Survey: An Analytic Study of Defect in Surface of Metal

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Abstract – Human eyes are enable to detect the micro defect in metal (steel). These defects may cause major problems in device or where it is used. So, the identification of such defects is a challenging task. Today metal (steel) is major row material for various industry. In the digital image processing is one of the major techniques to identify these defects. In this study various types of detection technique of metal are discuss. There is need of accurate and fast detection of metal defect in metal. Traditional methods are unable to detect the minor defect in metal. Some defects cannot be seen by human .If the defective material is used in the part then it results in poor production and quality.

Index Terms – Metal Defects, image processing, technique used in detector the defect in metal.

1. INTRODUCTION

The defect found in metal products and intermediate products are distinguished on the basis of size and location as well as nature and origin of defect. Metal with surface defects are rejected during manufacturing time to avoid further complications. Early detection of defect reduces manufacture cost and help to improve quality of products. One of the most important and required operation on image for defect is to recognize and categorize the various kinds of defects. Thermal is an important raw material for manufacture industries. Casting and welded structured objects may have different types of defects. Smaller defects include pits, bumps, holds, scratches that remain unnoticed until operation is incomplete. Automation plays an important role in any mass production in manufacturing industries. Rejecting or accepting final component before delivery to customer depends on its correctness of required dimensions and other features of the product manual examination is costly, time consuming, sometimes incorrect as it depends on the person who is going to test the product Hence it is human dependent. Quality checking is very important to withstand in market. To check quality of manufactured product it is necessary to identify fault in manufactured product to avoid defected product delivery to customer.

2. RELATED WORK

In the previous years, there are some of the defect detection techniques have been proposed. They are classified in four different approaches. Statistical, model based, structural and filter based. Histogram properties, autocorrelation, local binary patterns, GLCM can be used in statistical approach. With the help of GLCM various statistics of texture like entropy, dissimilarity, energy, correlation, Homogeneity, contrast etc can be determined. T. Aarthi et al [1] proposed a defect detection technique in metal using two dimensional discrete wavelet transform. For the analysis of surface they obtained numerical data from images .This data were used for performing statistical analysis which includes the calculation of mean, variance, standard deviation, kurtosis and skewness from the acquired image. HAARs and Daubechies[2] wavelets were used. In this approach authors went up to 3 level decomposition of image which consists of a 1/64 size smoothed sub image. K.N. Sivabalan et al.[3] used Gabor wavelet filter and Gaussian filter for surface analysis. In this technique Gabor filter were used to eliminate texture elements. Gabor filter output is applied to Gaussian filter to smooth the high energy points. Then fast searching algorithm and segmentation were deployed to find out the defects. But the drawback of this technique is that the method cannot identify defects in high intensity levels. Doo-Chul Choi et al[4], proposed an algorithm for detecting seam cracks in steel plates. An algorithm starts with segmentation of acquired image after that Gabor function is applied for creation of Gabor filter bank. G.M. Atiqur Rahaman et al.[5] ,proposed an automatic defect detection technique for ceramic tiles. For this purpose they use some image processing operations which include image acquisition, image enhancement, noise reduction and edge detection. Wagle and Kato [6], this technique can detect cracks underneath other components, such as washers in nut-bolt connections. The technique is suited for larger areas. Although the localization of the crack is accurate, the smallest length of the detected crack mentioned was 290 μm. As the cracks after bending have smaller dimensions, the technique is not ideal to detect them. Also the large quantity of cracks will probably scatter the image. Rupil [7] describes an experiment, which does not use a speckle pattern, but the surface is polished to ensure a clear image. It managed to detect cracks of 50 pixels or 160 μm using only a 3MP camera to reduce computation time. As

