Journal of Fiber Bioengineering & Informatics 5:3 (2012) 289–298
http://www.jfbi.org | doi:10.3993/jfbi09201207

Prediction of the Main Girths of Young Female Based on 3D Point Cloud Data

Cai-Yuan Kuang [a,b,c,*], Kai-Chen Ji [a,c], Rong Jin [a,c], Guo-Lian Liu [a,c]

[a] *College of Textile and Clothing Engineering, Soochow University, Suzhou, Jiangsu 215021, China*
[b] *College of Art, Jinling Institute of Technology, Nanjing, Jiangsu 211169, China*
[c] *National Engineering Laboratory for Modern Silk, Suzhou, Jiangsu 215123, China*

Abstract

Girths of human body are significant parameters in pattern design, affecting the fitting and aesthetics of clothing. In this paper, 110 female undergraduates in Soochow University were measured by using photogrammetric measurement and 3D non-contact measurement system. The silhouette of human body was extracted by using software Matlab to obtain width and thickness. The measurements of the girths were gotten via software Imageware based on 3D point cloud data. According to the ratio between thickness and width, classification of those females was carried out and the regression equation of each cluster was obtained. The analyzed results show that the proposed non-contact measurement method can reduce influence of subjective factors. Regression equations can be applied to predict main girths. It will be helpful in the automatic design of garment pattern.

Keywords: Image; Point Cloud Data; Body Shape Classification; Girth; Prediction

1 Introduction

In the modern society, people's demand on fitting and comfortability of clothing is increasing dramatically. Human body measurement has attracted the wide attention of manufacturers and consumers. Generally, measurement methods for human body consist of contact measurement and non-contact measurement. Contact measurement is operated simply, but time consuming and is to some extent influenced by subjective factors. Non-contact measurement can be divided into 2D photogrammetric measurement and automatic 3D body measurement. 3D body measurement system can measure many more dimensions with less time, however the system is expensive and is difficult to move. Photogrammetric measurement can obtain height, width and thickness of human body by capturing frontal and lateral images [1, 2]. Girths of human body are significant parameters in pattern design, so it is necessary to predict girth precisely.

*Corresponding author.
Email address: kcy@jit.edu.cn (Cai-Yuan Kuang).

Jiang A analyzed the problem existing in human breast girth prediction by using hyperelliptic model and EE parameter spline curve fitting based on non-contact measurement. By quoting regression analysis of mathematical statistics, Jiang proposed method of least squares and partial least squares regression to simulate breast girth. This method reduces complexity of prediction and improves accuracy [3].

Huang XL has simulated females' breast girth by using two-elliptic arcs model, two stage least-squares regression analysis and BP neural network separately. The analyzed results showed that two stage least-squares regression analysis can be applied to predict breast girth, waist girth, abdomen girth and so on. It was confirmed that BP neural network was suitable for neck circumference and knee girth calculation [4].

In the research of Tan F, girth of human body was set as dependent variable, width and thickness extracted by using software Matlab were set as independent variables, and linear equation in two unknowns was achieved to predict breast, waist and hip girth. This method exist subjective error because of manual measurement for girth [5].

In this paper, width and thickness of human body were extracted by using software Matlab, and girths were measured via software Imageware based on 3D point cloud data. According to the ratio between thickness and width, classification of young female was carried out and regression equation of each cluster was obtained. The validity of those equations was tested by using test subjects.

2 Experimental Methods

2.1 Subjects

110 female undergraduate students were selected as subjects, aged between 18 to 24. The subjects were asked to wear only bra and briefs, to relax and breath normally and stand upright with feet apart about 20 cm during the measurement. In addition, the female students were asked to remove jewel, watch and glasses. Their long hair has to be tied to make sure that the neck is correctly detected.

2.2 Measurement Methods

3D non-contact measurement method: SYMCAD stands for SYstem for Measuring and Creating Anthropometrical Database, using digital light projection technique, was applied in anthropological measurement. This system can measure 88 dimensions within 30 seconds and output 3D point cloud data.

Photogrammetric measurement method: Frontal and lateral images of the human body were captured via two Canon 600D SLR cameras simultaneously in natural lighting condition, controlled by a specific software. The error of measurement time is no more than one second. The size image is 5184×3456 pixels, and the distinguish ability of the image is 72 pixels per inch.

The ideal background color was determined for further research, after preliminary study in different background. The optimal shooting distance was confirmed by picture distortion test.