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Research paper

Denoising of Satellite Images Using Hybrid Filtering and Convolutional Neural Network

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Abstract

The concept of machine learning is useful for various applications and the Convolutional Neural Network (CNN) plays a major role on it. This paper proposes the denoising of satellite images using the machine vision. The noise in an image cannot be find out without distinguish the information and noise. The CNN differentiates the actual information and it is separated by the noise and applying the method to remove the noise. Also, it balances the effect of removing the noise from the original image. The noise removal image is enhanced for better visualization and the quality of the enhanced image is measured with Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR)

Keywords: *Image De-noising, Hybrid Filtering, Convolutional Neural Network (CNN), Image Enhancement*

1. Introduction

There are different types of noises affecting the image and it can be reduced by the filters used by the designer. At first, the designer has to identify the type of noise using some algorithms or some measurements. After that, the designer develops the algorithm with some filters for reducing such type of noise. Nowadays, it becomes easier by using machine learning tools and Convolutional Neural Network (CNN) implementations. The CNN checks the type of noise affected in an image and determines the corresponding filtering techniques to reduce the noises. The proposed work uses hybrid filtering technique to remove the noise in the image. After denosing, the image cannot be visualized clearly. To overcome this problem, the image enhancement is performed for better results.

2. Related Work

Bo Hao Chen et al. proposes Radial basis Function (RBF) based approach for Haze removal which learns single and multi-atmospheric veils to retain the visible edges [1]. Gurpreet singh et al. and Jia et al. proposed the machine learning concepts and deep stacked sparse auto encoder techniques to remove the noises in the medical images like MRI and CT scan images, by analyzing those images by the deep neural network [2, 3]. Roy.s.s et al. proposed the CNN based denoising techniques, which uses general denoising auto encoder, convolutional denoising auto encoder and variational denoising auto encoder for noise removal during reconstruction of an image, so called hybrid denoising method [4]. Huihui song et al. (2018) proposed a spatiotemporal image fusion especially designed for low spatial resolution images from MODIS and LANDSAT satellites. The Convolutional Neural Network is used to map the pixel between the two images, and also the weighting techniques are used to improve the details of every pixel [6]. Nowadays, the image denoising is performed by using deep stacked auto encoder, which is the technique derived from the machine learning and deep learning neural network. Here, the same denoising of images are implemented using Convolutional Neural Network (CNN) without using auto encoder. The CNN is also a part of machine learning concepts, which is useful to reduce the complications while implementing the denoising techniques in the image.
The main wavelet is discrete wavelet transform are very suit for satellite image enhancement, segmentation and restoration.In wavelet examination, the Discrete Wavelet Transform (DWT) breaks down a flag into an arrangement of commonly orthogonal wavelet premise capacities[13].

3. Proposed Methodology

The image with full of noises are given as a input to the trained convolutional neural network to determine the types of noises affected in that image. If the image is affected by more than one noise means, the CNN has to include various types of filters to reduce or remove the noise. The usage of many filters to remove the noises is called hybrid filtering technique [10]. If the image is affected by salt and pepper noise, then the median filter should be used to remove the salt and pepper noise [11]. If the image is affected by the Gaussian noise, then the Gaussian filter should be used to remove the Gaussian noise. If the image is affected by both salt and pepper noise and Gaussian noise, the both the filter should be used to remove those noises [12]. This can be done by the trained CNN. The trained CNN preserves the original information in an image during the removal of noise. The block diagram of proposed model is shown in figure1.
The process of evaluation considers different layers of an image to find the types of noises affected in the image. The hybrid filtering technique can be designed by CNN based on the noise affected in the image. The CNN also describes the procedure to be followed

during the implementation of different filters [7, 9]. At first, it removes the noises which can be easily removed. Then, it applies different filters to remove the rest of the noises. The different layers of input image are shown in the figure2.

