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The Laser Rotating of Non-contact Body Scanning System

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Abstract

This paper focus on the requiring of Made To Measure apparel production mode according to individual types and make calibration about body measurement and production in a line. In this paper, based on the measurement principle of structured light, a laser rotating body scanning of non-contact measurement system is introduced. Firstly, the key part of this system, such as digital motor, CCD, lens, etc, is introduced and discussed. Secondly, the principle of the whole system is brought up by analyzing the theory and realization of the structured light measurement, and a 3D reconstruction mathematical model is built based on the characteristic parameter of digital motor. Lastly, some important factors related to the accuracy of this system are discussed. The point cloud data of 3D body contour is acquired successfully via data processing and data piecing together. The further processing can be done according to the raw data. The validity of the principle of this system and the feasibility of arithmetic are verified by experiments.

Keywords: Laser; Structured Light; Mathematical Model; Non-contact Measurement; Body Scanning

1 Introduction

Human body measurement is different from dimension measuring of industrial applications. The human body is flexible and complex, and which is measured in the dynamic state and in dress in most cases, and its measurement methods are no harm to health. So there are special requirements for measuring equipment of the human body. Not only in the field of medicine and clothing, anthropometric data play an important role, but also in such aspects as sports kinematics research, health prediction.

Nowadays, the theme of the apparel industry tends to made-to-measure and e-commerce, the concept of made-to-measure has become guiding strategy in the new generation of clothing supplies [1, 2]. In particularly, the development of digital technology for clothing leads to the "seamless" business model, which include the use of advanced 3D body measurement system that can

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obtain all-round body size data in seconds, and large-scale anthropometric items, the way of made to measure by cutting according to individual body shape (made to measure, here after referred to as the MTM), the MTM automatic correction of CAD patterns, the automatic cutting on piece cutting bed, the real-time virtual trying on clothing, the clothing product data management and the clothing e-retail [3-6] and so on. The MTM becomes very popular as it can meet the personalized demands of consumers, and besides, its premise condition is the acquirement of 3D body data quickly and accurately [7, 8].

Since 1990s, many countries in the world have speeded up the research of non-contact 3D body scanning system. At present, the 3D body measurement technology abroad, mainly in the Euramerican developed country, have formed a certain industrial-scale and the measurement precision, scanning speed and operability etc of their instruments have reached a very high level. The representative products abroad are discussed as follows: ① Vitus/Smart laser scanning measurement instrument of the French Lectra company. It is equipped with four light beams and there are two CCD (Charge Coupled Devices) cameras and a laser with emission level one which no harmful for human eyes in each one [9]. The volume of the scanner is 225 cm×220 cm×285 cm with standard scanning time of less than 19 seconds, vertical resolution of 0.2 mm, and horizontal resolution of 0.1 mm. About 100 human body sizes can be automatically extracted and compatible with Excel data output format. After capturing the body surface imaging, the system can create a three-dimensional images of the high precision by computer. And with ScanWorX software, 3D editing and measurement can be performed. ② TELMAT type 3D human body measurement instrument of the German Assyst Bullmer company. It has automatic decision points, automatic calibration measurement space, automatic dimension generation, automatic body shape analysis and classification, automatic importing data in CAD system, automatic pattern generation, and the whole process is not affected by the human body movement and the color of underwear. The accuracy of the data can reach ±2 mm, measuring time is 40-3000 ms, the whole process takes less than 30 s. Data formats have IV, VRML(3D)-ASCII (measure) [10]. ③ The French SYMCAD Turbo Flash/3D is Telmat 3D body scanning system, which needs darkroom operations. Human with only underwear entered the room and stood in front of the illuminated wall. The side, front and back of the human, three different positions are shot by camera and scanned to calculate, the system can produce 50-60 accurate human body sizes and its data precision can be up to ±2 mm, and measurement data can be used in apparel CAD system in combination [11]. ④ A series of scanner production is made by textile clothing technology company (TC2) in the United States production, such as 2T4, 2T4S and so on [12]. With a phase measuring surface (PMP) technology, the system principle of the scanner is chose white layered profile measurement method, using white light source to projective sine curve in the human body surface according to the principle of light emission grid on the irregular surface of human body, inducing the deformation of grid shadow, producing the pattern that presents the outline of the human body surface, and can be detected by using 4 or 6 cameras. Body measurement system based on white light phase method is relatively cost-effective, has the simple principle, accurate and reliable measuring results and short scanning processing time, so it meets the requirement of rapid response in the apparel industry currently. ⑤ WB4, WBX, ARN and FAST scanner are made by Cyberware in the United States. It used the laser scanning method, obtains the data using the triangulation method. Its principle is using laser scanning triangulation technique to obtain 3D image and get the 3D data and a color structure graph of 24 points. The original human body data format is point cloud in order arrangement, which can be converted to the output format of 3D studio, MAX, DXF, IGESl24, OBJ, PLY, SCR, VR_ML by the systematic translation process. Users can take advantage of