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MATHEMATICAL ERGONOMICS STITCHLESS MODEL OF VOLUME FITTING STRETCH FOR DESIGN SPORT BRA

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Ergonomics intelligent design system of the volume fitting stretch for design the sport bra style and its simulation remains a major challenge, even if applications are numerous, from rapid mathematical for e-commerce to a stable arithmetical for stretch comfort design cloth of sport bra surfaces. This study compared seven sports bras on quantitative and subjective measures of arithmetical comfort as well as ergonomics of stitchless items for small, medium, and large breasted women during exercise. Representing different cup sizes were filmed while jogging on a treadmill at 6 mph in each bra style and in the nude condition. The average stitchless model of vertical displacement of the breast relative to the body was described mathematically for each condition. Two-way repeated measures of mathematical ergonomics of stitchless model of volume fitting stretch that is aimed for designing a sport bra and subsequent pairwise comparisons indicated significant differences by bra style in subjective mean comfort scores and a significant interaction between subjects' cup sizes and subjective mean support scores. Correlation coefficients between vertical displacement values, subjective measures of support, and subjective measures of comfort indicated that bras, which effectively controlled breast displacement, tended to score lower on comfort design. There were, however, exceptions to this trend, and no single bra rated well on all three measures of performance up the 3D fitting sport bra of woven stretch knitted cloth by using the method developed in this paper.

Keyword: Ergonomics, stitchless, fitting stretch, sport bra, comfort design.

Introduction

A sport bra is a bra that provides support to female breasts during physical exercise. Sturdier than typical bras, they minimize breast movement, alleviate discomfort, and reduce potential damage to chest ligaments. Many women wear sports bras to reduce pain, and physical discomfort caused by breast movement during exercise. Some sports bras are designed to be worn as outerwear during exercise such as jogging.

Historically, the recorded sizing system that is used for current bra manufacturing was founded in the year 1926, a system that was originally intended to classify breast shapes into analogous types. Warner Brothers [5], in America, incorporated the volume size into the bra size specifications in 1935. This gave birth to the alphabetically notated sizing system for bras and the basic modern bra sizing charts in use today, although manufacturers and bra designers of the different brands use different sizing charts for specific target markets. Consumers find their sizes by trial and error, by trying on bras of different styles, models and brands, until they find a bra that fits well. This is still the most dependable method of finding a bra that fits well, because of the differences noted above, as well as the fact that body measurements used for manufacturing bras are taken manually and are prone to error. Today, many countries still use the metric system whilst others prefer the imperial system to determine the bra under-band size. There are various International Standards Organisations systems, including the European, Japanese and Chinese bra sizing standards, in use today for developing bra-sizing charts. This work will only refer to the comparisons in the metric and imperial systems and the conclusions as drawn and reported by Zheng et al. [18] as these are the most popular bra sizing systems in use today.

Volume fitting stretch model of sport bra

Body Volume Index [16] is the relationship between the distribution of body mass to volume fitting stretch model and the location of the mass on the body. It is suggested as an alternative tool to Body Volume Index. It is a computer-based measurement of the body for obesity. Volume fitting stretch model of sport bra can differentiate between people who have the same rating, but who have a different body shape and body mass distribution. The basic of a person is measured manually by total weight and height, while the volume fitting stretch model of sport bra is calculated by using 3D body data and the appropriate software to determine volume or weight distribution. Volume fitting stretch model of sport bra measures where the weight and the fat are located on the body rather than total weight or total fat content. The 3D body scanner determines the three-dimensional outline of a person's exterior surface, so that computation can be used to calculate the part volumes and the part body composition of the person.