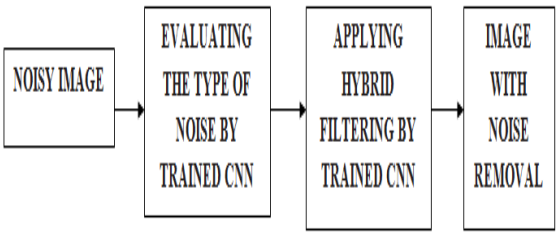


Fig.1: Block diagram of the proposed model

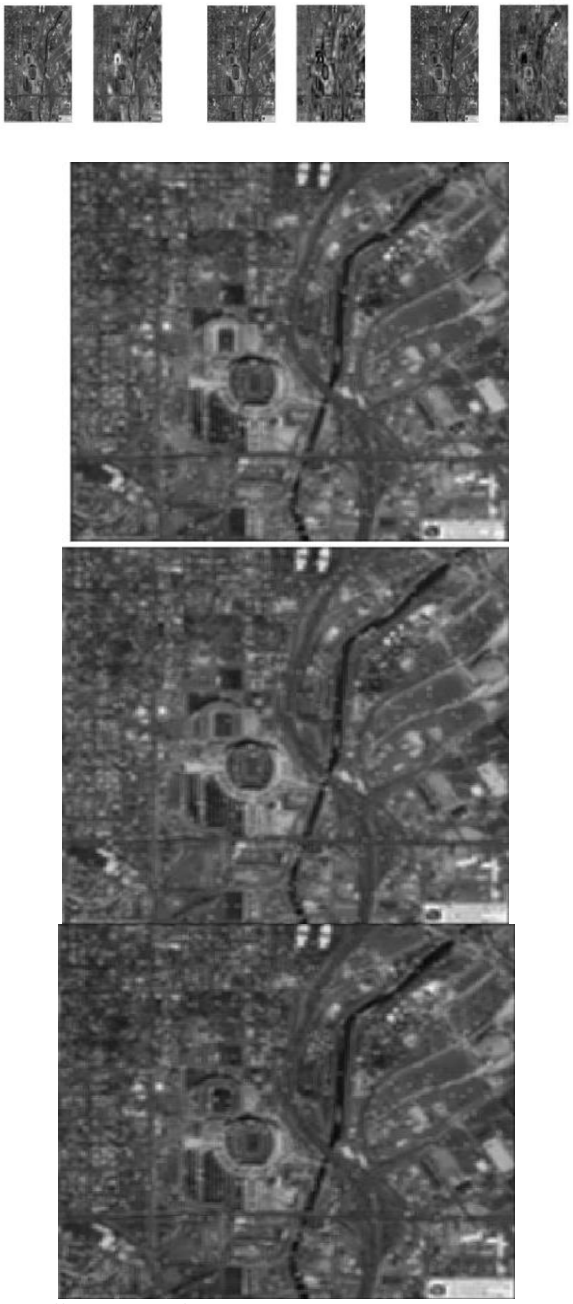
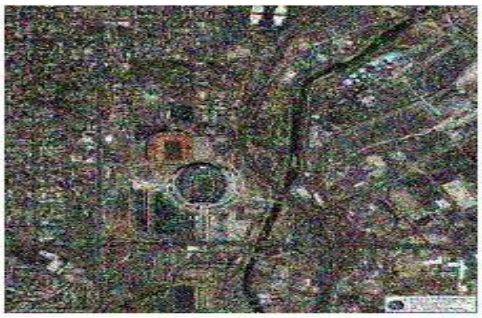


