeavor more regular information shared by them. The model is then unraveled by a greedy algorithm, to be specific weighted concurrent orthogonal matching pursuit (W-SOMP), which can proficiently estimate the global optimal arrangement. The proposed WJSR model is stretched out for mixed commotion evacuation by processing every patch set that contains a group of comparative patches extracted from the noisy image. In addition, the WJSR is consolidated with the global and sparse blunder priors, into a variational framework, to promote enhance the denoising execution. The proposed algorithm has taking after strides.

1) *Patch matching:* The comparable patches searching procedure is somewhat not the same as the above one, since the image patches in this issue could be corrupted by exceptions (e.g., IN) which truly distort the closeness structures of patches. Thusly, apply the above searching procedure straightforwardly on the raw images will prompt to great degree terrible results. To defeat this issue, the comparative patch searching procedure is led on the pre-filtered images instead of on the raw images straightforwardly.
2) *Weighted Joint SR:* Since the patches in every fragment are fundamentally the same as each other, it is sensible to expect that they lie in a subspace. Along these lines, each comparable patch is coded by the WJSR model. After all the patches are evaluated, the denoised image is then reconstructed by averaging all the overlapping patches.
3) *Global Priors and Sparse Errors:* To improve the nature of denoising result, two regularization

terms are considered in this algorithm, one is the global reconstruction constraint, the other is the consistency between the underlying estimation and the last output.

4) *Iterative Denoising Algorithm:* An iterative denoising algorithm is proposed to expel mixed commotion in this area. In this proposed denoising algorithm, the input reference image is the denoised image reconstructed by the WSR model. Dictionary is exceptionally critical in the SR model. In this approach, the Discrete Cosine Transform (DCT) is picked as the dictionary because of its simplicity.

IV. PROBLEM FORMULATION

The image de-noising is the technique which is used to remove noise from the image. When noise may added in the image it leads to reduce image quality due to which PNSR of the image reduced and MSE get increased. In the base paper technique is proposed which is based on weight based spears matrixes. In this proposed technique is image will be taken as input in which noise is already added. The whole image traversed using morphological scanning. When whole image is scanned according to features of the image spears matrixes are created in which image with the different features are stored in the matrix. When the spears matrixes are created, features which are different from other image are removed from the image. The main disadvantage of proposed technique is execution time and image denoising rate. To improve image de-noising rate and reduce execution time improvement will be proposed in existing spears matrixes.

V. TECHNIQUE : GREEDY ALGORITHM

The image de-noising technique will remove all noise from the image and it leads to improve image quality. In the base paper, technique is proposed which is based on to de-noise the image and improvement is based on greedy algorithm to analyze image features

STEPS OF GREEDY ALGORITHM

- Initially the set of chosen items is empty i.e., solution set.
- At each step
  - item will be added in a solution set by using selection function.
  - IF the set would no longer be feasible
    - reject items under consideration (and is never consider again).
  - ELSE IF set is still feasible THEN
    - add the current item.

Algorithms for optimization problems typically go through a sequence of steps, with a set of choices at each step. For many optimization problems, using dynamic programming to determine the best choices is overkill; simpler, more efficient algorithms will do. A greedy algorithm always makes the choice that looks best at the moment. That is, it makes a locally optimal choice in the hope that this choice will lead to a globally optimal solution.

IV. CONCLUSION

In this paper, a robust WJSR model was presented to simultaneously code a group of similar data corrupted by noise and outliers. Moreover, inspired by the greedy algorithm, we proposed a W-SOMP algorithm to solve the proposed WJSR model by approximating the global optimal solution. The approximation capacity of W-SOMP was theoretically analyzed and experimentally validated. Finally, we incorporated the WJSR model, global image priors, and the sparse errors into a unified framework to remove mixed noise in images. In the denoising framework, the WJSR is expected to explore the common information shared by the nonlocal similar pathes to preserve more image details. The global priors is used to ensure the restored image approach to the original image, and the sparse errors is utilized to force the outliers to be sparse. Experimental results demonstrate that our proposed denoising method achieved better performance in removing mixed noise than state-of-the-art methods.

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