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Hierarchical Analysis Method and Model Based Data of Controlling Parts of the Body for Clothing*

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Abstract

In order to study the accuracy of human measurement data more systematically, the analytic hierarchy model was established to evaluate the degree of measurement difficulty. Based on the manual measurement experiment, we extracted and analyzed the data from different angles, such as the proficiency of work, parts of human body, error correcting frequency and single factor. The three factors, difficulty of recognizing the defined points, dimension of the moving points and measuring path, are used as the standard of criterion level. The results showed that the structure of the body's parts of is the key to producing the measurement difficulty and the difficulty of recognizing the defined points is the most. Besides, shoulder width is the most difficult part to measure and the chest circumference is the least.

Keywords: Body Measurement for Garments; Manual Measurement; The Degree of Measurement Difficulty; Data Statistics; Hierarchy Analysis

1 Introduction

At present, China is in a period of transition from manual to computer measurement, and this period will be there for quite some time. At this stage more than 90% of customized measurements are handmade in China. Our group found that many factors in the long track and study of measurement technology, which affect the specification of manual measurement, not only improve the quality of manual measurement, but also support the feasibility study of computer measurement. Anthropometric techniques has developed from the traditional manual measurement to 2D and 3D measurement, while automatic measurement and the use of computer measurement, processing and analysis are gradually developing. Now measurement methods has a high accuracy and efficiency through continuous improvement [1].

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In the late 1980s, 3D scanning was introduced to the apparel industry. Over the past decade, the world has been using a 3D scanner to investigate body dimensions and has entered the application phase nowadays [2-4]. 3D scanning has certain applications in such fields as modification and development of apparel type, establishment of the human body model, three-dimensional design clothing, apparel e-commerce, MTM, standard mannequin, virtual display of fashion products, and virtual dressing and fashion shows [5-7].

Non-contact measurement, when combined with the apparel, is a big trend of technological development of human Anthropometric, and it perfectly realized the personalization of customized apparel [8]. Two-dimensional measurement is based on measurement of body of incomplete data that comes from calculating circumference size through the use of two-dimensional images of front, side, rear of body [9]. On the other hand, 3D body measurement technology is rapidly growing and superior to traditional manual measurement in terms of speed, data integrity and reuse of the obviously, otherwise, the results in digitized formats it produces can be imported to related apparel CAD software to rapidly generate clothing patterns and accelerate the digitalization process of garment enterprises [10-12]. Non-contact Anthropometric has many advantages: short measurement time, high measurement precision and multi-site of measurement body. But there are still some shortcomings: the two-dimensional measurement can not reproduce the real three-dimensional shape of the human body; there are certain dead angles in three-dimensional scanning for breathing and body shaking incurring instrument errors when extracting the body edges [13, 14].

Although the human body measurement technology has been perfect, the measured values obtained compared to the true values still have some errors and the body size measurement accuracy is difficult to evaluate. In order to compare with the accuracy of three-dimensional measurement and traditional measurement methods, many scholars designed experiments made conclusions that the manual measurement is more accurate than the three-dimensional measurement and provided a lot of view of this difference. Pan Li et al. used Vitus three-dimensional body scanner and Martin meter to measure 229 experimental samples in contact and non-contact Anthropometric methods, and selected the seven major controlling parts of the body to prove that the average difference in height and length direction is small, slightly larger than circumference direction, wherein the difference of the average of the bust is the most significant [15]. Wang Yanzhen et al. collected data of 200 samples with ScanWorX instruments and Martin meter and concluded that data of manual measurement is relatively accurate [16]. Using a 3D body scanner of the United States [TC]2, Zhang Shujun et al. obtained 105 samples, and verified that the values of cervical, shoulder, chest, waist, back length, arm length and hip obtained by the scanner is greater than that of manual measurement [17]. Ren Hong scanned 174 samples with German Anthroscan 3D VITUS body scanner, who are also measured 29 morphological index in the traditional manual measurement, and he concluded that 3D scanning measurement, analysis drawn 3D body scanning can accurately measure the seven indicators: height, leg length H, lower limb length, leg length, pelvis width, wrist circumference, hip circumference. But other indicators of measurement have large error and need further corrections [18].

However, many factors affect the accuracy of anthropometric measurement and the relationship between them is very complex. Currently, domestic and foreign methods of analysis of controlling parts of the human body clothing data are many but there is no uniform standards and perfect system. For example, to ensure that the measurement data is statistically available, reproducible measurement results were used to assess uncertainties. Our group used soft feet and Martin ruler to collect a lot of human data and conducted experiments. Due to the following advantages