

# Parameterized Model for Virtual Human Deformation

Huajie Cui<sup>a</sup>, Ruomei Wang<sup>b,\*</sup>, Yi Li<sup>c</sup>

<sup>a</sup>*School of Software, Zhongshan University, Guangzhou 510275, China*

<sup>b</sup>*Department of Computer Science, Zhongshan University, Guangzhou 510275, China*

<sup>c</sup>*Institute of Textiles and Clothing, The Hong Kong Polytechnic University, Hung Hom, Hong Kong*

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## Abstract

With the development of the theory of virtual reality, three-dimensional virtual human is being applied in clothing engineering design. Parameterized model for virtual human body hence becomes more and more important. In this paper, a parameterized model for virtual human body was reported. In this model, the virtual human body was partitioned into several parts (head, right arm, left arm, trunk, right leg, and left leg). Based on the partitioned human model, the proportional characteristics of the human body were used to calculate the offset of the vertices to implement the deformation on specific part of the body. The interpolation method was used to smoothen the deformed surfaces. The experimental results show that this method had good deformation effect.

*Keywords:* Virtual Human; Deformation; Parameterized

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## 1 Introduction

Virtual Human is the representation of a human's geometric properties and behavioral characteristics in a computer-generated space (virtual environment) [1, 2]. With the development of the theory of virtual reality, three-dimensional virtual human is being applied in clothing engineering design. According to the requirement of different human body's size, the parameterized human body can provide human body deformation. It has a great application in clothing individualization design.

Currently, there are two main ways to obtain three-dimensional human models: (1) Using the modeling software (such as Maya and 3D Max); (2) Using three-dimensional scanner to obtain the geometric data of the body surface. These two methods can provide a certain sized human model. In order to meet the numerous needs of individual virtual human models, the researchers began to try the idea of model reusing. Model reusing is the method to create different size of human models by doing deformation on the existing models obtained by traditional methods [4]. So, according to the human body generated by software or scanner, the model reusing method

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\*Corresponding author.

*Email address:* isswrm@mail.sysu.edu.cn (Ruomei Wang).

uses the deformation technique to produce new human body with new body size. It's highly efficient and low in cost when used for various applications.

In order to achieve model reusing, the key issue to be resolved is how to deform a certain part of the human body and guarantee the body's physiological characteristics to remain the same. Currently, most of the virtual human deformation methods only use the simple linear transformation and smooth operation, and do not adopt the different methods for different parts of the body, so the effect is not very good. In addition, many methods have strict requirements on the models (such as data format, body posture, etc.), which lead to bad application prospects, so most of the current virtual human models are not applicable in this category.

In this paper, a new deformation method which adopts a different approach for different parts of the body is proposed. The individual human model can be quickly created according to the input parameters (such as bust, waistline, etc.) and with a smooth transition between parts. The most important advantage of this method is the human body deformation with proportional characteristics of the human body.

## 2 Related Work

Researchers have done a lot of work on virtual human deformation. Seo and his partners proposed a method which uses the Bézier curves and B-spline curves to achieve local editing on the human body [5]. Later, they proposed another individual human model approach. Based on the input of 8 body sizing parameters, a personalized human skin model can be generated by interpolating the models which was obtained by three-dimensional scanner [6]. Their approach can reuse the existing human models so that corresponding models can be created by simply adjusting the input body sizing parameters. It is really fast and easy.

Mao et al [3, 4] proposed a simple human model customization method by access to 12 individual body sizing parameters and respective x-axis, y-axis, z-axis scaling on the corresponding part of the body surface, which quickly produced lots of models with different sizes. Then, J. Li proposed a personalized human model adjustment method, generating individual human models by modifying the 15 body sizing parameters [7].

Overall, the virtual human deformation techniques can be divided into two categories: Template Interpolation and Section Ring Deformation [8].

Template Interpolation is using two or more human models with the same topology to create a new human model by interpolation method. For example, if you want a model with 55cm waistline, you may have to find out two models in the database, one with the bigger waistline and the other with the smaller. Then, the ratio is calculated between the three waistlines and used as the parameter of the linear interpolation to obtain the coordinate location of the new points. The disadvantage of the Template Interpolation method is that a database needs to be created, and it requires the models to have the same topology.

The deformation method proposed in this paper is based on the Section Ring Deformation. At a certain location on the human body, if we use a horizontal or inclined section to intersect the body surface, we can obtain several intersection lines. The collection of the lines is always like a ring, hence the name Section Ring. By scaling the Section Ring, the local deformation of the virtual human body can be achieved. In previous publications [4] and [6], they use the simple