Surface Texture Detection
Calculating Area of Crack using Image Processing

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Abstract—**The main objective of this approach is to enhance and detect defects on an image of a surface using digital image processing technique. Enhancement of the image using morphological operations and image segmentation techniques enables differentiation between defects and background. This perspective of texture detection incorporates functions to validate the two-dimensional properties such as area of a defect using '*regionprops*' operation. Thus, these operations helps in accurately evaluating a surface using MATLAB software.**

Keywords—image enhancement; Morphology; regionprops

I.   INTRODUCTION

Image enhancement and texture detection using image processing is an important phenomenon to solve many preliminary problems such as dissension and reference accuracy. Therefore, surface attributes and geography has been the research topic for years.[1,2]. Many systems have been developed, from the simple comparator to complex optical instruments for measuring surface attributes [3]. Recently, image analysis has been made easier and more flexible by the occurrence of digital computers and vision systems [4,5]. The term surface texture analysis is a basic issue in image processing and computer vision; therefore, this is a topic which has been researched for last few years. [6,10]. Basically, the texture detection approaches can be divided as: direct and indirect contact methods. Direct contact method uses stylus instruments; the surface which is to be investigated is made a direct contact with the instrument to give surface topology. Stylus instruments have limited adjustability to measure different geometrical surface[10,11].Other limitation of the stylus instrument is it is slow. In contrast, the indirect method uses optical instruments which do not require any contact with the surface. In this paper, an indirect method using digital image processing for examining surface irregularities has been developed and its capability is investigated experimentally. Detection of surface irregularity is an initial step towards precise evaluation of surface texture.

Further it is preceded by quantitative analysis of two-dimensional parameters of a specific surface defect. This is done by using morphological operations like opening and closing operations, and functions like '*regionprops*' which accurately measures properties like area, centroid and perimeter of a defect in an image in "pixels" [12,13]. This may be then inferred according to the user's need.

II.   METHODOLOGY

After referring to the various theories the following methodology can be used to accurately measure two dimensional properties of a surface defect.
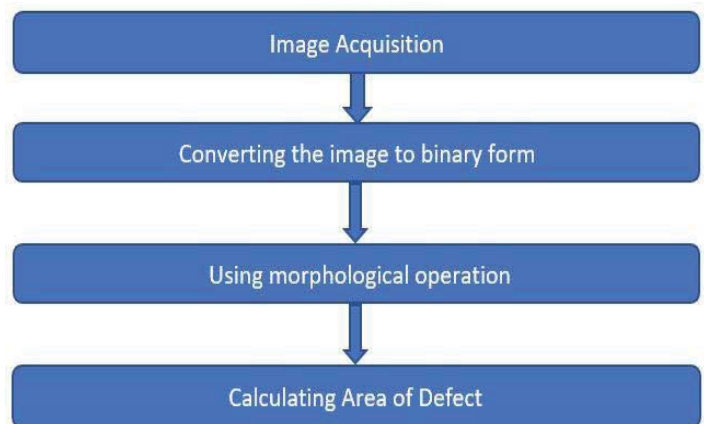

Image Acquisition

To continue the analysis, the image obtained is converted into binary using the MATLAB software.
                   "BW = im2bw(I, level)"
BW = im2bw(I, level) converts the grayscale image I to a binary image. The output image BW replaces all pixels in the input image with luminance greater than level with the value 1 (white) and replaces all other pixels with the value 0 (black).

A.   Applying the Morphological Operation

Morphological operation is applied on an image, where the image is considered as a subset and a predefined template known as Structuring element. The center of the structuring element is held on every pixel of an image and check whether they are same or not. If they are equal the pixel under the center element is turned into a black pixel this procedure is operated on an entire image.The dimension of the structuring element may vary according to the input image. As a result, all the defects in an image is obtained and area of the defect is calculated.

B.   Closing operation used in this method

Closing is a morphological operation in image processing. Closing is similar to dilation operation in which it enlarges the boundaries of foreground (bright) regions (and reduces background color holes in such regions),but it does not harm on original boundary shape.The morphological operation is determined by a structuring element. The structuring element is used to sustain the background region which is replica of the structuring element,or which contain the structuring element completely, while removing all other background pixels.

C.   Calculating Area of defect

The area of a crack in the image is calculated using the matlab function "regionprops".

$$\text{"stats =regionprops(BW,properties)"}$$

returns measurements for the set of properties specified by properties for each 8-connected component (object) in the binary image, BW. "stats" is struct array containing a struct for each object in the image. Regionprops can be used on contiguous regions and discontiguous regions. The area is calculated using the argument 'Area' in place of properties in regionprops.

III.   RESULTS AND DISCUSSION

From the observation the following can be inferred:

- Result has been obtained keeping in mind the requirements for precisely measuring the two-dimensional properties of particular defect or crack present at the focus.
- The output image shows the enhanced crack present on the surface.The mathematically calculated output is shown by the variable 'Area' which is in structural form, the area of the crack can be converted into an array of pixels.
- This can be converted in square millimeter using the formula1 millimeter^2 = 0.001479 * No. of Pixels.
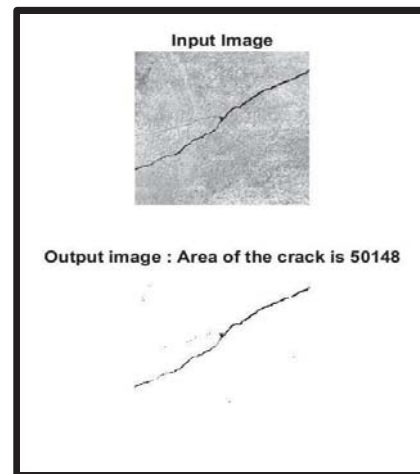 The maximum area in the output gives the area of the longest crack.
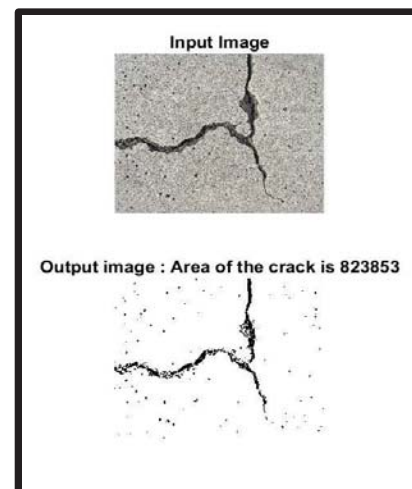

Fig 1 : Detection of single crack

Fig 2 : Area of crack is given by maximum value

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