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# Porosity Measurement in Sand Images

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***Abstract—***

***The fundamental arrangement of granular behavior is important to know about the soil stability and influence the design of structural foundations. The structural stability is particularly useful in earthquake events. Therefore, to work on measuring the arrangement and orientation of an assemblage of granular particle is essential. In this paper, we evaluate the porosity of the given sand images using image processing technique. An adaptive thresholding technique has been used.***

***Keywords— Image processing, image segmentation, shape analysis.***

## I. INTRODUCTION

Image processing is any form of signal processing for which the input is an image, such as photographs or frames of video. The output of an image processing can be either an image or a set of characteristics or parameters related to the image. Most image processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing are also possible.

The main objective of the paper is to measure the arrangement and orientation of an assemblage of granular particles. For computing the local variations in porosity, here we are proposing a technique called adaptive thresholding. With the help of these local variations, porosity maps are generated to understand the shear characteristics of granular particles.

## II. LITERATURE SURVEY

Stress induced anisotropy or fabric in granular masses is discussed on the basis of biaxial compression tests performed on two dimensional assemblies of oval cross sectional particles. The contact normal, the shaped of their particles, and the shape of the associated voids. These are discussed in order to define the corresponding anisotropy in terms of a second rank fabric tensor. Generation of new contacts in the direction of the maximum principal compression is closely related to the formation of column life load paths in that direction and is a major process which leads got the stress induced anisotropy, The stress induced anisotropy due to the formation of elongated voids seems to be a contributing factor to the post peak failure of the material.[1] Selection of the most suitable method of sand sample preparation becomes difficult because all available methods affect the fabric and dry density of samples, and none of the available methods are shown to be unique. A series of Consolidated Drained (CD) and Consolidated Undrained (CU) triaxial compression tests were conducted on sand samples prepared using pluviation and tamping techniques, under both dry and moist conditions. The standard triaxial test setup at IITB is described first. Stress strain behaviour for samples prepared with different sample preparation methods showed considerable difference in the peak stress and dilation, whilst all sample reached the peak stress at 5 to 10% axial strains. Results showed that samples prepared using tamping technique usually strain softens, whilst samples prepared by pluviation technique may harden or soften with strain depending up on the sample relative density and confining pressures applied during testing. Hence, pluviation technique proves to be the more reliable technique to prepare samples for triaxial testing. Discussions in this paper presents data relating to the CU and CD triaxial compression tests on samples prepared using pluviation and tamping techniques, under both dry and moist conditions[2]. A series of drained biaxial compression tests were conducted on two sands to determine the effects of consolidation history on their critical states. Specimens of each sand were consolidated along at least two separate paths in void ratio-effective stress space, creating several unique consolidation histories. Because the sands were dilative, strains localized during shearing and the evolution to critical state occurred only within the shear band. Digital images were obtained through a plexi glass sidewall throughout each test. Digital image correlation techniques were used to quantify the displacements within the band, and a linear regression technique was used to formulate a displacement function from which strains were computed. The critical state was achieved within the shear band in each test, but the critical state line was found to depend on the initial state and subsequent consolidation HISTORY OF THE sand specimens.[3]

## III. PROPOSED WORK

The proposed architecture is shown in Figure 1.

 

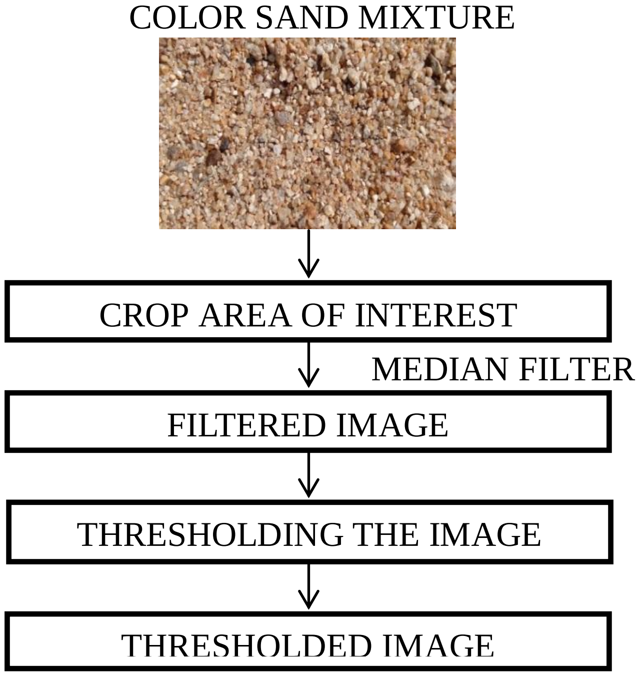


Fig 1 Proposed System Architecture

The Shear strength of granular geomaterials, such as sands, is significantly influenced by the arrangement and the orientation of particles and voids within a deposit. This arrangement is also referred to as the "soil fabric" and can be quantified by measures such as the number of particle contacts and the orientation of particles. There are many components involved in the definition and the measurement of the soil fabric, and they include the shapes of the voids, the shapes of the particles, and the distribution of the inter-particle contact normal vectors In recent years, various researchers have been able to examine the fabric more closely using X-ray Computed Tomography (CT) and discrete element modeling. In this paper, we intend to focus on developing a technique to measure one aspect of soil fabric, namely, the porosity of the aggregate mixture. The porosity is the percentage of inter-particle voids in a specified volume of the soil mixture. Soil porosity is defined as the volume of voids to the total volume analyzed and can range anywhere from 0 to 1, with 0 being an empty void space or a void filled with water and 1 indicating that the solid volume occupies the total volume analyzed.

