

Comparative Study on Prediction of the Girths of Young Females' Body

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Abstract: To compare the advantages and disadvantages of the measurement and girth fitting methods of human body, in this paper, 248 female students were selected as subjects. Frontal and profile images of human body were taken by digital camera. The width, the whole thickness, the front segment thickness and back segment thickness of cross-sections at chest, waist, abdomen and hip were measured by photogrammetric measurement. The curve consisted of two-elliptic arcs and BP (Back-Propagation) Neural Network were employed to model chest girth, waist girth, abdomen girth and hip girth based on the measured data, and the girths were obtained respectively. These two methods were compared in this paper.

Keywords: non-contact measurement, girth, curve fitting, predicting method

1. Introduction

At present, with the improvement in people's living standards, the consumers begin to concern about the garments' personalized, fitness and diversity, so the unique style design of many garments is not only reflected in chest, but also needs more attentions in waist and hip. To meet the consumers' demands from garments, the fashion designer should be very familiar with the sizes of the human body's girth, especially the girths of torso. Human body measurement, the key of garment design and manufacture, is a significant demand to keep up with the developing trends of today.

1.1 Measurement Methods

1.1.1 Manual Measurement Method

The traditional measurement methods are those where the tools directly contact the human body, and measure the static sizes like the length, the width, the thickness and the girth of human body. The main measurement tools include flexible rule, altimeter, ambulator, antennal meter and so on. The traditional measurement methods are used widely because of its simple operation and low price of measurement tools. However, the traditional human body measurement methods mainly are carried out based on manual

measurement, the speed of measurement is very slow and the requirements from the measurers are extraordinarily high. The measurer who is not skilled should be trained to decrease the measurement error before measuring.

1.1.2 3D Non-contact Human Body Measurement

3D human body measurement scanning technology is used to describe the 3D characteristics of human body, by using the surface light (laser, white light or infrared) of human body projected by the photosensitive capturing equipment to form the image of human body. SYMCAD of Telmat, Turbo Flash/3D, TechMath-RAMSIS, TC2-3T6, Cyberware-WB4, as well as Vitronic-Vitus, are commonly used in human body measurement s now [1].

There are many advantages in the 3D scanner, the speed is more, the measuring precision is higher and the number of measured parts of body is more than the traditional measurement. The TechMath scanner of Germany can finish the whole scanning process in 20 seconds, capture 80,000 points of human body and obtain 85 sizes. Moreover its precision is less than 0.2 mm. The [TC] 2 of United States can obtain more than 80 data by scanning 45,000 points of human body, and accurately reflect the full state of human body. The TuringC3D of Britain can capture the

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surface materials of the object, and describe its colors and materials, which is very useful in studying the marking objects. When it was used in measuring the human body, the data can be outputted and used to design garments directly [2].

1.1.3 2D non-contact human body measurement

Photogrammetric method which applies one or more CCD cameras to photograph directly the different postural digital images from the front, the profile and back of a human body is used in 2D measurement system, and the body contour images can be obtained by using graphic image processing, then the 3D sizes of human body can be obtained by conversing the 2D sizes.

At present, a few institutions research 2D measurement system in the world. The typical 2D measurement systems are Contour 2D System of TechMath of Germany and BoSS-21 System of VISMAGE SYSTEMS of Canada. Contour2D System has been applied to the project of human body measurement for designing the German military uniforms. The sizes of human body obtained by using BoSS-21 System can be exported, printed or stored in the database [3].

1.1.4 Comparison of measurement methods

Using traditional manual measurement methods are simple, but it can't meet the demands of measuring human body rapidly and largely. Besides, many factors come into play during the measurement of human subjects, which can result in the appearance of numerous sources of error. Some of the important sources include posture, identification of landmarks and pressure exerted by the measurers. There are more advantages in 3D non-contact human body scanning system than the traditional measurement. However, those scanners were not widely applied in common clothing academy and company because of their high price. Besides, Non-contact automatic measurement of 3D human body is a very new technology. There are still many unresolved technical problems. For a number of parts of human body (head, shoulder, armpit and under crotch, etc) it is very difficult to obtain the complete data because of the influence of scanning method, thus the accuracy of some data may be influenced. Furthermore, not all

the 3D scanner systems can be compatible with the CAD systems, which has limited the application of 3D human body measurement technology in the garment industry to a maximum degree. However, 2D non-contact human body measurement also can collect many measurement data quickly while its cost is low.

1.2 Comparison of fitting methods

There are several typical methods to fit the girths of human body, such as pyperelliptic fitting, parameters of EE-spline curve fitting, regression analysis model as well as logarithm fitting [4-5]. Pyperelliptic model has good theoretical basis and application, but its coefficient requires a large amount of statistical data to be determined, so it is very difficult to establish a unified pyperelliptic model. Parameters of EE-spline cure fitting needs a large number of measurement points to establish the control polygon, while it can only get the width and thickness of human body based on photogrammetric measurement, so it can not obtain a very approaching curve. Regression analysis includes multiple linear regression and dualistic and quadratic regression. Multiple linear regression is very complex because it involves many variables. The error obtained by dualistic and quadratic regression is very small while it uses lots of tested samples, or the predicting precision is not high. Logarithm fitting has a high requirement to the precise of the intercept and its calculating process is very complicated.

Comparing the advantages and disadvantages of above measurements and girth fitting methods of human body, in this paper, the width and thickness which were defined as independent variables, were measured directly from the front and profile images of a human body based on photogrammetric measurement. Two ways, fitting cross-sections with two-elliptic arcs, and predicting girths with PB Neural Network, were used to obtain the girths.

2. Method

248 female undergraduates students were selected as subjects, aged from 18 to 26 years old. The subjects were asked to wear only bras and briefs, relaxing and breathing normally, standing uprightly and separating the feet about 20 cm during the measurement.

The photographs were taken by digital camera,