

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

Nosing out Defects on the surface of a Steel Product in Manufacturing industries: Result Oriented

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ABSTRACT: Emanating are new methodologies in the domain of image processing, especially when it comes concerned with identification of many types of defects on surfaces of steel products. Manual practices yield in difficulties, time consumption and inaccuracy. Hence there is definite need of automation in this field. This paper is highlights the results obtained after processing of the proposed methodology.

KEYWORDS: GLCM, Probabilistic neural network, Co-occurrence feature.

I. INTRODUCTION

Emanation of various technologies in the domain of recognition of surface defects on steel products has been proposed. But there is involvement of manual practice too. Basically when we have to enforce man power then the use of an automation system comes into doubt. In order to get rid of this very limitation we have proposed a better method.

Moreover, the manual inspection might give inconsistent results especially when it comes to evaluation of variety of surface defects of the product of steel in a manufacturing industry. Methods of analysis of surface defects and its testing are used to assure the correctness and quality of the surface defect after it is completed. These are divided into non-destructive and destructive methods. Literally this term refers to testing and analysis focused on the strength and quality of the defect, but may refer to technological actions to check for the position, presence and extent of defects. Non-destructive methods include magnaflux tests, fluorescent penetrate tests, hydrostatic testing, eddy current (electromagnetic) tests, tests using X-rays, magnetic particles, and gamma ray based methods and acoustic emission techniques. Also, other methods include ferrite and hardness testing. Moreover, other destructive methods include tensile strength break testing, acid etch testing, nick break testing, back bend testing, and free bend testing. A few examples of destructive testing include macro etch testing, fillet-weld break tests, transverse tension tests, and guided bend tests.

Common weld defects include the following defects, which are Lack of penetration or excess penetration, Lack of fusion, Porosity, Undercut, Inclusions, Cracking, Lamellar tearing. We know, welding defect is any flaw that compromises the usefulness of a weldment. Any of these defects are potentially disastrous as they can all give rise to high stress intensities which may result in sudden unexpected failure below the design load or in the case of cyclic loading, failure after fewer load cycles than predicted. Bad weld grooves is one of the reasons for causal of welding defects. Poor processing conditions and error in operator can also be causes. Consumables being incorrect and wrong techniques are also root causes behind surface defects, especially weld defects. The global economic development has gradually led steel production industries to increase its production rate ensuring simultaneously stringent limit on the quality of product. This has an obvious benefit in terms of quality assurance.

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Inspection may be manual, conducted by an inspector using imaging equipment, or automated using machine vision. One (destructive) method involves the microscopic analysis of a cross section of the weld. Since the similarity of materials between weld and work piece, and between good and defective areas, provides little inherent contrast, the latter usually requires methods other than simple imaging.

Section II explains the Related work. In this section a brief survey has been done on existing methods; there disadvantages (if any) are highlighted. Section III deals with various classes of defects on the surface of steel product(s). Furthermore in section IV proposed methodology is discussed in details. Section V highlights results and discussions.

II. RELATED WORK

Considerable algorithms were proposed for encountering flaws on surface of steel products. One by one as we proceed ahead, we will have a look over the previous proposed methodologies. But the standard algorithm is the one in which complexity is lesser and accuracy is better.

A) Survey 1: Dig up via wavelet technique

Well! After a definite series of experimentation it was merely found that when it came to comparison between the three procedures, one of the three won the race. The experimenters took a casting, that in that casting there were X shrinkages, Y air hole defects and Z foreign objective defects. Shrinkage is a slight dimensional reduction due to reduction in the volume of the moulded material during the solidification and cooling process. Air hole defect occurs when bubbles of air are formed within moulded material, after its cooling. The defect caused by a foreign object of higher material density, due to which an image of low optical density appears is foreign objective defect.

The method of detecting defects by use of the wavelet technique proves to be better. But the drawback was that for each image the total number of levels of multiresolution had to be found out by manually [1].

B) Survey 2: Geometrical detection

There were two issues here. First issue was the illumination being awry. The second trouble was with the background being intricate. This very algorithm was tested on several samples; on more than some 400 samples. The result came out 86% or a little more of samples getting detected [2].

C) Survey 3: Rummage based on Multi variate analysis

There was use of two methods. But it became important to knock out necessary data from database of important data sets [3].

D) Survey 4: Ferret through Geometrical features

Here by the help of noise reduction techniques the noise of defected region is reduced. After this the image is converted in binary image. Outer walls is traced by the 3*3 filtering technique. After the trace of boundary, points are plotted. Now the geometrical features are extracted [4].

E) Survey 5: Fibre defect detection

Well! Not only in steel but we have done research in textile industry also. The three approaches were – model based, spectral and statistical. Damn different results were given by all approaches and it was suggested that the combination could give better result than a single approach being used [5].