Volume fitting stretch model of sport bra is used as an analysis tool in this study on size prediction. Stretch model of sport bra was a conclusive indicator for use in further studies, which were conducted on Europe women. The subjects were initially recruited on visual observation of being “breasted” and on dress size 32 or larger. After the different bra styles are graded and manufactured, the bras are fitted onto live fit models wearing the different grading styles to check for obvious distortions in styling, manufacturing and the positioning of the bra cup under-wire to obtain comments from the models. This information is used to improve the fit of the samples. Pattern dimensions are adjusted; and the new samples are modified accordingly and sent to the sampling department until the “fit” is correct. The sport bra specification depends on the torso dimensions of the fit models and not on the actual garment specifications, although sport bra are manufactured according to specifications that are altered to fit the torso of a fit model with a given set of torso body dimensions.

The fabric of sport bra cup is cut into a circular mould in the garment shape, and flattened into a 2D pattern piece. The top of the cone is used to design the sport bra cup notations that are graduated from the size 32 to 42C. The graduated cones are purchased from the international company, which produces the sport bra graduated moulds upon the specific request and specifications of volume fitting stretch model of sport bra, and used as is for the different sizes of sport bra cups. The sport bra sample is adjusted on the relevant fit model and the adjustments to the sample size are made accordingly to [1, 2].

Li [12] reports that the average absolute threshold for the breast region of the “female skin” is dependent on the fabric to skin contact and the mechanical interaction of the bra during wear. The process is explained as the application of pressure and mechanical stimulation of the skin, which triggers various mechanoreceptors resulting in an array of touch sensations. For this study, it is also worth noting that the static pressure when wearing a sport bra, in the standing position, was at the back, in the side and at the shoulders. In addition, wearer preference in the choice of the bra size was related to pressure distribution.

The initial sample bra design is sketched and volume fitting stretch model of sport bra mostly from stretch fabrics or combinations or blends thereof, cut from flat panels and accurately shaped to the nearest millimeter. The pieces are sewn or fused together into a three-dimensional garment and fitted onto a live model, to check the support of the torso without obvious distortions or discomfort to the wearer. Designing bras is not only lengthy but complicated process that requires various skills including design creativity, detailed knowledge of fabric performance and precision pattern making. Typical bra design process involves three broad stages, namely, concept, design, pattern development; this is a standard process flow diagram throughout the bra manufacturing industry [8].

Objectives and challenges of design

Volume fitting stretch model of sport bra and discussions with intimate apparel manufacturers and retailers in Europe have clearly indicated a need for more accurate and relevant torso measurement data, notably breast, volume or sport bra cup size, breast volume contour and size and depth, as well as sport bra sizing systems for sizes of Europe women. In addition, the 3D scan technology lends itself admirably mathematical ergonomics stitchless model of volume fitting stretch for design sport bra for this purpose as it has the ability to extract traditionally difficult measured breast areas.

Volume fitting stretch model of sport bra can either encapsulate or compress breasts. Bras that encapsulate breasts have Ergonomics molded cups, while compression-type bras restrict movement by flattening the Volume Fitting of breasts. Encapsulation-type bras generally are more effective at reducing discomfort, but some women prefer compression stretch designs. Volume fitting stretch model of sport bra, which is the most common stitchless sports bra, is basically designed like a tank top with Ergonomics Model of the bottom half cut off. Other designs use gel and water pads, silver fibers, and air bags, which can be molded, compressed, and shaped. A compressed bra is designed to push the breasts against the chest to reduce movement and bounce. Other bras are stitchless knitted in circular patterns, giving varying stretch and support. A common design of such uses a stretchable, absorbent fabric such as Lycra designed to reduce irritation by drawing perspiration away from the skin. Women also wear stitchless Sports bras after certain surgical procedures. In those situations, a front-closing sports bra with a compression, seamless cup is recommended for healing and comfort. Certain fabrics such as Lycra have been invented to help reduce swelling and help "even-out" a bust line that has been altered by a surgical procedure.

Ergonomics models of stitchless sports bras are also manufactured for men with large breasts to enable them to take part more comfortably in physical activity. Some descriptions are used euphemistically to describe bras for men as chest binders.

