PAPER • OPEN ACCESS

Blast Fragmentation Analysis using Image Processing

View the article online for updates and enhancements.

Blast Fragmentation Analysis using Image Processing

Ujjwal Kumar, Ayesha Shaik*

School of Computing Science and Engineering, Vellore Institute of Technology
Chennai-600127, India
Email:* ayesha.sk@vit.ac.in

Abstract. This paper proposes an image enhancement algorithm for rock particle images during blast fragmentation. Image enhancement of rock piles plays an important role in rock size distribution. To measure the rock size, the original images are not of good quality. So our method is used to enhance the image to help the rock size distribution. The proposed method is implemented in Matlab software.

1. Introduction

In the rock blasting scenario, the success of fragmentation plays a major role. The muck pile distribution is done by classifying the muck piles based on their length and size and successful classification leads to successful fragmentation. The rock images captured during blast will be of noisy because of the dust molecules emerged due to blast.

The fragmentation also affects the hauling, crushing and loading operations as well. So, it is necessary to analyze the fragmentation and optimize the blasting parameters. The enhancement of the rock images to be done to optimize fragmentation analysis. There are various ways for rock size distribution measurement. Categories are as follows:

- Direct method
- Indirect method

In this opinion, the use of image processing programs that were formed and made it possible to estimate the distribution of rapid and absolute blast frag- mentation in different way. A few of them are as following: -

- Goldsize
- Fragscan
- Tucips

Along with the above mentioned software package utilized in the mining industries, the improvement of applying computer vision and image processing operations came to existence. They are used mostly in rock particle detection in moving belt conveyor or in remote sensing developments and they have their inherent limitations in terms of accuracy, precision, and reliability of the measurements. The limitations will be due to set of variables that effect outcome of the results and misidentification of the blocks during digital imaging stage.

For fragmentation analysis, the digital image outline should be obtained for individual rock particle and then the size and dimensions of the molecules need to be measured. If the digitization is done manually then it will be time-consuming. So, an image enhancement technique is proposed in this article for rock particle images during blast fragmentation.

The rest of the sections are organized as follows section 2 details literates review and section 3 presents automated particle dictation. Section 4 details implementation detail and results and followed by section 5 conclusion.

2. Literature Survey

In Blast fragmentation analysis, the image evaluation system uses segmentation approaches to computer-aided detection of muck pile side discovery. This method separates the picture into comparable fields. Edge identification and fully system dependent on morphology are two instances of this gadget such as: - segmentation of the picture of rock molecules typically the primary and more than one difficult step. All the outcomes of the study, which involves observing the volume, shape, and floor of the muck pile, is strictly dependent on the quality of the effects of the segmentation.

The entire following analysis task including muck pile mass, shape and character, gradually depend on the segmentation effects entity. Within the segmentation strategy, the rate of improvement should determine the accuracy of the expected mass division.

Since the rock fragments image alters from one to another it is challenging or difficult to create or produce one segmentation technique for all classes of muck pie images. This segmentation technique is developed for only certain types of muck pile images with unique properties for segmentation. In [1], the measurement efficiency of different dimensions of the molecules to know the how the particle sizes are distributed is carried out using the separated rock particle images. The authors of [1], watershed algorithm is utilized for separating touching molecules in the rock images.

To identify the outline of molecules in limestone moving on conveyor belt, edge detection algorithms has been carried out using morphological operations for 3D data [10]. The overlapping problem for coal molecules on conveyor belt has been solved using Otsu thresholding to convert to grayscale image, exponential high pass filter and Fourier transform for image improvement, and morphological operations for edge detection in [12].

The size prediction of the coal molecules on conveyor belt for particle identification purpose in order to know the size fraction, the textual characterization of the coal images are processed by the computer vision strategies [6]. A water shed algorithm by detecting the clods in the soil using segmentation which is applicable for remote sensing [4].

