

The Research of Molded Bra Cup Inner Surface and Its Capacity^{*}

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Abstract

Different bra cup inner surface leads to different capacity and style in dress. As a result, it is important to consider inner surface and its capacity in bra cup designing. In this paper, molded cup with wires is viewed as the research subject: its 3D model is rebuilt in Geomagic Studio, and its capacity is defined and measured in Unigraphics. Then a wearing experiment is conducted where one model wears molded cup bras of same size but different inner surfaces to study bra push-up and upgrade function and by analyzing the difference between cup capacity and breast volume. The research result is that the bigger difference between cup capacity and breast, the greater its influence on breasts. Moreover, with similar total bra cup capacity, the push-up and upgrade functions of bra cups in different degrees are presented. Furthermore, molded bra cup is split to blocks and analyzed in order to examine the impact on different functions. There is a certain guiding principle to inner surface shape design of molded bra cup.

Keywords: Inner Surface; Molded Cup Capacity; Breast Volume; Difference Value; Impact on Breast

1 Introduction

With one-step-forming technology developing, molded cup bras nowadays have become more and more popular. It can present a naturally smooth configuration and reduce the production cost of cutting and sewing and provides a wide range of designs combined with different levels of softness and support [1, 2]. Bra cups are always designed in the reverse software and CAD/CAM. They are made and wore by fitting evaluation. Then whether cup surfaces or curves are appropriate is determined. If not appropriate, they are modified repeatedly. That process wastes much time and costs much. So it is necessary to search more features to conduct cup designing. Geometrically, the molded cup bra is composed of two convex surfaces that form both the outer surface and inner surface of the bra. It generates a semi-closed space that can accommodate the breasts.

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When closed by constructing some surfaces, the space is viewed as bra cup capacity. The bra cup capacity is different and the influence on breast in dress is diverse. Bra designers usually measure molded cup capacity by wire diameter and cup axis height. The larger diameter and higher cup height are, the greater bra cup capacity is. This method is inaccurate with a variety of molded cup inner surface shapes as a lot of molded cups are partial or whole thickened to meet some functional requirements.

The push-up and upgrade function of molded bra cup can actually be taken into consideration in that the capacity of bra is insufficient and the phenomenon of breast spillover appears. So the difference of breast volume and molded cup capacity must be calculated to investigate whether bra capacity is sufficient. Also, breast volume is to be measured. Breast volume measurement is mainly used in medical field. In 1991, Qiao Q [3] found that breast volume was positively correlated with weight and the circumference of breast, waist, hip, and was negatively correlated with height by using traditional methods for 125 Chinese young women and the related equation is used to guide Asian female breast plastic technology. Since the middle of the 20th century, many scholars such as Ingleb [4, 5] have developed water volume replacement model to achieve breast volume rapidly, accurately and easily according to the principle of Archimedes. In order to demonstrate the range of volumes within each size and the variation among different bra sizes, McGhee DE [6] measured the breast volume of a large number of women via water displacement and their corresponding bra sizes. As the optical technologies advance and the use of computer graphics becomes popular, the technology of breast volume measurement can get more accurate measurement results. Malini etc. [7] put forward the method of ultrasonic measurement for breast for the first time in 1985: ultrasonic scanning probe was used to scan transverse or longitudinal on the breast at 1 cm gap distance. At present, the method of computer aided optical measurement techniques to scan breast is widely used. Breasts cloud points processing, feature extraction and curve/surface reconstruction are conducted in reverse software by fitting horizontal curve, vertical curve and the curve on breast surface with certain distance according to the curve fitting principle [8], and building breast mesh model to get breast volume using calculus technology. SUN Q [9] extracts horizontal line, vertical line through BP and molded cup depth that influences molded cup capacity in the search of molded cup feature recognition. However, cup inner surface geometry is not considered.

In this paper, molded bra cup capacity, breast volume, and its influence on different breast shape value in dress are studied by using computer optical measurement technology to scan molded bra cup, detailed points cloud data achieved through 3D CaMega CPC binocular 3D scanner, bra surface reconstructed to obtain 3D molded cup and try-on experiment conducted. The research of molded cup capacity can provide evidences for molded cup designers and researchers to understand and design geometry of cup inner surface better.

2 The Research of Molded Bra Cup Capacity

Although a semi-enclosed space, molded bra cup can be converted to an all-enclosed entity based on the requirement by generating surfaces. The all-enclosed space is regarded as molded bra cup capacity. As molded cup capacity changes, its effect on breast changes. The study is meaningful to the research of the matching relationship between molded bra cup and the inner surface geometrical morphology.