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Vol. 4, Issue 7, July 2015

III. VARIETY OF DEFECTS ON SURFACE OF STEEL PRODUCTS IN AUTOMATION INDUSTRY

The detection of defect is important, but classification of defects is more important in its comparison.

A. Surface Defects on the basis of its Appearance

Surface defects of steel plates can be broadly categorized into two main categories:

- 1) Textural defects
- 2) Geometric defects.

Textural defects can be detected based on textural analysis. Whereas the geometrical defect is considered, they can be detected using algorithms based on morphological operations. Techniques have been mastered to detect these two defects very well. So, let us move to the next section of defects.

B. Defects of surface with respect to the localization in Space

As far as classification of surface defects on basis of space localization is concerned there are two principal types of defects encountered, which are as follows:

- 1) Local defects
- 2) Distributed defects

The disagreement among both the above defects is only their discontinuity over the surface of the very product. The former appears in a discontinuous way and also occur on various places of the surface. Whereas, on the other hand, the latter spreads over the product surface in a very continuous manner. This difference over this property of appearance makes the two defects different. Moreover there are various ways to predict them. Scale grain, rolled in scale, slab edge, and salt and pepper are amongst the defects which spread in a continuous manner on surface. Therefore, these defects may be classified as distributed defects. Head mark, rupture, bruise, scratches, blister, crack, etc., are amongst those defects which are not so continuous over the surface. Hence these fall under the category of local defects.

Now when it comes to weld defects, we must know that it is nothing but a flaw. The chances of its causal might be due to bunch of reasons in its root cause. Reasons such as worse weld grooves, bad processing circumstances, consumables being not so correct and last but not the least there might be problem with operator. As far as cracks are concerned, reheat cracks are quite frequent molybdenum steel products. Solidification cracking can be avoided by a proper filler material. Weld defects such as fusion line cracks and others such as hat cracks are caused due to extreme high voltage. Causal of transverse cracks are due to the high level of residual stress and hydrogen.

IV. PROPOSED METHODOLOGY

Many algorithms have been proposed for detecting defect on surface of steel products but the standard algorithm is the one which accommodates lesser complexity and better accuracy.

Training samples undergo texture analysis. Before further going ahead we need to know that training samples is nothing but the database. Well! texture analysis seeks to derive an efficient and compact quantitative description of textures so that various mathematical operations can be used to compare, transform alter the very textures. Now extraction of texture features from the training samples takes place. Filter is applied on test images; any efficient filtering process can be taken for convenience, say, for instance we take wavelet. Lifting wavelet filtering technique and Daubechies wavelet filtering technique are the two types of wavelet filters are applied. High and low frequency components are separated into four sub bands, namely LL, LH, HL, HH, where 'L' stands for low and 'H' stands for high. This is been done by the use of these two filters.

Gray Level Co-occurrence Matrix (GLCM) is applied on the input images, i.e. test images. By the GLCM technique Co-occurrence features of the very images are extracted and that too after the two filtering operations. Four parameters of input images are extracted via this procedure. We will see exactly which parameters are we extracting. And we get to know those parameters are homogeneity, contrast, correlation, and energy.

International Journal of Innovative Research in Science, Engineering and Technology

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The classifier used in this methodology is Probabilistic Neural Network-Radial Basis Function (PNN-RBF). This classifier classifies test images into multiple categories. Both, the Features of training samples and input image samples are fed to this very classifier. For example, if there are 10 samples, then the 4 features extracted from GLCM technique will combine into 10×4 i.e. 40 features. Now these 40 features will get compared to the features of training samples and one conclusion will be given; the result will be given, i.e the input sample is normal or not. If it is normal, process stops there itself stating that the image is normal. But, if it comes to be defected then segmentation is performed on it. The post processing operations like thresholding and filtering is performed on it. The post processing operation comprises of Gray to Binary conversion. Moreover, suppression of Salt and Pepper noise takes place. By these Morphological operations the region of interest, i.e. region of defect can be detected easily.

V. RESULTS AND DISCUSSIONS

We will see stepwise results of the proposed methodology in detail.

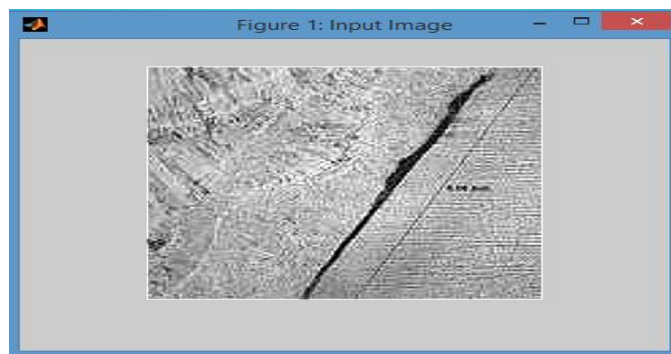


Fig 1. Input Image

Fig 1 is the input image which is fed as the testing image. From the input side the test images are fed. Filtering technique is applied on test images; here we can take any efficient filtering process, say, we take wavelet here for convenience. Two types of wavelet filters are applied, which are Daubechies wavelet filtering technique and lifting wavelet filtering technique. By the use of these two filters low and high frequency components are separated into four sub bands, namely LL, LH, HL, HH, where 'L' stands for low and 'H' stands for high.