Analyzing the images on the moving conveyor bolt with the camera location, overlapping molecules, blurred images, speed of the conveyor belt, generation of dust, and treat them has been discussed [2]. After analyzing the image, image enhancement using Gaussian filter for manual outline of the coal molecules. The segmentation of the particle boundaries by applying image processing has been discussed [5], [13].

Even though segmentation strategies have been utilized successfully for object detection and recognition and using them for distributing the particles based on their sizes, still it is a open domain for the researchers to work on [10], [6], [2].

The image enhancement techniques for blurred images have been discussed in [3], where median filter and its inverse has been utilized to restore the image. The unmanned aerial vehicle captured images are seriously affected by weather conditions and convolutional neural network is used [11] to improve the quality of the image. Edge- based Texture Histogram Equalization (ETHE) is used for enhancing the quality of the retinal images in [7] and the efficiency is measured by Blind or Reference less Image Spatial Quality Evaluator (BRISQUE) image quality measure.

Image enhancement techniques based on multi-fusion has been presented in [8] as the fusion based techniques required less time when compared to the optimization or learning based approaches. The enhancement of magnetic- resonance images are done using histogram equalization for better diagnoses and localization of the image pixels in [9].
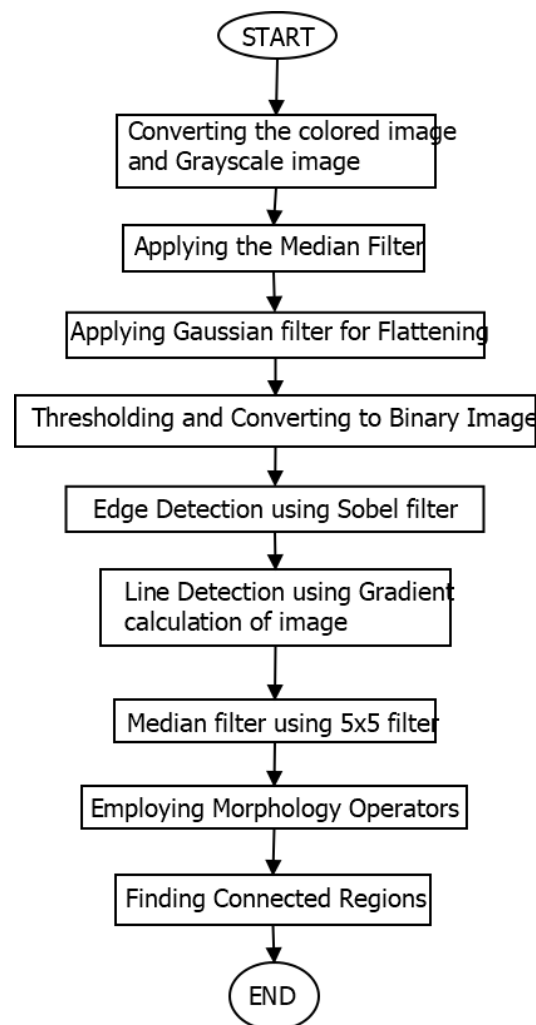
Fig. 1 Block diagram for proposed method

3. Proposed Method

The proposed method discusses the enhancement of quality of rock size images. In the Fig. 1 the procedure for the proposed method is given. As shown, the input images were initially transferred to the space of the gray scale. Hence, gray scale image is in the combination of black and white that's why this function is used because when ever need to perform any operation in that case gray scale is easily perform that operation.

Then after this perform median filter hence it uses when image has sports on the mage in that case median filter helps cover that sports it takes the median value of the image surrounded around sports. If the image needs any filter than in that case, perform Gaussian filter which helps to provide clear image.

Threshold operation perform it is also the combination of black and white but highlighted black reason of image and after this operation it is easy to convert the image in binary image. Hence, in this method there is a need to process the image and find this size and area of the rocks in order to find this need to find the edges of the rocks and it can be achieved whit the help of the Sobel filter.

