Particle-Size Analysis of Wood Fiber and Powder Based on Image Processing and Recognition

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ABSTRACT

This article describes how to realize a wood fiber and powder automatic production and detection, using a mesh detection method based on image processing and particle-size analysis. With this method, the image will be transformed into an HSV color space, segmented based on S component with Ostu; calculated and analyzed with shape factor F, then rectangle fit, and finally the rectangle’s length is converted into mesh. During wood flour mesh recognition, this article proposes the use of a rectangle fitting algorithm. In accordance with the actual demand for mesh recognition, a micro-nano wood flour mesh recognition system based on a modular approach has been designed and developed. This is as well as a mesh recognition design program based on wood flour features. The experiments and particle-size analysis results demonstrate that compared with traditional methods, the proposed approach is of higher accuracy and appropriate for extension.

KEYWORDS
Mesh detection, Particle-size analysis, Shape factor, Wood fiber

1. INTRODUCTION

As a kind of new environmental material, micro-nano wood flour whose application is decided by mesh has been applied more and more broadly. Traditional mesh recognition method cannot meet the recognition demand of current produce that is of high-efficient and fast speed because of low work efficient and too much operation among wood flour producing. Therefore, it is a fast and effective mesh recognition method that is the key to realizing automatic monitoring mesh in the wood flour producing industry.

During image processing, in view of the low contrast and high noise shooting environment, this paper firstly transforms color space from RGB to HSV, and carries out the binarization based on S component; then in order to remove noise and impurity, improve the image by hole filling, math morphology technology and so on; finally detect the edge of the target by the modified morphological multiscale operator to gain wood flour’s contour successfully.

Many fields have adopted image processing techniques and they have gained success, so this paper processes the microscopic image, extracts and analyzes the relevant feature parameters so as to get the particle-size of the wood powder based on rectangle fitting and particle-size analysis.

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2. WOOD POWDER IMAGE PROCESSING AND RECOGNITION

2.1. Particle Feature Extraction

Target recognition accuracy directly depends on image segmentation whose algorithms usually aim at gray images that may lose much color information. This paper adopts HSV color space that fits eyes sensory and has the independence and uniformity of color image processing. After analyzing HSV’s component images, S component shows enough saturation information, has the biggest contrast between the target and background and better highlights complete particles. So segment the image by OSTU and area threshold filtering based on S component.

According to the inherent characteristics, the images can be divided into two categories: the image characteristics of texture feature description object shape description of the object surfaceshape feature and gray change. Wood powder were mainly based on the mesh shape feature recognition of wood powder, according to the research needs of this paper, the extraction of the wood particles of the perimeter, area.

Perimeter is represented by the symbol $P$, the calculation formula is as follows.

$$p = N_i + \sqrt{2}N_h$$

(1)

where $N_i$ is a number of wood flour on the boundary, $N_h$ is a number of wood powder boundary.

The area is represented by the symbol $A$, the calculation formula is as follows.

$$A = \sum_{i=1}^{M} \sum_{j=1}^{N} f(i, j)$$

(2)

where $f(i, j)$ is image, $M \times N$ is the side length of image.

In consideration of morphological feature, shape factor $F$ has been used.

$$F = \frac{P^2}{4\pi A}$$

(3)

where $P$ denotes the perimeter of the particle projection region; $A$ denotes the area of the particle projection region.

With a comparison and analysis about various data, it’s found that $F$ has a close contact with a particle’ projection shape:

1. When $F$ is some values such as 1.275, 1.927, 2.160 and so on, its projection shape is close to ellipse-like; after a detailed observation and analysis on wood powder samples, the bigger the gap between the long diameter and the short diameter of the ellipse is, the closer the ellipse is to a oblong, namely a rounded rectangle;
2. The greater $F$ is, the closer wood powder projection shape is to a needle-like shape, which appears to be rectangle-like under the microscope;
3. As for a regular rectangle, the greater the value of $F$ is, the more the shape of a particle is out of roundness and the bigger its surface’s acute angle is.
Histogram-Based Compression of Databases and Data Cubes
www.igi-global.com/chapter/histogram-based-compression-databases-data/13812?camid=4v1a