Fig.2: Different layers of an image duringthe evaluation process by CNN

4. Results and Discussion

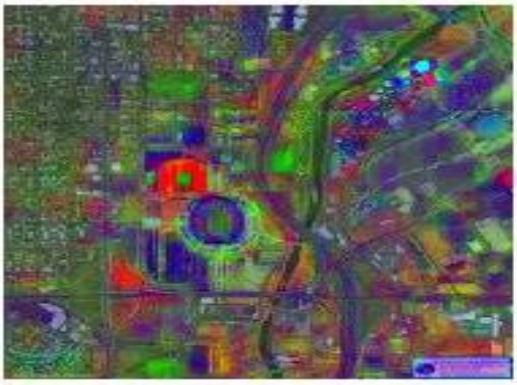
The figure 3 (a) shows the noisy image, which has taken as input and the CNN performs stage by stage processing of removing noise shown in figure 3 (b). The complete noise removal image is shown in figure 3 (c) and the enhanced output image is shown in figure 3 (d). The quality of denoised image can be measured by Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR). The table 1 shows the obtained PSNR and MSE values [7, 9]. The figure 4 shows the message box of obtained MSE and PSNR.



(a) Noisy input Image

(b) Stage 1 Noise removal

(c) Output image with complete noise removal



(d) Enhanced output imagee

Fig.3: Input image and Different output stages of CNN

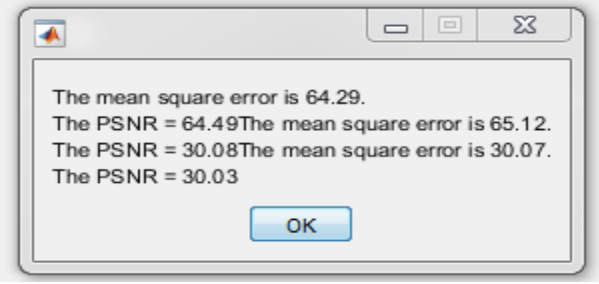


Fig.4: Message box displaying MSE and PSNR

Table 1: Evaluated MSE and PSNR of both input and output images

	NOISY INPUT IMAGE	CNN OUTPUT IMAGE	ENHANCED IMAGE AFTER IMAGE DE-NOISING
MEAN SQUARE ERROR (MSE)	**63.85**	**64.09**	**30.06**
PEAK SIGNAL TO NOISE RATIO (PSNR)	**64.69**	**30.11**	**30.11**

5. Conclusions

Thus, the noise can be removed with the help of CNN by preserving the information in the image. The resultant image has free from noise and having only original information. It can be possible by applying hybrid filtering technique, which is periodically changed by the CNN.

(Fig6.Initial Level Energy Assigned)Here medical components are identified based on assigned energy level and each component status are received to the cluster head and then forward to the microcontroller from the separate cluster group.(Fig7.Medical components to be received from cluster head) After received the medical components based on the energy status then it forwards to the hospital server with collected medical components in the medical field organization. (Fig8. Calculation of energy level) The received medical components of energy level to be forwarded to the specific component from the cluster head. Each clusters are happened parallel the same scenario for find out the energy level and easy way to saving the energy based on replica of components to be filtered in the medical field organization. (Fig9. Number of Nodes Vs Packet Delivery Ratio) In X-axis is the Number of nodes and Y-axis is the Packet Delivery Ratio or Data Communication for lifetime of the patient status to be increased as well as to increase the power consumption.(Fig.10 Number of Nodes Vs Throughput) In X-axis is the Number of Nodes and Y-axis is the Throughput (Mbps) for Data Transmission from the node and identify the multimedia data status and then energy consumed based on the initial assigned energy level. (Fig.11 Number of Nodes Energy Prediction) In X-axis is the Number of nodes and Y-axis is the Prediction of energy level using the harvesting energy statusimproved when performs the algorithm with protocol to be high stage of the medical field performed in the wireless sensor network.Monitoring, object tracking, and power consumption with low or high battery lifetime consumed using Efficient Energy Saving Cluster Formation Algorithm. These networks massively distributed nature provides increased resolution and fault tolerance of the sensor nodes with saving energy improved in the hospitalization environments which those networks are based on the cluster formation under the wireless sensor node is battery operated with energy constrained.

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