DE-NOISING OF STEEL PLATES USING BINARY WINDOW COUPLING MEDIAN FILTER

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Abstract

The quality of image is spoiled by various types of noise and it can be removed by different filtering mechanism. These mechanisms help to maintain the quality of the image and also increase the SNR (Signal-to-Noise Ratio) value. This research introduced a new filter Binary Window coupling median filter (BWCMF) to improve the quality and reduce the computation time. The proposed effectively suppresses the impulse noise in the image whiles preserving the image edges information, lower processing time and enhancing the image quality. The proposed filter compared with Mean, Median and winner filter. The performance of this algorithm is measured by PSNR and MSE (Mean Square Error). The result shows that the proposed filter increases the PSNR value and reduces MSE (Mean Square Error) metric values and produces good results.

KEYWORDS: Mean Filter, Median filter and Winner filter

INTRODUCTION

Steel is one the high demanded industrial material. It has major role to play in increasing the per capita income of the country. It also acts as the basic material in many industries like construction, infra structure, making machineries, etc., steel is the material which found in common demand worldwide.

Therefore, quality assurance of the material is considered as the most important attribute. Due to increased competition in product supply makes, the manufacturer task to find suitable market for his/her product challenging. But, there is always ever ending requirement for the quality industrial products in market. Hence, it is becoming unavoidable to have an eye on perfection of the product to meet up the international standards. This helps the steel industries to compete globally.

Efficiency in Crude steel production must be maximized and inspection in the quality has to be enhanced. In present scenario the quality check is done visually by employing man power. This process is time consuming and the efficiency of the work is not completely reliable to meet the global standards. Hence it has laid a path to automate the defect detection and classify the defected products to reduce the defects in the finished products.

TYPES OF STEEL DEFECTS

The most common defects identified in the cure steel is classified broadly in following categories as:

a) Surface defects

b) Textural defects

c) Dimensional defects

Surface defects are changes generated on the surface of the sheet such as corrosion, burn, offal (entrails) - Non-metallic materials existed on the surface of the sheet-, holes, scratches and cracks produced on the surface of the sheet. Textural defects like folding of sheet steel and dimensional defects like being convex or concave. In Figure 1, some of these defects have been shown [1].

In this research proposed a enhanced pre-processing techniques for the steel surface defects. The identified defects are further classified into different categories. This enhances the automated defect identification without any human intervention. This process reduces the time and increases efficiency.

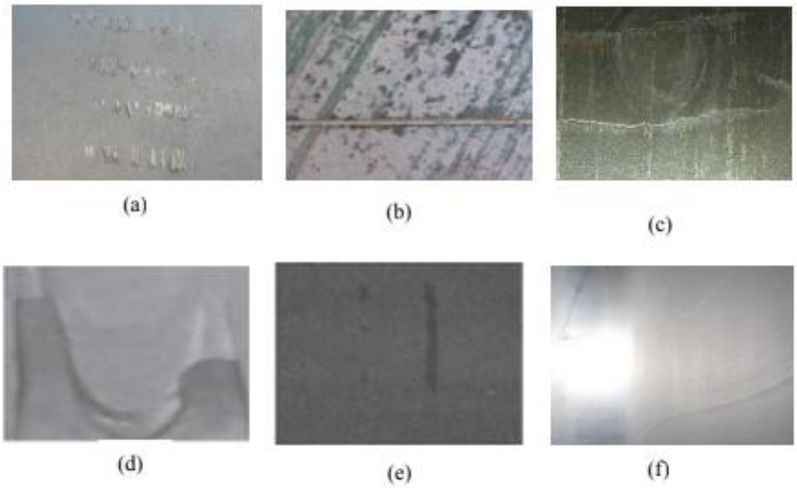

Fig 1: Sample images of hot rolled steels. Roll imprints (a), transverse scratches (b), transverse cracks (c), scar (d), oil stains (e), lighting variations (f).

Existing Methodology:

A good amount of reported works on manned inspection and defect detection are based on statistical and filter based approaches [6]. The most well known approach is grey-level co-occurrence [10] matrix is used for feature extraction in defect detection.