the computation time is not essential with the detection of micro-cracks in bended steel, the camera resolution can be picked higher to improve the detectable crack size. According to Griesbach and Goldfine,[8] a crack of 50 μm could be detected with permanently mounted sensors. With the large deformation of the specimen on the outside radius of the bend, special precautions have to be taken to prevent damage to the sensors. According to Goldfine [8] absolute values can be used, thus allowing measurements to be taken after bending. Normalization.Mayuri [9] divided their work into three sections. Firstly preprocessing steps include gray scale conversion, threshold effect and noisy objects elimination. then secondly the separation of pipe from image is performed by filling the regions by selecting points, interactively. And in the third section, the mathematical operations are done on the defected image and faults are detected. Dilation and erosion operations are performed and calculate the area and eccentricity of defected surface. Using the eccentricity value, the defect is classified accordingly. Tsai [10], proposed a fast normalized cross correlation computation for defect application. The calculations of image mean, image variance and cross correction between image to be invariant size of template window is allowed by the some ratable scheme which is utlilized.Traditional normalized correlation operation is compared with the proposed system and it does not meet speed requirements for applications. The computational complexity can be dramatically reduced. Since the proposed method is invariant to the window size, a user can select a proper window .size to maximize the detection effectiveness for the object under inspection without trading off the computational efficiency. Jagdish Lal Raheja [11], proposed a "Fabric defect detection based on GLCM and Gabor filter: A comparison". K.N.Sivabalan,Dr.D.Gunanadurai [12] proposed Efficient defect detection algorithm for gray level digital images using Gabor wavelet filter and Gaussian Filter". Mostafa Sadeghi, Faezeh Memarzadehzavareh[13], proposed a "Flaws detection in steel plates Using Gabor Wavelet". Rashmi S Deshmukh [14] , proposed a Comparison Analysis for Efficient Defect Detection Algorithm for Gray Level Digital Images Using Median Filters Gabor Filter and ICA .

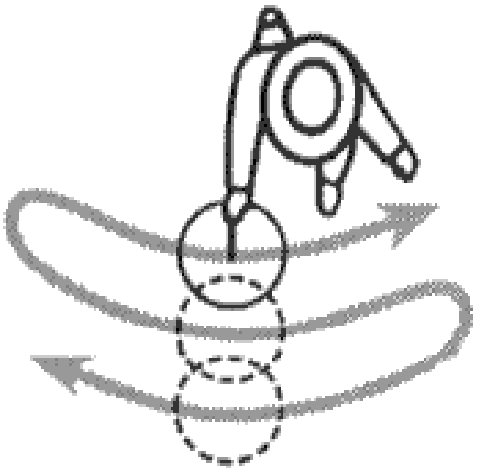
3. METHODOLOGY

Metal Detector Operation for General Techniques .Referred by Author Graham Bell Jr [15] proposed operating a metal detector to requires some easily and basic learned skills to achieve the best performance and to increase finding the targets. The basic operating techniques for the metal detector are as follows.

3.1 Sweeping 1

Sweeping is the first and the basic metal detecting technique. Sweeping is the need to operators. This is the moving of the search Coil from side to side across the ground in order to find buried targets. How the ground area is covered .It is illustrates with the help of sweeping motion is shown in figure no 1.

Figure 1 Sweeping



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When sweeping, you should, In sweeping technique slightly overlap each sweep so that cannot miss any targets is shown in figure no 2.

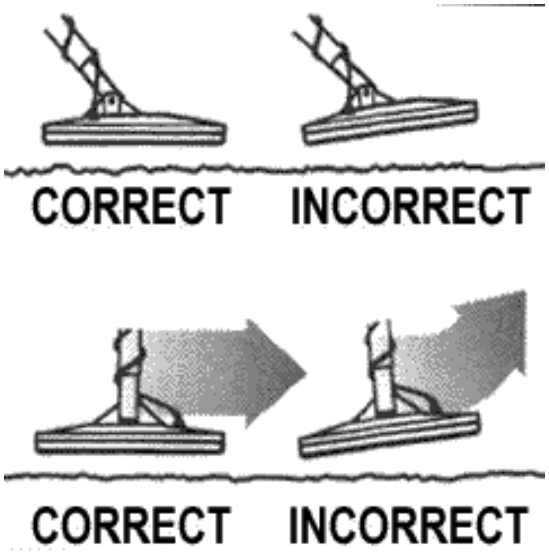

Figure 2 Sweeping technique

To prevent the loss of detection of deep targets to keep the search coil parallel to the ground at all times. The coil at the end of each sweep sometimes has a tendency to to lift operators. The loss of detection depth is possible to be avoided. Don't forget to listen for signals, especially faint ones while sweeping. The dig only the very loud target signals when in fact the faint signals may be a deep or small target.

