Journal of Fiber Bioengineering and Informatics 16:3 (2023) 269–281

Cite as: J. Gou et al.
doi:10.3993/jfbim02371

A Construction Method for Personalized Bra Sample Models ⋆

Juan-Juan Gou [a], Long Wu [a,b,*], Jing Qi [a,b], Bo-An Ying [a,b], Yue Wang [a]

[a] *Apparel & Art Design College, Xi'an Polytechnic University, Xi'an, Shaanxi 710048, China*

[b] *Shaanxi Union Research Center of University and Enterprise for Apparel Intelligent Design and Manufacture, Xi'an, Shaanxi 710048, China*

Abstract

As a close-fitting clothing for women, bras are in direct contact with women's breasts and fully fit. The bra structure design based on the difference between upper and lower busts cannot meet individual differences. To solve the problem that traditional large-scale bra production methods cannot meet the individual needs of consumers For this problem, a parametric design method for one-person-one-version personalized bra samples is proposed. By analyzing the morphological characteristics of different breast shapes and the composition factors of bra samples, the breast is regarded as a combined model of ellipsoid and cone. The geometric model of breast shape is established, and the model is analyzed by surface flattening technology, and then the breast is obtained. Mathematical representation of breast characteristic structure lines include root circumference, surface arc length, and lower teat cup arc. According to the relationship between the breast and the size of the bra sample, the parametric relationship model of the bra sample is obtained, and the knowledge model of the bra sample is constructed based on the relationship model, which provides a method for realizing the personalization of the bra sample.

Keywords: Bra personalization; Geometric model; Parametric relational model; Template knowledge model

1 Introduction

Intelligent manufacturing is the main direction of Chinese manufacturing. For the clothing industry, one of the goals of intelligent manufacturing is to realize the personalization of clothing. The innovation of science and technology and the popularity of intelligent manufacturing have

⋆Project supported by Wuhan Textile and Clothing Digital Engineering Technology Research Center in 2022 (SZH202202), Natural Science Basic Research Program of Shaanxi (Program No. 2023-YBSF-203), Young Innovation Team Research Plan Project of the Shaanxi Provincial Education Department in 2022 (22JP027) and the Shaanxi Union Research Center of University and Enterprise for Apparel Intelligent Design and Manufacture.

*Corresponding author.
Email address: wulong7398@163.com (Long Wu).

Sep. 2023

promoted the reform and development of the clothing industry. With the improvement of people's living standards, consumption concepts have also changed. In this era dominated by consumers, the attitude of pursuing personalization is increasing rapidly, and the market trend is gradually changing to diversification, hierarchy and personalization. As close-fitting clothing for women, bras should be designed in a personalized and tailor-made way to meet diversified consumer needs.

The current bra market fails to cater to individual needs, and traditional plate-making methods lack the ability to automate plate-making. Many scholars have researched the realization of personalized tailoring of bra models. To solve the problem of low efficiency of traditional manual and CAD plate making, Cheng Tiantian used Matlab software to realize the customization of personalized bra styles. This personalized realization method cannot be called real personalization [1]. Chen Yuexing graded the production of bra samples based on the individual needs of consumers, and proposed a digital bra pattern-making method. There is no systematic evaluation method in the sample evaluation part [2]. Taking the fit of bras as a starting point, Ma Jing conducted an in-depth study of the influencing factors of bra cups and breast matching and provided a reference for the realization of personalized customization of bra samples [3]. To reduce the duplication of labor in the bra structure design of the enterprise, Wang Yan studied the relational model of the bra structure design and proposed that the bra pattern design method driven by the relational model cannot realize fully automatic pattern making [4]. Ma Jiajian proposed a positive hierarchical design method based on personalized customization, to meet consumers' needs for bra fit [5]. DeirdreE.McGhee et al. studied the breast volume and corresponding cup size of 104 women and analyzed the changes in volume and different cup sizes in each size range [6]. BradleyP. Studied the continuity of bra cup size and developed a standardized bra cup system, redefining the measurement standard of cup size [7]. Hyun-YoungLee measured the three-dimensional data of the breast with the help of a three-dimensional body scanner and, based on this, designed an ergonomic bra cup line that conforms to the curve of the breast and chest [8].

Among the previous studies, the current research on considering different breast shapes and designing styles according to them is relatively limited. In the research process on the individualization of bra models, there is still no systematic method to realize one version per person. Dobson once pointed out that the clothing pattern is the symbol of the highest technology in the art of clothing molding, and it is the best way to make the clothing fit the human body accurately to the greatest extent [9]. It can be seen that structural design according to different breast shapes is a key factor in bra fit. The individual demand for bras is much higher than that of other clothing, and the traditional method of using the difference between the upper bust and the lower bust to mass-produce bras cannot meet individual needs [10]. The goal of this study is to create personalized bra samples based on the knowledge model of the cut-piece bra samples.

2 Methodology

2.1 Breast Geometric Model Construction Based on Breast Characteristic Parameters

2.1.1 Geometric Model Construction of Breast Shape

The fit of the bras is the basis of the sample design. Faced with differences in breast shapes, a single pattern-making method cannot cover all breast shapes. This study selects the disc-