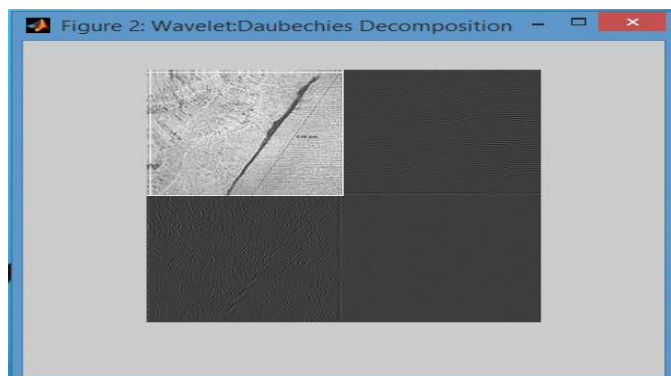


Fig 2. Wavelet Daubecheis Decomposition

Fig 2 shows the result after application of daubechies transform. Mathematical transformations are applied to signals to obtain a further information from that signal that is not readily available in the raw signal. In the following we will

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assume a time-domain signal as a raw signal, and a signal that has been "transformed" by any of the available mathematical transformations as a processed signal. There are number of transformations that can be applied, among which the Fourier transforms are probably by far the most popular. The transformations are applied to signals to obtain a further information from that signal that is not readily available in the raw signal.

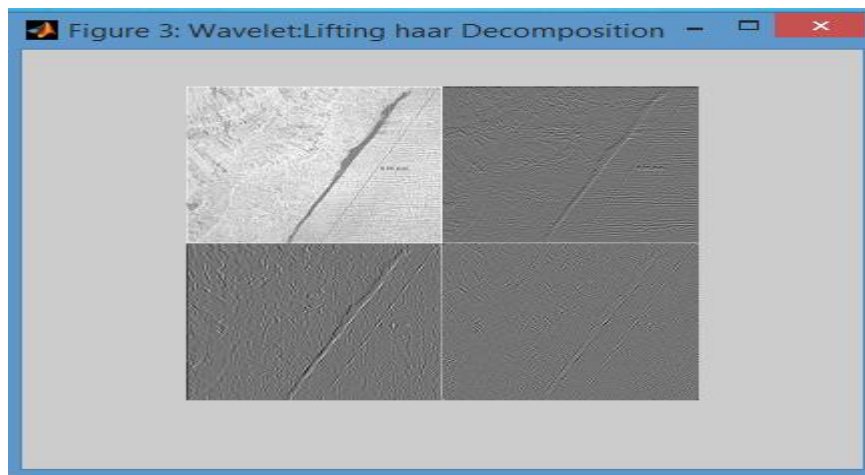


Fig 3. Wavelet Lifting Haar Decomposition

Fig. 3 that is the wavelet Lifting Haar Decomposition elaborates more of the detailing. Most of the signals in practice, are TIME-DOMAIN signals in their raw format. In many cases, the most distinguished information is hidden in the frequency content of the signal. The frequency SPECTRUM of a signal is basically the frequency components (spectral components) of that signal. The frequency spectrum of a signal shows what frequencies exist in the signal.

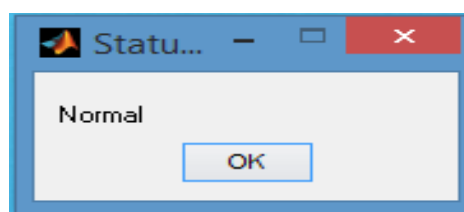


Fig 4. Status: Normal

After the application of Haar transform, we get to know whether the image is defected or not. If image is not defected with any sort of weld defects then we get the status as "Normal". Fig 4 shows this concept. Basically when in the process it is known by the classifier that the image is not defected, this dialog box is flashed within little time and process stops here itself.

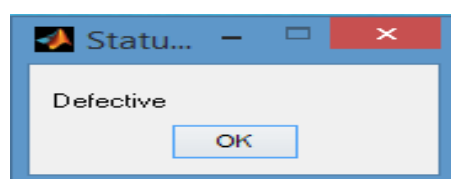


Fig 5. Status: Defective

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Vol. 4, Issue 7, July 2015

Whereas, after the application of Haar transform, we get to know whether the image is defected or not. If image is defected with any sort of weld defects then we get the status as “Defective”. Fig 5 shows this concept. Basically when in the process it is known by the classifier that the image is defected, this dialog box is flashed within little time and further process begins.