Another problem arises from the shoulder straps of standard bras. Standard well-fitting bras are constructed in the form of a "square frame" with all dimensions adjusted for each woman in a normal standing position, with arms to the sides. When a woman performs an activity, which requires her to lift her arms above the shoulders, the frame is strained because the chest band, putting direct pressure on the shoulder trapezius muscles, anchors it. This may result in neck and shoulder pain, numbness and tingling in the arm and headaches [10, 14]. In order to avoid such problems the bra shoulder straps are usually crossed at the back, or the bra is worn halter-style.

The main goal of this work is to determine whether the volume breast fitting quadrant data will provide the sport bra manufacturers with appropriate data for the styling of cup panels of the stretch sport bras for women in Europe.

Theory of volume fitting stretch model of sport bra

Ergonomics stitchless bars model (without ordinary sewing) of volume fitting stretch is aimed for styling the sport bra. In theory, the cup of sport bra size is based on the fitting chart, but in fitting, the placement of the bust on the chest wall affects the underbust girth stitchless shape because it is different for each woman. Hence, the sport bra shape may remain the same across grades, and the stitchless bra pattern may be close from one graded cup size to the next, but the length of the wing around the body will change. Subsequently, an individual will have to fit stitchless sport bra for size prior to purchasing, as the ultimate choice of stitchless sport bra largely depends on comfort.

Sports Bra Design

Unlike traditional monitor bands, which encase the electrode in a hard plastic shell, the conductive textile is a flexible, seamless part of the nylon and Lycra bra that is presented in the figure 1. The best part of this design is that one would not be able to tell where the conductive area if one feels the garment. The only "hard" part of the bra is a small, snap-on transmitter that sends heart rate data to a third-party heart monitor watch.

Fig. 1. Sports Bra design [19]

There are two basic design styles of sports bras: compression and encapsulation. The former flattens breasts to redistribute their mass evenly across the chest; the latter supports each breast separately in its own cup. The design engineering of bra often compared to suspension bridges with support coming from directions: straps, band, circumference, and two intersection 180° arcs of the cups [13]. In order to design a volume fitting stretch model, which accomplishes this engineering feat and is comfortable to wear, requires a designer with expertise and a high level of heuristic knowledge, with heuristic knowledge being problem-solving techniques that use self-educating techniques [8].

In the past century, photographers used still cameras in study of human and animal movement by taking a series of shots in an attempt to capture the movement to be studied and the type of movement and the analysis requirements largely determine the camera and analysis system of choice. Human motion analysis system uses maker sets, instrumented devices (such as electrogoniometers), and imaging methods ranging from television to video systems [15]. Three-dimensional motion characterization of Volume fitting stretch model can be obtained using cameras and optoelectronic techniques, which incorporate markers positioned on prominent anatomical landmarks of subjects [15]. A quantitative film or video analysis is usually performed with computer-linked equipment. Digitalizing a film or video, which involves the activation of a hand-held pen, cursor, or mouse over subject joint centers or other point of interest, with the *x*, *y* coordinates of each point subsequently stored in the computer data file [7]. From the literature, characteristics of volume fitting stretch model of supportive sport bra should meet the requirements of consumer performance perception of reality of fit of sports bras, as well as users' design performance, and insight into the complex engineering problem involved in designing sport bras for improvement of fit and support.

2. Implementation

Volume fitting stretch model of sport bra that is made by using V-Stitcher™ is the most powerful 3D design and visualization software accelerating the entire product development life cycle; interfaces seamlessly with AccuMark pattern design, grading and marker making software, enabling fast and easy transformation of 2D patterns into 3D volume fitting stretch model of sport bra. V-Stitcher is a key component of Gerber's Product Lifecycle Management offering, which significantly reduces product development costs and improves time-to-market through the creation of virtual volume fitting stretch model of sport bra samples. Using 3D simulation to test multiple print variations; allowing user to make important design decisions before a physical sample is produced; saving both time and money. Transformed 2D patterns to 3D volume fitting stretch model of sport bra of Patterns developed in AccuMark are used to create the virtual samples in V-Stitcher. Only Gerber Technology offers a direct interface between AccuMark and V-Stitcher, and with easy file sharing there is no need for data conversion, real-time fit approval sessions can be held online, across the globe. 3D notes, and the ability to save and embed the 3D files allows for maximum flexibility when creating tech packs with WebPDM.