In order to detecting edges, it may me the possibility to find some line in the image that why line detection method is perform because if any line is in image present in that case the lines between rocks can be visualized. In order to detect the image size and area of image morphology operations need to be per- formed which is a broad set of image processing operations that process images based on shapes. Morphological operations such as dilation and erosion can be used for adjusting the pixel

values based on the pixels in the neighborhood. For dilation, the output pixel will have the maximum value of all the pixels in the neighborhood and for erosion; the output pixel value will have minimum value of all the neighborhood pixels.

4. Results and Discussion

The proposed system is implemented in Matlab and results are presented as follows. The result that comes from the analysis of above steps is following: While Split Desktop is one of the most commonly used software packages for the analysis of blast-triggered fragmentation, there may be a need for the correction of its guide. Therefore, due to the false representation of broken rocks and fault within computerized rock identification, it is painful and time soaking up. In GoldSize software, stone rims can be segmented only manually and over time.

(a) Original Image   (b) Grayscale Image
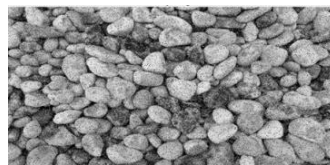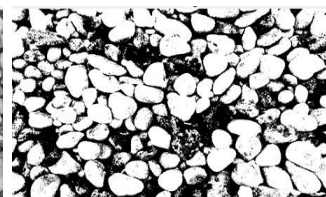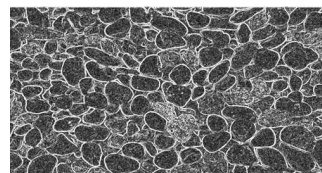

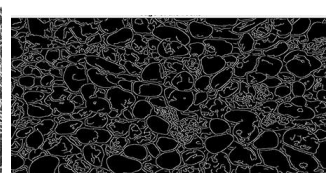(c) Noisy Image   (d) Median filtered

(e) Gaussian filtered   (f) Thresholded

(g) Sobel filtered   (h) Edge detected

(i) Line detected   **(j) Median filtered**

(k) Dilated   **(l) Eroded**

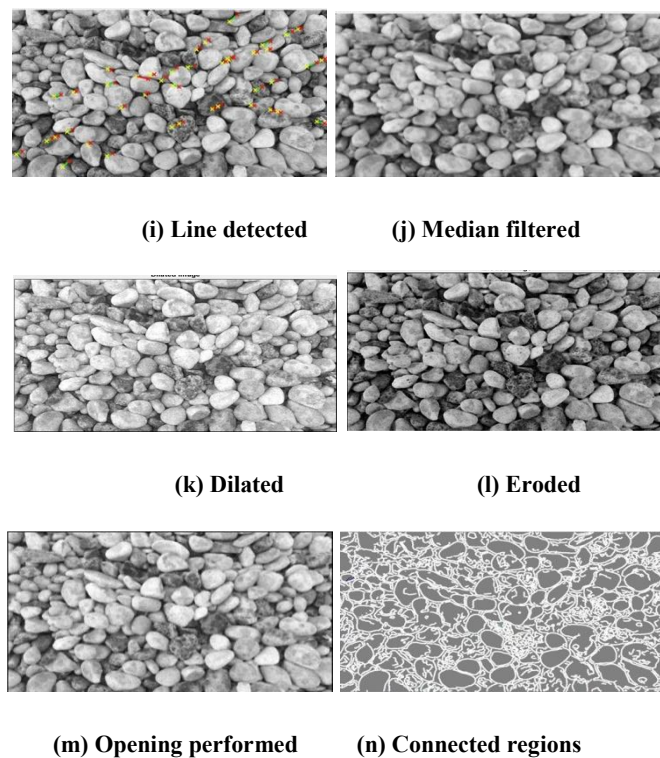**(m) Opening performed**   **(n) Connected regions**

Fig. 2. Implementation results

Managing the scrap constraint is the primary and most crucial step in the processing of image on which the resulting calculations are based. Examining the effects if many of these techniques procedures and mistake found that the precautionary approach was ideally suited for calculating the size distribution of laboratory objects, usually due to its ability to robotically evaluate scrap limits within the lowest.