3.2 Pinpointing the Target 2

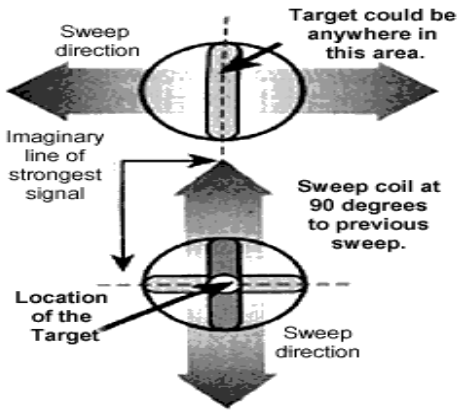

Figure 3 Pinpointing the target

3.3 Digging the Object 3

Johnny b proposed [16].Once the target is pinpointed check the hole again for single and clear the surface material. If there is no signal, the target is between the surface materials. Afterwards search the area until the target is located. And if the signal is still there, remove the few inches of soil from the surface ground and if the target is not visible, swap the coil over the hole again. It should become louder. A valuable coil can be defaced or split in a piece of gold in two by a swift blow to an object with a pick. If the object is not visible there is need to scan the soil which has been dug up so the soil should be pile carefully.

3.4 Whilst digging 4

To locate the target spread the soil out and sweep the coil over it. They the coil on the side near the hole picks the soil from the pile and passes it near the coil. If there is no signal then put the soil in the second pile for from the first and grabs other handful of soil. Until a signal is received continue this process then the target is in our hand. When the object is located sift it through the soil. Once the target is achieved is is good to run the detector on the hole again to make sure that no other targets are to be found. Once it is found there are more chances that there are many target closed by, so it is said to search the surrounding area very carefully.

4. GENERAL METAL DETECTING TIPS

Once the basic operational techniques are mastered, we can move on to more advance technique. It has been detected for almost 20 years and these are just few of the tips picked up over the years. Better research is invaluable in locating good productive sites. Always obtain permission to detect area and never assume that it is right. Swing the coil low and slow always modern detectors used icroproceesor so if the coil is lift at the end of the sweep, then vary the coil high above the ground, or vary sweep speed , the random noises are got at the microprocessor tries to keep up with our actions. If we swing fast we may miss the targets. The detector does not respond quickly as we except or we may not here the target signal. Because its duration to large so slow it down any give the detector time to evaluate the targets..Some people will tell you to buy expensive headphones because they are the best, but my experience is that this is not always the case. There are many medium-priced headphones available around the world that is quite adequate for the job. Remember, you are not listening to a symphony orchestra! It's probably more important to wear a comfortable set that you like the sound of. It is very important to study your instruction manual and understand your detector. Time spent practicing and playing around with your machine is time well spent?. Firstly, assess the area to be searched, and then set the discriminator to reject the surface rubbish. Remember that if you set the discriminator to eliminate drink caps/tabs You may also miss 9ct rings with broken bands, so don't worry if you dig up some junk, at least you won't reject good targets..

5. CONCLUSION

In this paper, survey of various methodologies for detection of defects is presented. This methods classified into sweeping, pinpointing the target, digging the object, whilst digging. A brief description of these method including advantages and disadvantages is given whenever known. The statistical spectral and model based approaches given different results. So, the combination of these approaches can give better results instead of using individual approach. This paper also give a review on various methods and tools used for detecting surface defects on metal.

Sr. No	Author	Method	%of detection
1.	Jadish Lal Raheja[11]	Gabor filter	98.33%
2.	Mustafa sadeghi[13]	Gabor Wavelet	90-98%
3.	RashmiSDeshmukh[14]	Feature Extraction method	90-95%
4.	K.N.Sivabalam[12]	Gabor and Gaussian filter	85-93%

Table 1 Comparison of defect detection technique.

The above table shows that the comparison of accuracy of defect detection. The maximum accuracy is 98.35% for Gabor filter.

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