Virtual samples reduce the need to exchange physical samples through the mail, saving time and costs. 3D samples enable faster detection of errors and earlier corrections. They help to eliminate the distance between stakeholders. Besides that, virtual samples present real life images of collection and color ways in high quality, as well as interactive 3D catalogs, at any point in the pre-production, production or merchandising process. Virtual Samples can be used for internal design reviews before factory creates first prototype samples. Such models provide designer with better introduction of design ideas. They simulate texture, draping and fit of volume fitting stretch model of sport bra by displaying them on a realistic, virtual human body form based on user's pattern, fabric and texture data. Draping simulation is based on advanced mathematical and physical algorithms implemented in fit throughout development process.

In addition, using new databases formed after scanning (air gapes values, lengths of cross section' contours in vertical and horizontal directions, wrinkle depths, etc.) one can calculate the pattern parameters (front, back, sleeve) for the block reconstruction. By this way user can transform the indexes belonging to 3D volume fitting stretch model of sport bra with non-simple shape as sport bra into the indexes of flat 2D pattern [4, 17], which were put on the standard type of female model [17].

There are several techniques to set up the garment of woven stretch cloth, such as Bezier patch, B-stretch theory patch, etc. The shape of the woven stretch cloth set up by these techniques is suited for interactive modification by designer. However, the aim of current research is to control the shape of the 3D volume fitting stretch model of sport bra of woven stretch cloth automatically. Therefore, in this paper the 3D volume fitting stretch model of sport bra of woven stretch cloth is constructed by using the technique of basic concepts of surface patch. Such concept means that a piece of cloth or other material used to mend or strengthen a torn or weak point of the original surface. The transformation of the shape of the 3D volume fitting stretch model of sport bra of woven stretch cloth can be mastered by controlling the parameters of key form points. This technique, introduced only recently in computer graphics, has proven to have very good performance for instance used implicit integration in the context of cloth animation with great success [4, 3, 17].

Material and methods

The input data for the current research are the classification types of breasts presented in the figure 3 as well as different bra styles, which are most common in Europe (figure 2).

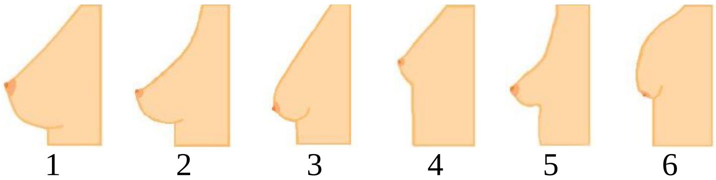


Fig. 2. Different types of breasts [6]:
1 – Perfect breasts; 2 – Swooping Breasts; 3 – Saggy or Ptotic Breasts; 4 – Small Breasts; 5 – Tubular or Constricted Breasts; 6 – Pectus Carinatum or Pigeon Breasts

soft bra balconette full-cup minimiser sports

Fig. 3. Different bra styles for women [9]

The body measurements used for the breast model correspond to women sizing as it is shown in the table 1.

Table 1 – Illustrating Women's sizing [20]

Label sizes	S	M	L	XL	IX	2X	3X	4X
Dress size	4-6	8-10	12-14	16	14-16	18-20	22-24	26-28
Bust*	32-34	34-36	37-39	40-42	39-41	42-45	46-49	50-53
Waist*	25-27	27-29	30-32	33-35	32-34	35-38	39-42	43-46
Hip*	35-37	37-39	40-42	43-45	42-44	45-48	49-52	53-56

* Measurements by inches

In the software program, the bending properties of cotton fabric were considered for the fitting bra. In this study, a twill-weave 100-percent cotton fabric was used. Fabrics generally show nonlinear response in bending. Their nonlinear moment-curvature response is often measured by the Kawabata bending test system [11]. The scale of the property curves depends on the measurement devices.

