Journal of Fiber Bioengineering and Informatics 17:4 (2024) 191–205

Cite as: R. Pang et al.
doi:10.3993/jfbim03051

3D Body Data Analysis of Women's Top Sizes Aged 18-25 Years

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Abstract

Few studies in China use age as a criterion for garment size analysis in female body shape research. This project addresses the challenge of designing clothing that fits young women aged 18-25 by examining their upper body shapes. Combining Martin measurements and three-dimensional scanning, data on 198 women's body characteristics were collected, and morphological changes in their upper bodies were analysed.

The upper body shapes were categorised into four types, and representative silhouettes were compared. The body shape classification results were combined with the national chest-waist difference classification method. The primary control variables for women's shirt sizing were determined, and a linear regression equation was used to obtain the segmented values for each control variable.

Ultimately, a specification system for women's shirt sizes was established, providing a novel approach to research on body types and sizing systems.

Keywords: Body Shape Study; 3D Scanning; Top Size; Sizing systems

1 Introduction

1.1 The Status of Human Body Measurement Methods

Anthropometry, a branch of anthropology, consists of skeletal and in vivo measurements. In the context of clothing, body measurements primarily focus on live measurements. To enhance garment fit, digitising human body shape characteristics by measuring various body dimensions is crucial to achieving a precise and objective understanding of body shape. This process translates body shape into concrete measurements, forming the basis for size composition, production, and theoretical research [1], as well as human body shape analysis.

The Martin measurement method employed in this project, proposed by anthropologist Rudolf Martin in the human textbook (1928), is internationally recognised. This method uses the skeletal

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Dec. 2024

endpoints or joint points of the human body as measurement points and records the size and shape of the human body using numerical values [2].

Non-contact human body measurement methods, characterised by high accuracy, rapid speed, and extensive information content, are currently the predominant methods. This method encompasses a computer-aided measurement system composed of a light wave generation device, a light wave receiving device, and a light wave processing device using optical projection imaging technology [3]. Noncontact measurement methods include photography, the Moir é plot method, clothing deformation testing, and a three-dimensional human scanning system.

Commonly used 3D human scanning systems include Cyberware WB4 and TC2 from the United States; Vitronic and Tec Math from Germany; Lectra and Telmat SymCAD from France; Japan's Hamano Voxelan HEW 1800, Hamamatsu Body Line, and other clothing-developed countries possess measurement institutions that adopt advanced and scientific measurement methods to measure the human body of their citizens annually. Simultaneously, they conducted long-term tracking research on the human body shape of their citizens and timely supplemented and updated the size and size of clothing used.

Yoon J developed an artificial intelligence body shape system that can use 3D body images collected by 3D human scanners to predict the three body types proposed by Heath Carter's body shape theory [4].

Tan Z developed intelligent software that can automatically calculate the size of 28 body parts and accurately determine the body type of young women in the Central Plains [5].

1.2 The Status of Body Type Classification Methods

The core of clothing revolves around the human body. Each country possesses distinct classification standards for female body types and clothing size settings, such as international standards ISO, Chinese standards GB, Japanese women's clothing specifications JIS, German women's clothing standards DIN, American ASTM standards, British size system BS, French women's clothing standards FRA, BEL, Italian women's clothing standards ITA, etc. [6-11].

The division of body shape constitutes the foundation of size standards. It not only involves clearly distinguishing the physiological body shape of the human body but also necessitates consideration from the perspectives of sample production convenience and size coverage improvement [12].

Scholars have long classified human body types, employing increasingly professional and scientific methods ranging from one-dimensional data analysis to two-dimensional cross-sectional data research and subsequently to three-dimensional morphology research.

Vuruskan A uses subjective visual analysis to classify body types, using basic dimensions such as chest, waist, and hip circumference as evaluation parameters. The body types are divided into five: hourglass, inverted hourglass, spoon, triangular, and elliptical [13]. Mi Kyung Yoon proposed a method based on measuring the three-dimensional vector direction angle to define and classify the upper body profile. The upper body profile is divided into standard, forward-bending, and backwards-tilting types, and the measurement results are analysed [14]. The project aims to develop a dressing style that fully reflects the body shape of middle-aged women in South Korea. The study classified the body shape and investigated the anthropometric characteristics