Above these are the results in which clearly see that how the algorithms work. In Fig. 2(a) is the input image i.e. Original image. Fig. 2(b) shows the output of gray scale image and Fig. 2(c) shows noisy image here one can see that when the blasting is occurred in that case there are may be possibility of noise and now one can remove the noise with the help of median filter and Fig. 2(d) shows the output of median filter.

Fig. 2(e) is the output of Gaussian filter. Fig. 2(f) is the output of threshold image thresholding it convert the gray scale or colored into binary image. Fig. 2(g) shows the output of sobel filter it will help in edge detection sobel filter gives the outline of the rocks and Fig. 2(h) is the output of edge detection in which clearly shows the edges of rocks. Fig. 2(i) shows the output of line detection generally it is used for linear path but it may be the possibility the line between rocks.

Fig. 2(j) is the output of median filter in 5x5 matrix. Fig. 2(k), Fig. 2(l) and Fig. 2(m) is the output of morphology operators. Fig. 2(k) and Fig. 2(l) is the output of dilated and erode image. The visual quality of the enhanced rock images are listed in Table 1. The qualities of the images have been measured using the no-reference image quality measures such as FFT-Quality and DCT-Quality.

Table 1: Visual Quality of the Enhanced Rock images

Rock image	FFT-Quality	DCT-Quality
1	0.0121	0.1105
2	0.0040	0.0162
3	0.1135	0.9954
4	0.0091	0.1259

5. Conclusion

In order to analysis of fragmented rock in Matlab software is used to examine and accelerate fragmentation willpower of the destroyed rock. The duplication of laboratory samples with a different duration scheme was agreed to check the performance. The proposed method provides the enhancement of the rock image used for rock size distribution as well as edge detection and finding the connected reasons between the rocks.

References

[1] Al-Thyabat, S., Miles, N., 2006, An improved estimation of size distribution from particle profile measurements, *Powder Technology* 1**, 66(3),** 152–160

[2] Al-Thyabat, S., Miles, N., Koh, T., 2007, Estimation of the size distribution of particles moving on a conveyor belt, *Minerals Engineering* **20(1),** 72–83

[3] Ali, S.A., 2020, Image enhancement techniques for images at blur motion and different noises, *AL-Rafidain Journal of Computer Sciences and Mathematics,* **13(1),** 48–60

[4] Chimi-Chiadjeu, O., Le H´egarat-Mascle, S., Vannier, E., Taconet, O., Duss´eaux, R., 2014, Automatic clod detection and boundary estimation from digital elevation model images using different approaches. *Catena,* **118**, 73–83

[5] Hamzeloo, E., Massinaei, M., Mehrshad, N., 2014, Estimation of particle size distribution on an industrial conveyor belt using image analysis and neural networks, *Powder Technology,* **261**, 185–190

[6] Jemwa, G.T., Aldrich, C., 2012, Estimating size fraction categories of coal particles on conveyor belts using image texture modeling methods, **39(9**), 7947–7960

[7] Kandpal, A., Jain, N., 2020, Retinal image enhancement using edge-based texture histogram equalization, *7th International Conference on Signal Processing and Integrated Networks (SPIN)*, *IEEE*, 477–482

[8] Parihar, A.S., Singh, K., Rohilla, H., Asnani, G., Kour, H., 2020, A comprehensive analysis of fusion-based image enhancement techniques, *4th International Conference on Intelligent Computing and Control Systems (ICICCS)*. 823–828

[9] Patel, S., Bharath, K., Balaji, S., Muthu, R.K.,2020, Comparative study on histogram equalization techniques for medical image enhancement, *In: Soft Computing for Problem Solving*, *Springe*r 657–669

[10] Thurley, M.J., 2011, Automated online measurement of limestone particle size distributions using 3d range data, *Journal of Process Control* , **21(2)**, 254–262