3. Result and discussion

Volume fitting stretch model of sport bra uses numerous practical examples, figures, charts, and graphs to bring the material to life. In addition, descriptions of technological advances show where we have been and how technology has advanced the field. Through the discussion of the various stressors and adaptive mechanisms with various environmental conditions, various training modes can be used to alter sport-specific capabilities and enhance performance. During the developing process, the area of the surface may change. The Finite Difference Method, and Patterns developed in AccuMark are used to create the virtual samples in V-Stitcher.

3d surfaces of clothes

Volume fitting stretch model of sport bra in our opinion the weakest position of the modern 3D CAD design is ignorance the clothes patterns influencing for the 3D features. In this direction we did some works, which include a new classification of 3D clothes shapes based on the usual features of shape (such as closely fitting, loosely fitting, semi closely fitting, etc), on one hand, and the air gapes in the system “body-clothes” on the other. This classification allows to connect the 3D shape and 2D patterns and to predict the clothes shaping. As example, you can see the fragment of such classification that we created for women clothes.

Measurement schedule

Three trained arithmetical anthropometrists measured and recorded each dimension three times using a tape measure to the nearest sixteenth of an inch to minimize error, one arithmetical anthropometrist measured while the other dimension was deemed as the physical measurement for that dimension. The potential field for application of volume fitting stretch model of sport bra is design of the patterns under consideration of the material behavior through mechanical and physical properties.

If curved element of contours of lightweight textile structures are covered with an undefined shape of the reinforcing textile, the mechanical component properties may deteriorate. Hence, the patterns should be developed directly on the object to apply the reinforcing structures to the desired 3D shape according volume fitting stretch model of sport bra to the required load and thus avoiding rework.

The research is directed on working out of methodology of volume fitting stretch model of sport bra throughout of the new design of clothes in system "software and three dimensional body scanners".

Two new databases are in a basis of this methodology of research: the first one includes the schedule of indexes about the patterns (2D), collected from the second half XX–XXI; the second one includes the quantity information about the outline clothes shapes (3D) of the same period, digitized by the body scanner.

The new technology that connects the flat patterns (front, back) of volume fitting stretch model of sport bra, on one hand, and the outline shapes of systems "body-clothes", on the other hand, is developed for main kinds of sport bra clothes. Curves can be created by the grid method at each block of a semi-fit silhouette and loose-fit silhouette. The grid method is the way to divide the width and height of a block by the number of a row and column and to arrange the curves on the piece. Since flattening is made by using the length of a segment of a triangle, curves were created at each grid diagonally. Thus, using 3D curves, we obtained 2D triangles. We also made grids by connecting two triangles, arranged each grid to keep the length of the outer curve and calculated the surface flattening piece of each block. This surface flattening piece is called an apparel pattern consisting of each silhouette (fig. 4).

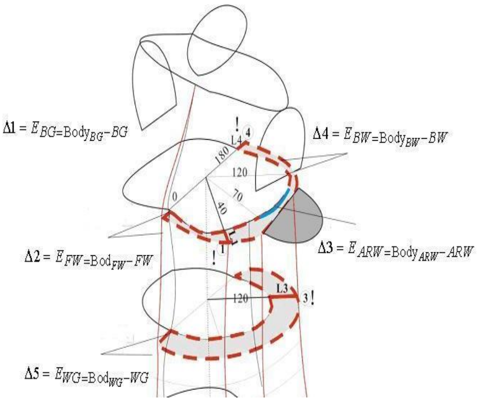


Fig. 4. Topological fitting clothes of frame of 3D system "woman body, sport bra" for putting on the surface from textile materials [4]

Then we can calculate the volume fitting stretch model of sport bra, in which the fitting equation of the chest circumference ($\Delta 1$) of stretch distance coefficient is as follows:

$$\Delta 1 = E_{BG=Body_{BG}-BG} \quad (1)$$

$$CSDC = \frac{100}{n}\left[\sum_i VSC + Y_i \,/\, \sum_i VSC + \chi_i\right] - \Delta 1 \quad (2)$$