Kruger et al.[11] applied GLCM and Fourier Domain analysis for defect diagnosis in the x-ray images. Also filter based methods are also used for the same purpose. The methods are further divided into three types [6]. Ade [12] proposed “eigenfilters” in spatial domain, a set of masks obtained from KL transform of local image patches, for texture representation.

Kumar and Pang [13] introduced a method to detect both the defective and non defective regions of the image. And those images are collected and optimized filters were used on it. Bharati and MacGregor [15] used PCA for texture analysis of steel surfaces.

Recently, Tomczak et al. [17] applied PCA in texture analysis of wood and rock images. They proposed a scheme which divides up texture image into non-overlapping areas, applies PCA for describing e ach area and uses fuzzy c-means to classify each area as defective or non-defective.

Many other methods apply frequency domain filtering. Especially when no straightforward kernel can be found in spatial domain or the application is real time. Fourier transform and the fast form of it called Fast Fourier Transform (FFT) are one of the major tools in frequency domain filtering. Tsai and Hsieh [18] used the Fourier transform to reconstruct textile images for defect detection.

The line patterns in a textile image, supposed to be defects, were taken out by removing high energy frequency components in the Fourier domain using a one-dimensional Hough transform. The differences between the restored image and the original one were considered as potential defects. A similar idea was explored by Tsai and Huang [19], but low pass filtering was used to remove the periodic information. These methods will not be suitable for defect detection in random textures [6]. Since Fourier coefficients are based on the entire image, Fourier transform is not able to localize defective regions in spatial domain. In order to add spatial dependency into Fourier analysis, the windowed Fourier transform is introduced, that is the basic idea of joint spatial/frequency domain techniques. Gabor and Wavelet transforms are two well-known techniques of this category. Turner [20] for the first time proposed the use of Gabor in texture analysis. Since then, the Gabor filter banks have been extensively studied in texture analysis and visual inspection. Dr.M.RenukaDevi, V.Kavitha [26] introduced a hybrid filter to solve the problem of noises in the citrus fruit images. It combined the following two filters such as median and wiener filters. In this paper performance of all filters were compared using metrics such as PSNR and MSE[25].

Proposed Method

The proposed effectively suppresses the impulse noise in the image whiles preserving the image edges information, lower processing time and enhancing the image quality. The proposed method uses the overlapping window to filter the signal based on the selection of an effective median per window. In the proposed method the size of the window is fixed, however, the median may be different from the value at the middle of the sorted pixel values.

Algorithm Steps:

The proposed novel filter consist of the following steps

Step 1: Read the noisy image

Step 2: Image conversion rgb image to gray scale

Step 3: histogram based image contrast enhancement

Step 4: Add Salt & pepper noise. Applying binary window coupling Median Filter (BWCMF) for Gray Image. Indexing Row of noisy pixel. Indexing Coloumn of noisy pixel

Step 5: Indexing Column of window. Extracting noisy window. Checking complete winow is noisy or not.

Result and Discussion

The proposed method is implemented by using MATLAB and compared with existing algorithm. The following figures show the experimental result of proposed method. Figure 1 shows the input image given to the proposed filter. The input image is converted in to gray scale image, then it is introduced with noise and this is denoised by proposed method. It gave higher PSNR value.

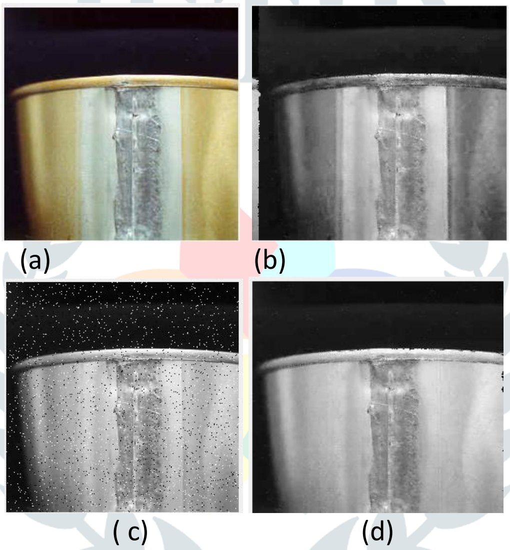

Figure 1.(a) Input Image (b) Gray Scale Converted (c) Image with Speckle Noise (d) noise removed with Proposed filter

