



Hardness Measurement of Metal Using Matlab

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ABSTRACT

The design in this project showcase the implementation of a Hardness Measurement Of Metal Using MATLAB. Hardness is the property of a material that resists bending, scratching & plastic deformation. In this method, a specific force is applied on the surface of metal. Thus, it results in the formation of an impression. The depth of the impression formed on the surface of the metal depicts the hardness of the metal. The value of depth measured is the value of hardness. In the present investigation, the hardness of a material is measured from the diameter of the indent formed. The depth and diameter of indentation directly proportional to each other. In the present study, images of the metal were taken for analysis. Image analysis using MATLAB software is employed to measure the diameter of the indentation from obtained images. Thus, from the measured value of diameter, the appropriate hardness value of the metal is calculated.

Keywords: Bending, Scratching.

1. INTRODUCTION

Hardness is the property of a material that enables it to resist plastic deformations, usually by penetration. It may also refer to resistance to bending, scratching, cutting. Hardness is not an intrinsic material property dictated by precise definitions in terms of fundamental units of mass, length & time. A hardness property value is the result of defined measurement procedure. The usual method to achieve a hardness value is to measure the depth or area of an impression left by an indenter of a specific shape, with a specific force applied for a specific time. The diameter of a circle formed by the impression is proportional to the depth of impression.

2. Need of the System

Due to human error, it was unable to find the accuracy. To overcome this problem we use the MATLAB Software. We decided to analyze this problem using look-up table. According to look up the table we can get accuracy in measurement of hardness. Image analysis using MATLAB Software is employed to measure the diameter of the impression from the obtained images. Thus, from the measured value of diameter, the appropriate value of the metal is calculated. This system consumes less time.

3. Proposed System

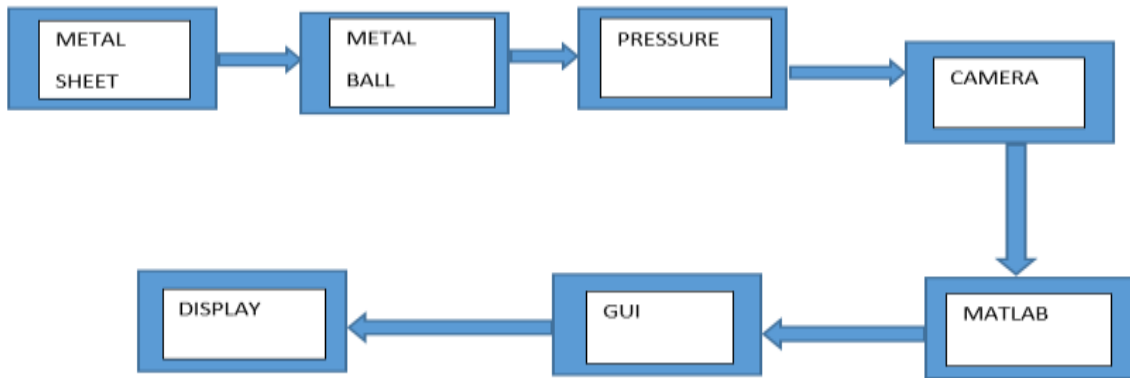


Fig. Block diagram

Firstly we press the metal ball on the metal sheet. The metal ball has fixed diameter. Due to the pressure of metal ball on metal sheets curve is formed on the metal sheet. Depending on how much metal ball is pressed on the metal sheet we can calculate the diameter of a metal ball by using sphere formula and measure the depth from the diameter. We can capture this image by using the camera at a constant distance & send this image to PC. We take this image in MATLAB from PC. The captured image is analysed in GUI. After that, we find the depth of sphere by MATLAB software. On basis of depth, we find the hardness of a metal by using look-up table. By using the mathematical calculation of sphere and MATLAB calculation can be cross check so we can easily analyze accurate hardness of the metal.

4. SOFTWARE IMPLEMENTATION

4.1 Image Acquisition

In this process, the spherical impression is formed acquired as an image using the camera for reading the metal surface with the specification. Image acquisition plays an important role for a measurement. A large amount of data is obtained from the image. A number of operation is done over the image. Hence it is necessary to capture the images with higher quality.

