ABSTRACT

The sheep body size measurement is primarily realized by human experts at a low efficiency, which does not meet the requirements of animal welfare. In this study, we propose a non-contact measurement method based on machine vision. Sheep images are first captured by the camera, and then processed to obtain the sheep contour which can provide the sheep contour for calculating the sequence while getting the effective determination of measurement points. The experimental results demonstrate the effectiveness of the no-stress measurement of the sheep body size parameters.1

INTRODUCTION

Body size is one of the important parameters to evaluate the growth status of sheep [1]. The present measurement way is normally by manual that it was thus inevitable that the farmers would direct contact with the sheep. In recent years, living animals-based body size measurement and conformation appraisal have garnered increasing attention from the researchers. Most of the investigations are based on livestock, such as cattle, pig and sheep [2-7]. The identification of the sheep measurement points is not a simple task due to great complexity of wool, which belongs to edge detection, a highly laborious task, consisting of the search and determination of measurement points. It is similar to other related fields in identification methods. For non-contact body measurement, Xue et al [8] introduce the Particle Swarm Optimization algorithm to solve the optimal measurement point. Dong et al [9] propose and implement a statistic based lane edge search algorithm.

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IMAGE PROCESSING

Image Acquisition

The camera is used to acquire the image by shooting the side of the sheep. To testify the effectiveness of the algorithms, two image data of sheep from are constructed, in which the position of sheep are different, as shown in Figure 1.

Image Preprocessing

Preprocessing comprises three main steps. The first is that histogram equalization is applied to transform the color RGB image to binary image. The second is that morphological operations are used for noise elimination. Opening operation and closing operation are the basic operators in mathematical morphology. Opening operation and closing operation are dual [10]. The third is that canny detector is used for the boundary detection of sheep [3].

BODY SIZE MEASUREMENT

The Measurement Points Selection

The measurement points are selected in this paper based on inflexion extracting. The contour boundary of sheep image is formed with 16- direction chain codes. The search loops until a closed boundary is obtained, and then retains the coordinates of search points. The specifications of the peak are set when the curvature for each contour point are attempted to be calculated. The inflection point is in the locations of local peak as compared to the point on the crest of the contour [11]. Figure 2 shows the result of extracting inflexion point. Generally, it is time to take three points continuously from the rump inflection point sequence to create a triangular shape [12] that geometric parameters are calculated with the formula of Helen-Qin Jiushao. We can consider the maximum curvature as the distal end point of the ischial tuberosity. The other points should be determined by calculating the shortest distance between the points of the partial contour line and the ground.

![Figure 1. The sheep image.](image-url)
Calculating Process

The relationship between the target point and its corresponding imaging point is obtained by spatial resolution, the experimental value of body size parameters corresponding to the distance between the two pixels on the sheep image can be determined [4]. In the calibration board, the distance between adjacent circular hearts is 30 mm. Get the coordinates of marked center and calculate the pixel of the distance. Based on analysis and computation results, coefficient of resolution is 1.35 in left image and it is 1.52 in right image. Figure 3 shows all the sheep measurement points after selection. Body length is the distance between two corresponding measurement points. Height at withers and rump height are the vertical length which join the corresponding measurement points to the ground.

RESULTS

It can be observed from Table 1, the experimental values on the body size from two different positions of sheep reveals an overall better performance as compared to the measured values. Measurements on the sheep body size showed lower errors for rump height and height at withers and higher for body length. As can be seen, the measured values of body length exhibited the lowest measurement performance, which was mainly caused by the difficulty of the measurement points selection in the different positions of sheep.
TABEL I. MEASURED AND EXPERIMENTAL VALUES ON SHEEP BODY SIZE/CM.

<table>
<thead>
<tr>
<th>Figure 3 parameters</th>
<th>measured values (cm)</th>
<th>experimental values (cm)</th>
<th>relative error (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>left image</td>
<td>height at withers</td>
<td>75.50</td>
<td>74.40</td>
</tr>
<tr>
<td></td>
<td>rump height</td>
<td>76.30</td>
<td>74.95</td>
</tr>
<tr>
<td></td>
<td>body length</td>
<td>92.60</td>
<td>88.87</td>
</tr>
<tr>
<td>right image</td>
<td>height at withers</td>
<td>75.50</td>
<td>75.89</td>
</tr>
<tr>
<td></td>
<td>rump height</td>
<td>76.30</td>
<td>76.99</td>
</tr>
<tr>
<td></td>
<td>body length</td>
<td>92.60</td>
<td>89.94</td>
</tr>
</tbody>
</table>

CONCLUSIONS

In this study, computation of the sheep body size parameters and identification of the measurement points are derived for two different positions of sheep. Future work will explore an improved method of the sheep body size measurement based on binocular stereo vision for the next stereo matching. In addition, more sheep images from various angles should be processed to improve the measurement precision.

REFERENCES