The PSNR value of the image at various noise density is used to assess the quality of image.
The Table 1 shows the comparison of PSNR value of existing with proposed filter. The comparison made between median, mean and winer filter with proposed filter. When compared with existing filter the proposed algorithm produced better result than other filters with different noise density. Table 2 shows the RMSE values of existing and proposed system. When comparing with other system proposed system shows the lowest RMSE value.

Table . 1 PSNR value of Different Noise Density

		Noise Density in db							
	15%		25%	35%	45%	55%	65%	75%	85%
Median filter	68.13		69.56	70.55	71.57	74.46	75.52	79.09	80.62

Mean	63.47		64.42	68.08	70.76	71.51	73.54	75.44	76.82
Winner Filter	68.44		69.40	72.45	74.56	76.45	78.34	80.23	82.07
Proposed Filter	69.12		71.23	72.45	73.56	74.67	75.56	77.67	85.06

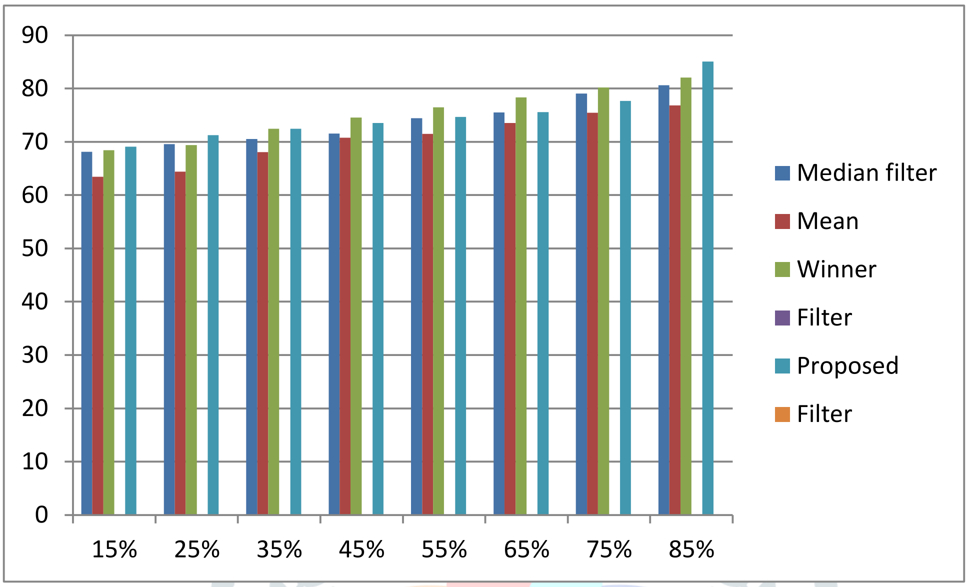

Figure 2 Comparison of PSNR values with proposed filters

Table 2 RMSE value of Different Noise Density

Filter	Noise Density in db							
	10	20%	30%	40%	50%	60%	70%	80%
Median filter	1.032	1.050	1.030	1.010	0.990	0.980	0.970	0.985
Mean	1.010	1.008	1.000	0.990	0.980	0.975	0.962	0.960
Winner Filter	1.023	1.045	1.072	0.972	0.976	0.983	0.964	0.990
Proposed Filter	0.990	0.980	0.960	950.43	0.860	0.825	0.810	0.790

Conclusion

In manufacturing industries images play a important role. Defect classification is used to predict the defects in steel plates and also its defects percentage. The pre processing is one of the stage in classification of defects identification. Preprocessing of steel images are very important. Filters are used to remove the noise and improve the image quality. The proposed filter offered good result. The experiment result prove the quality of the image. To prove the Efficiency PSNR and RMSE values are taken for comparison. The proposed system provides the relevant result than the other existing system.

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