4.2 Image Conditioning

To get required data various processes are done over acquired image. The step include in conditioning of image is,

4.2.1 Gray Thresholding:

This function can be used to convert a grayscale image to binary image. The output of $BW = \text{im2bw}(I, \text{level})$ image BW replaces all pixels in the input image with luminance greater than level with value 1 (white) and replaces all other pixels with value 0 (black). Specify level in the range [0,1]. This image is relative to the signal level possible for the class of the image. Therefore level value 0.5 is midway between black & white, regardless of class. To compute the level argument, we can use the function `graythresh`. If you do not specify level or if trash is empty ([]) edge chooses low or high values automatically i.e `im2bw` uses the value 0.5

$\text{Level} = \text{graythresh}(I)$ this function convert the image to black & white in order to repair for boundary tracing. The function $BW2 = \text{imfill}(BW, \text{'holes'})$ fills holes in the binary image BW. A hole is set of background pixels that cannot be reached by filling the background from the edge of the image

4.3 Circle Detection

The function $s = \text{regionprops}(bw2, \text{'centroid'})$ uses for calculation of centroid, area.

The function $\text{Centroids} = \text{cat}(1, s.\text{centroid})$ gives x & y coordinate of a circle which helps to give the diameter of circle easily.

4.4 Pixel Range Calculation

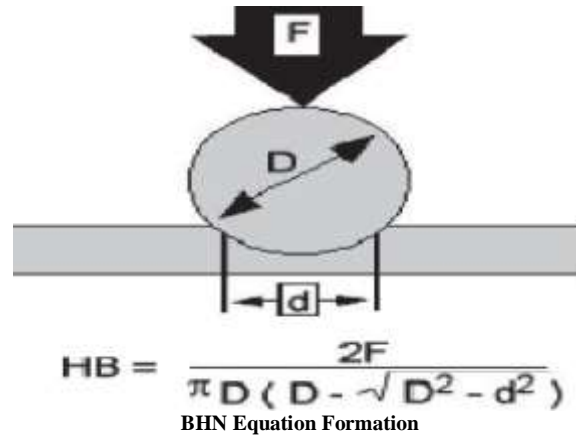
Using Hough Transform from the detected circle the number of pixels that occupied in the line of the diameter of the circle.

The main steps of Hough Technique approach for extraction of circles were:

The output of this method produces binary images having 1's at the edge location. The Hough technique algorithm was then applied to compute all the circles in binary images. The algorithm used a three-dimensional array $P(xc, yc, r)$ where (xc, yc) are the coordinates of the center & r is the radius of the circle. The result of Hough technique

is an image that contains large no of candidate circles. The no of pixels that are occupied in the line of the diameter of the circle of impression is obtained as a result.

4.4 Hardness Detection:



Compare with look-up table we calculate hardness,

Diameter of Impression(in mm)	Hardness Value(in BHN)
4.00	229
4.05	223
4.10	217
4.95	146
5.00	143

5. PROGRAM

```
Circle Detection program:clc; %clear the command window
close all; %close all figure
clear %erase all existing variable
format longg; %return is the maximum representable value of its input
format compact; %supressess many black lines that appear in the output
fontSize=14;
folder='D:\project';
baseFileName='cc.png';
fullFileName=fullfile(folder,baseFileName); %load the image
subplot(2,2,1); %subplot the image
imshow(fullFileName); %show the real image
title('origibal image');
x=imread(fullFileName); %read the image from file
y=rgb2gray(x); %convert the original image into gray image
subplot(2,2,2);
imshow(y); %display the gray image
title('original gray image');
level=graythresh(x);
bw=im2bw(x,level); %convert gray image to binary image
subplot(2,2,3);
bw2=imfill(bw,'holes');
s=regionprops(bw2,'centroid','area');
centroids=cat(1,s.centroid);
areas=cat(1,s.area);
imtool(x);
hold(imgca,'on')
plot(imgca,centroid(:,1),centroid(:,2),'r*');
```

hold(imgca,'off')

4. CONCLUSIONS

Thus this process provides a specific solution for the measurement of the diameter of the indentation produced while measuring hardness using Brinell hardness measurement method. In addition, this process eliminates the human labor that is being utilized in measuring the diameter of indentation during hardness measurement. It also provides the value of hardness straight away, instead of just providing the diameter of the indentation. It also reduces the lead time that is required to manually measure the diameter of the indentation. This process utilizes only half the time that is required to measure the diameter of the indentation manually. Finally, while using a different camera or different lighting, the threshold values for dilation and edge detection should be adjusted in accordance with the new acquired image. Once the necessary threshold values are loaded into the program, the process of measurement of hardness is carried out without any human interference.

5. REFERENCES

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