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ORIGINAL ARTICLE

AUTOMATIC RECOGNITION OF SCATTERING POINTS USING IMAGE PROCESSING TECHNIQUE

PALLAKI PRANAYDEEP REDDY , T.V.RAMA KRISHNA , MS G PRASAD AND K.RAMBABU

M.Tech, Dept of ECE, KL University, Andhra Pradesh, India.
Professor,Dept of ECE,KL University, Andhra Pradesh, India.
Dean, ELOIRA, Hyderabad, Andhra Pradesh, India.
Professor,Dept of ECE,KL University,Andhra Pradesh,India.

Abstract:

An optical sensor consists of many optical components. In some sensors surface finish plays a major role in the performance of sensor. High performance sensors require highly polished and smooth surfaces. Average roughness of the surfaces has to be around couple of angstroms. Scattering of light from the surface indicates the roughness. In sensors like Ring Laser Gyroscopes, back scattering is major problem as its results in lock-in of the counter rotating laser beams. Surfaces here should not scatter. There is a need to measure the scattering and quantify. *We propose to develop techniques to quantify scattering. A laser beam is made to fall on the surface and images of surface under test will be captured at different angles. Scattering centers will be identified and the same are marked on the image of the s****urface. Image processing is*** *car****ried out with mat lab****.*

KEYWORDS:

Scattering, Scattering points, Noise Suppression.

INTRODUCTION

In present scenario optical sensors have become an important role in many appliances. For the sensors to perform properly, the components should be highly polished. If the optical surfaces are not smooth enough, then we may not get the desired output due to several deficiencies. One such deficiency is scattering[4]. Optical surfaces are cleaned through chemical cleaning to avoid scattering, but due to surface roughness of components optical scattering[4] can take place. Scatterometers are used to testify scattering. But scatterometers are quite expensive. For the purpose cost effectiveness instead we can use Image Processing technique to identify scattering (bright) points and extract them. Before going to Use Image processing , We need to take the images of the optical component while the surface of the component is being hit by laser beam in all the possible angles. After that the images will be sent to a system, Where the images undergo Image processing Techniques[2,3] to identify bright points and identify them.

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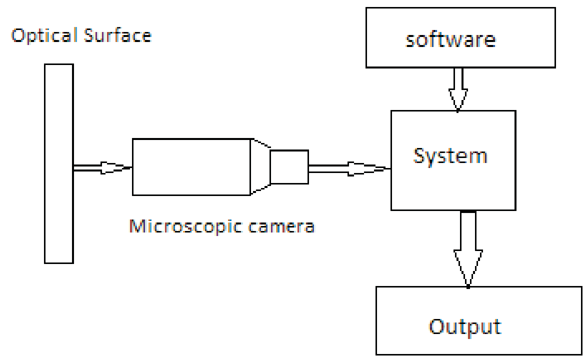


Fig.1 Scenario of Extracting scattering points

This paper is organized as follows. Section-2 describes Operational Hierarchy of the proposed algorithm. Section-3 illustrate Theoretical approach in extraction of scattering points. Section –4 describes the results achieved with the proposed algorithm and explains the necessity for the use of algorithm.

2. OPERATIONAL HIERARCHY

Extraction of scattering points on the optical surface is same as the identification of bright objects in the Image. In the image of the optical surface, the scattering points are brighter than other parts of the optical surface. So we need to find the bright points in the image of optical surface.Fig.2 shows the procedures of image processing for identifying the scattering points on the substrate surface. The process include Image acquisition, Gray level transformation, Threshold limiting, Segmentation, count and position of Points.

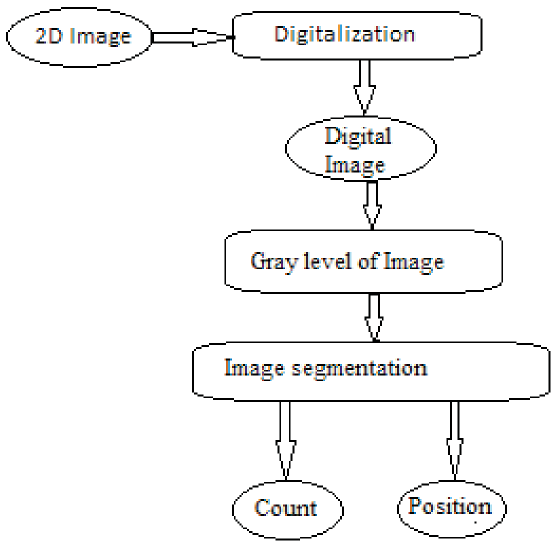


Fig.2.Hierarchy of the procedure.

The hierarchy can be explained as:

1)Image acquisition [2] is helpful for all the Image processing techniques. It transforms Image to the format suitable for processing.
2)Threshold limiting sets the limit at which segmentation takes place.
3)For scattering points the count and position are needed to be found.

4)Count and positions can be displayed according to the requirement.

