Journal of Fiber Bioengineering and Informatics 7:2 (2014) 247–260
doi:10.3993/jfbi06201411

Automatic Modelling of the Lower Bodies of Young Females Based on Digital Photographs

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Abstract

The determination of curve generation rules for the body features is the lynchpin in the creation of computer generated three dimensional (3D) lower body human mannequins. In this paper, methods to determine the characteristic features of the curves, such as the waist curve, abdomen curve and hip curve were analyzed as a precursor to creating female lower body 3D mannequins. Methods to generate the profile curves for the different body features were devised by adding insertion points onto the curves. The relationships between the coordinates of the insertion points and body measurement data were analyzed using SPSS software and rules for the generation of curves for each of the featured parts were determined. Subsequently these were used to provide the basis for the creation of a female lower body 3D mannequin, which can be useful for the further development of clothing e-commerce. The modelling system was developed by automatically extracting anthropometric data from a non-contact 2D anthropometry system (photographs) and used to generate human models according to their different body features. The system can facilitate the interactive design of different fashion styles and the automatic generation of garment patterns.

Keywords: Computer Aided Design (CAD); Characteristic Position Curves; Mannequin Modelling; Point cloud Data; Anthropometry

1 Introduction

Associated with the evolution of the garment industry and the increasing demands by consumers for clothing that both fits well and is comfortable to wear, there has been a steady development in 3D garment CAD systems. The design and development of apparel through the use of intelligent, information-based, 3D CAD has become commonplace within the contemporary garment industry. The establishment of 3D garment mannequins provides the basis for the development of three-dimensional CAD for garments. The methods used to create 3D garment mannequins determine the research direction for 3D garment CAD systems, the level of difficulty in their development and the integrity of the systems devised [1, 2].

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The human body is a complex free-form surface which requires adaptive modelling tools to be able to reconstruct the 3D body surface using measured data. Although three-dimensional drawing software can be used to create a model of the human body, this does not provide a convenient method to determine the key anthropometric data points for subsequent garment modelling. Furthermore it is also difficult to design and control the human-computer interaction interface to produce the three-dimensional CAD software [3, 4].

Various methods have been used in the development of human modelling technology. These include wireframe, solid and surface models. Wireframe models have the advantage of a simple structure, require less data, lower computer hardware requirements and they compute rapidly. However they produce ambiguous data that is difficult to understand, give a poor sense of reality and cannot realize hidden line removal and shading. Solid models have the advantages of being unambiguous and are able to realize cross-sectional profile operation and hidden line removal, with control of localised features to achieve a high sense of reality and clearly defined textures. Despite this, it also has various disadvantages, such as a complex structure, making it difficult to realize surfaces, requiring a vast amount of data and a high specification of computer hardware and slow computational speed. Surface models produce high resolution and real surfaces, and they can achieve hidden line removal, and can control localised features to produce realistic images with clearly defined textures. However, to produce complex structures they require both a large amount of data and a high computer hardware specification and they also tend to compute at a slow speed [5-9].

3D garment CAD systems have been principally developed for: virtual sample manufacture (or tailor-made manufacture), remote clothing fitting (or virtual fitting and virtual shopping), merchandise planning, and quick response manufacturing. 3D modelling of the human body is the key element necessary for the development of these systems [10-12].

Nadia Magnenat-Thalmann has studied the problem and proposed solutions for the automatic modelling of animated virtual humans. Methods for capturing the shapes of real people and parameterization techniques for modelling static and dynamic shapes of virtual humans were classified, summarized, and compared. Finally, methods for creating clothed virtual humans were reviewed [13].

Many researchers have proposed methods for simulating human mannequins using 3D human body scanners based on 3D point cloud data. For example, Wu simulated a mannequin using scanner software [14] and Zhang provided a technical platform for the parameterized design of a female body model with different chest shapes [15]. However, few researchers have considered the simulation of human mannequins based on 2D photographs of humans.

In the present study, we aimed to automatically generate individual 3D human models based only on data extracted from front and side photographs, which can be processed rapidly with low costs. Moreover, such automatic generation of individual 3D human models can meet the individual needs of customers, provide technical support for personalized customization and electronic commerce, and satisfy the requirement for interactive design of products based on the use of 3D CAD.

In the research reported in this paper, reverse engineering software was used to conduct secondary development of the point cloud data, and the body features of the female lower body were studied to establish the rules for automatically generating female lower human models, which can be used to model an individual female's lower body. Subsequently, a modelling system was developed to generate the anatomical features of human models from data automatically extracted