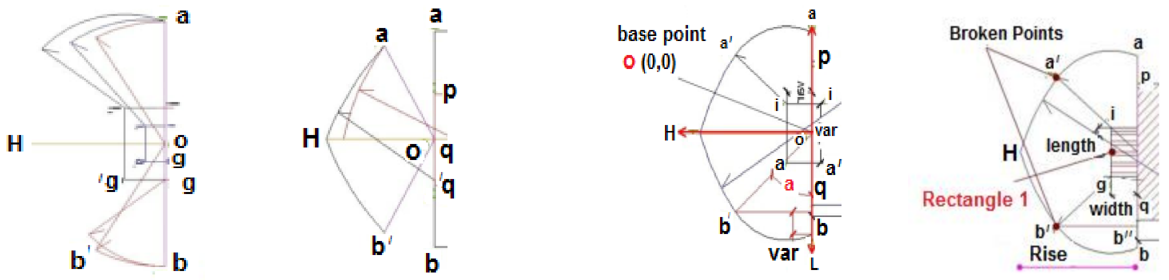
where Y – maximum (minimum) distance of node from the edge of the waistline contour and χ; n – number of nodes.

Geometry breast model

We can illustrate the volume geometry of breast model for design fitting of sport bra through the mathematical ergonomics of stitchless model of volume fitting stretch of the sport bra.

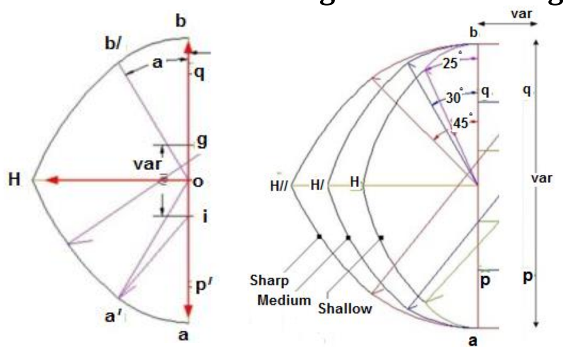
In order to provide an in-depth discussion of how the principles of ergonomics can be applied in the context of geometry breast model for design of sport bra and other physical performance and physiology, enhancing geometry breast model was used. Such a model is to improve safety of breast as well as to insure the performance of sport bra.

In the figures 5 and 6 illustrations of the developed initial profile and its geometrical parameters are presented [Source: Authors].



a b c d

Fig. 5. Geometry breast model as volume fitting stretch model of sport bra: a) possibility of the center apex points of the first and the second arcs; b) possibility of the center apex points of the third and the fourth arcs; c) general initial profile of apex; d) apex throw model of volume fitting stretch for design sport bra



a b

Fig. 6. Geometry breast model as volume fitting stretch model of sport bra [Source: Authors]

The derivation of the sub-types of the pointed domes according to their geometrical attributes constitute the geometry breast model as volume fitting stretch model of sport bra (BVR):

$$BVR_1 = \begin{bmatrix} ig = i'g' = \dfrac{m_1}{n_1}ab \\ ii' = gg' = \dfrac{m_2}{n_2}ab \end{bmatrix} \begin{vmatrix} (length) \\ (width) \end{vmatrix} \qquad (3)$$

$(B) = or:$

where length:

$$La = 25', 30', 60' \; and \; 45'$$

$$(aa'' = bb'' = m_3 / n_3 ab, 0$$

$$\mathrm{BVR}_2 = \begin{bmatrix} p'q' = pq' = \dfrac{m_4}{n_4}ab \\ qq' = pp' = \dfrac{m_5}{n_5}ab \end{bmatrix} \begin{vmatrix} (length) \\ (width) \end{vmatrix} \qquad (4)$$

where width:

$$(width)\left\{ \begin{bmatrix} = \dfrac{m_1}{n_1} xab \\ 0 \end{bmatrix} \angle B, \begin{bmatrix} \dfrac{m_2}{n_2} xab \\ \dfrac{m_3}{n_3} xab \end{bmatrix} \right\} \qquad (5)$$