3. THEORATICAL APPROACH IN EXTRACTION OF SCATTERING POINTS.

3.1 Gray level of image:

The image is divided into small grid cells and each grid cell is represented by the intensity levels. When the elements of an gray level image are of class unit8, or class unit16,they have integer values in the range [0 255] and [0 65535],respectively. Each pixel represents the gray value for the position of corresponding grid. If we consider an image as a matrix of M rows and N columns, Then a particular pixel can be represented as:

$$\{f(m,n) : m \in \{0,1,2,...,M-1\}, n \in \{0,1,2,...,N-1\}, f(m,n) \in G\} \quad (1)$$

Where G is the set of gray scale values.

3.2 Image segmentation with threshold:

Image segmentation is the most important process in image analysis .The means to segment bright points can be classified as two approaches: region segmentation which describes objects by regions, and boundary segmentation which describes objects by boundaries. Owing to obvious difference between the scattering points and the other parts of the optical surface, region segmentation is easy to use in inspecting scattering points by simply implementing threshold for segmentation as

$$f1(m,n) = f(m,n) * w(m,n) \quad (2)$$

Where $w(m,n)$ ia window function defined as

$$w(m,n) = \begin{cases} 1 & f(m,n) \geq k, \\ 0 & f(m,n) < k, \end{cases} \quad (3)$$

Where K is a gray scale threshold.

3.3 Extraction of position:

Extraction of position of the scattering points is an iteration process. We have go through all the possible pixels present in the segmented image. That is ,we have to through

If

$$f1(m,n) = f(m,n) \quad (4)$$

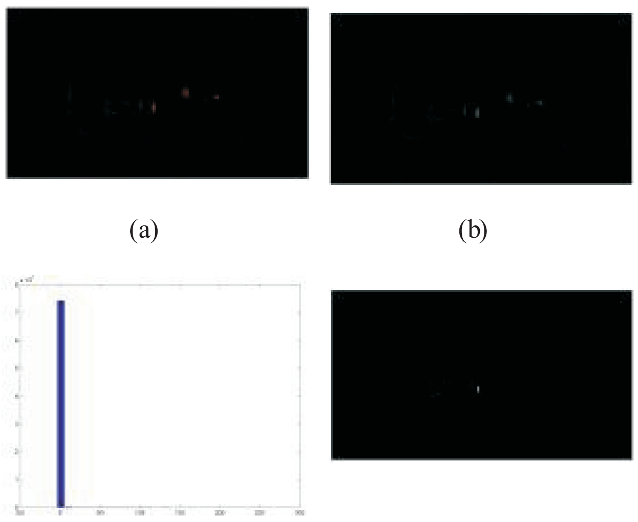
Then we consider them as scattering points. We ignore all other points. These points can be extracted by going through all the pixels in the segmented image one by one.

3.4. Count:

Count can be achieved by initialising count to Zero and When ever equation .4 is achieved then the value in the counter adds by one and ignored elsewhere. By the end of extraction of scattering points the count represents the total number of scattering points in present in the image of optical surface.

4. RESULTS AND DISCUSSION

The proposed procedure estimates the scattering points in the image of optical surface. There will be a definite difference between the intensity of the scattering points and the back ground. The analysis is carried out using the difference in intensity levels of the image. Various results regarding the steps involved in the process can be seen in fig.3 which include gray level image, histogram, image representing scattering points.



(a) (b)

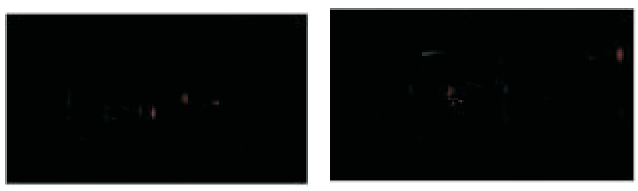
(c) (d)

Fig.3 Various results of image processing techniques (a) Original Image (b) Gray level Image (c) Histogram (d)Image representing bright points .

The bright points position representing the above sample fig.3 are:

(869 944)(869 945)(869 946)(870 944)(870 945)(870 946)(870 947)(871 943)(871 944)(871 945)(871 946)(871 947)(871 948)(872 943)(872 944)(872 945)(872 946)(872 947)(872 948)(873 943)(873 944)(873 945)(873 946)(873 947)(873 948)(874 945)(874 946)................................soon……(1000 960)
The number of bright points in the Image implying fig.3 t can be counted as 653.

The naked eye perception regarding the scattering points is indefinite. Eye cannot completely differentiate the level of scattering that takes place .i.e. the difference in the number of bright points present in the Image. This can be justified ,if we consider the images in fig.4. below.



(a) (b)

Fig.4. Representation of two similar Images having different bright points.

Now let us have a look at the number of bright points in the images represented in fig.4, which will be different with respect to each other. By having a look at images in fig.4, we consider both the images have the same level of scattering. But in reality both the images have different number of scattering point. Table.1 explains the above theory.

Table.1. Comparison of number of bright points in the images in fig.4.

Image	(a)	(b)
Count	**653**	**659**

5.CONCLUSION

We have achieved Scattering centers that that are attained from the images of the optical component that are taken while the surface of the component is being hit by laser beam in all the possible angles. We also achieved the positions and the number of scattering points that are achieved from the same images

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PALLAKI PRANAYDEEP REDDY
M.Tech, Dept of ECE, KL University, Andhra Pradesh, India.