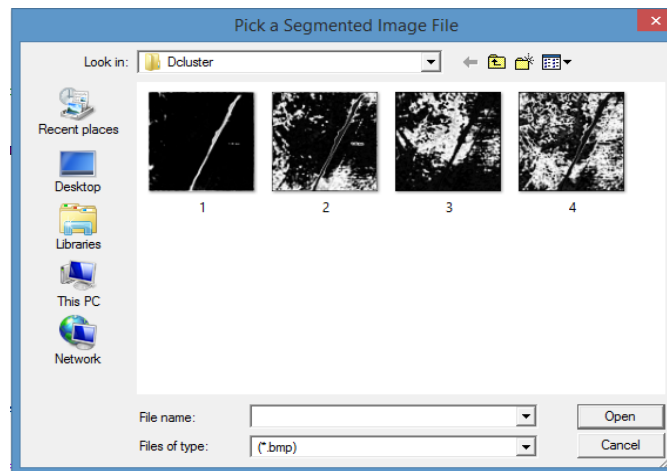


Fig 6. Picking a segment

Fig 6 is the picking of a segment from the clusters. The images are either represented by a matrix of their pixel values (bitmap representation) or by a colour histogram. In both cases, the proposed system does not require feature extraction and performs recognition on images regarded as points of a space of high dimension. We also propose an extension of the basic color histogram which keeps more about the information contained in the images.

When trying to classify images, it is very difficult to have a representation which takes into account the intrasec features of a class rather than the specific features of its objects. In spite of the fact the color histogram technique is a very simple and low level method, it has shown good results in practice. As color is a discriminative component in image classification we keep this information, where the luminance component provides enough information to recognize objects.

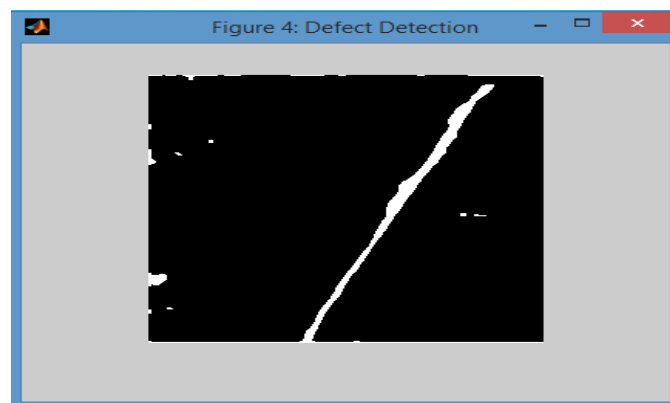


Fig 7. Defect Detection

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Fig 7 is defect detection of the weld defect. Here the defected part gets highlighted. The defected part is in light colour whereas the rest part is black. When it comes to post processing , encompassing the process of images being altered comes into picture. Raster images are stored in a computer in the form of a grid of picture elements or pixels.

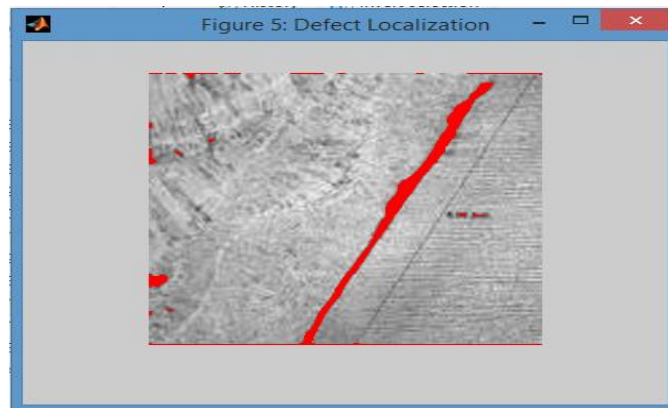


Fig 8. Defect Localization

Fig 8 is the defect localization. Finally the defect is localized here. . If it is not defected, process stops there itself stating that test image is normal. But, if it comes to be defected then segmentation is performed. The post processing operations like filtering and thresholding will be performed. In post processing operation, Gray to Binary conversion takes place. Moreover, Salt and Pepper noise is suppressed. Finally, by these Morphological operations the defect region can be detected. The complexity is lesser of the proposed methodology as compared to previous methods.

VI. CONCLUSION

In this paper, we have seen results of the method to detect the defects on surfaces of the products of steel used in manufacturing industries. Finally we come to the conclusion that the proposed methodology is more efficient than the other methods. The advantage here would be low complexity and high compatibility.

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