## IV. PROPOSED WORK

**Noise Removal**

Color sand mixture image is given as input and removing the noise. The image is filtered using median filter. The purpose of using median filter is that it not only removes noise by also preserves the edge in the image. Once the noise is removed a filtered image is obtained. The original image and the noise removal image is shown in Figure 2 and 3.

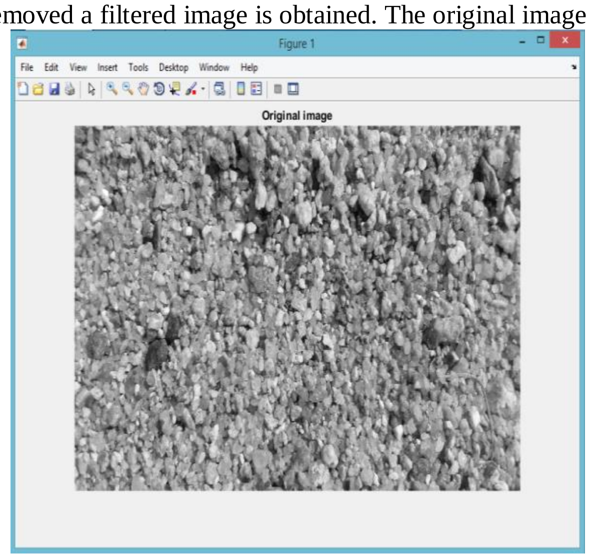


Fig 2 Input image

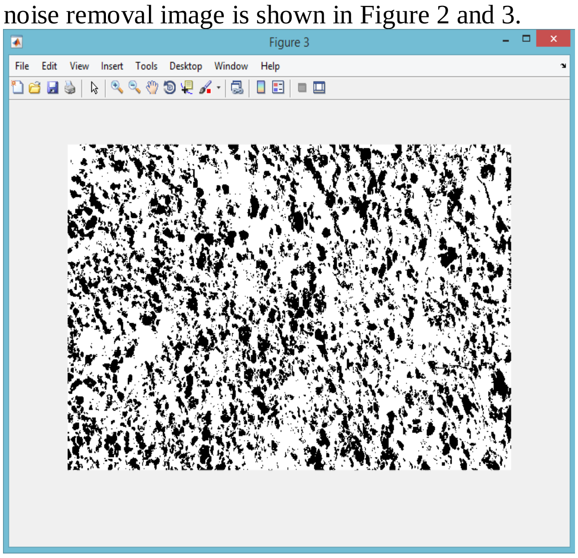


Fig 3 Noise removal using median filter

**Segmentation**

The filtered image after noise removal is given to the next step which is segmentation. Segmentation is the process of separating sands from the other part of sand mixture images. Segmentation is done using thresholding method. The output of segmentation will be a thresholded image and is shown in Figure 4 and the histogram of the gray level image is shown in Figure 5.

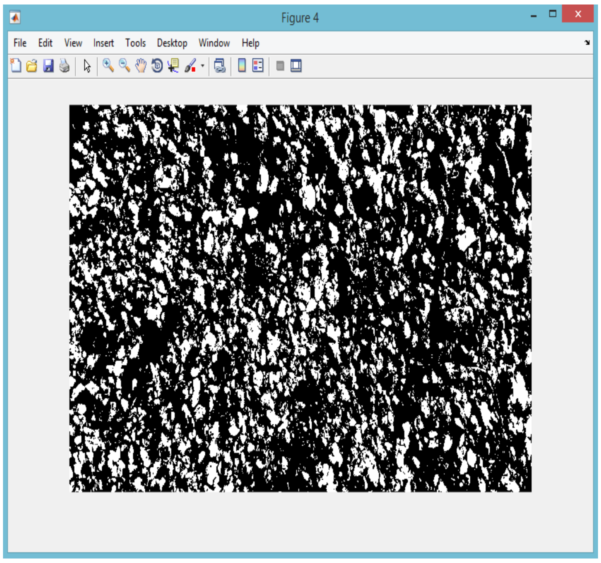

Fig 4. Segmented image after thresholding

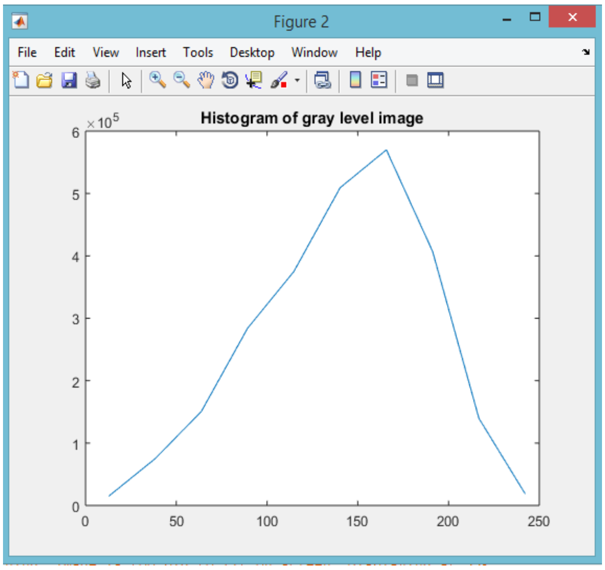

Fig 5. Histogram of gray level image

## V. CONCLUSIONS

In this paper the several image processing techniques are used which includes noise removal, feature extraction. Since median filter is used fast removal of noise, threshold image edge preservation of the image is achieved.

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