$$\left\{\begin{vmatrix} 2/\frac{m_1}{n_1}xab \\ 0 \end{vmatrix},0,0\right\} \qquad \left\{\begin{bmatrix} 0 \\ 0 \end{bmatrix}\angle 30,\begin{bmatrix} 2/4ab \\ 1/3ab \end{bmatrix}\right\} \qquad \left\{\begin{bmatrix} 2/6ab \\ 0 \end{bmatrix},\angle 45,\begin{bmatrix} ab \\ 2/6ab \end{bmatrix}\right\} \tag{6}$$

in equation (i) in equation (ii) in equation (iii)

(i) Sport bra design of two-centered breast of volume fitting model;

(ii) Sport bra design three-centered breast volume fitting model;

(iii) Sport bra design four- centered breast volume fitting model.

Then fitting equations of the breast model are stretch distance coefficients that are computed as follows:

$$\Delta 2 = E_{FW=Body_{FW}-FW}; \tag{7}$$

$$BSDC = \frac{100}{n}\left[\sum_i VSC + Y_i / \sum_i VSC + \chi_i\right] - \Delta 2; \tag{8}$$

$$\Delta 3 = E_{ARW=Body_{ARW}-ARW}; \tag{9}$$

$$ASDC = \frac{100}{n}\left[\sum_i VSC + Y_i / \sum_i VSC + \chi_i\right] - \Delta 3; \tag{10}$$

$$\Delta 4 = E_{BW=Body_{BW}-BW}; \tag{11}$$

$$BSDC = \frac{100}{n}\left[\sum_i VSC + Y_i / \sum_i VSC + \chi_i\right] - \Delta 4; \tag{12}$$

$$\Delta 5 = E_{WG=Body_{WG}-WG}; \tag{13}$$

$$BSDC = \frac{100}{n}\left[\sum_i VSC + Y_i / \sum_i VSC + \chi_i\right] - \Delta 5; \tag{14}$$

$$\Delta 6 = E_{HG=Body_{HG}-HG}; \tag{15}$$

$$HSDC = \frac{100}{n}\left[\sum_i VSC + Y_i / \sum_i VSC + \chi_i\right] - \Delta 6, \tag{16}$$

where Y – maximum (minimum) distance of node from the edge of the waistline contour and χ; n – number of nodes.

The fitting form of designing system “body-clothes” consists of horizontal and vertical cross sections that crossed in more important and informative points. Systems of the equations, uniting both databases and allowing directing the indexes, which belong to the outline shape of the volume fitting stretch model of sport bra, are generated. Relationships for the values of shapes and silhouettes of system "body-clothes" under the influence of pattern indexes (eases equal to differences between the pattern sizes of volume fitting stretch model of sport bra and body dimensions, configuration of counter lines, position of darts, etc.) are obtained. Informative areas of main kinds of clothes and the equations for their changing are defined. In the figure 5 the theoretical frame of women volume fitting stretch model of sport bra is shown in order to describe volume fitting stretch model of sport bra. In the table 2 a fragment of the new classification, which connects 2D pattern and fitting “body-clothes”, is resulted.

Table 2 – Fragment of the new classification connecting 2D pattern and fitting "body-clothes" (for women body 164- 88-96 and body)

Kinds of clothes shape	Pattern eases, cm			Fitting clothes on women body, cm, in different sections on the bust/hip/waist levels, degree			Fitting darts of sport bra		
	ease to half bust girth	ease to half waist girth	ease to half hip girth	front, 0…70	under armhole, 70…120	back, 120…180	Front	Side	Back
Very closely fitting	1,8…3,0	2,5…4,0	2,5…4,0	0,46 0,34 0,26	0,35 0,64 0,37	0,37 1,26 0,28	0,12 0,20 0,19	0,25 0,44 0,17	0,17 0,62 0,82
Closely fitting	3,0…5,0	4,0…7,0	4,0…7,0	1,75 1,33 2,05	1,55 1,76 0,57	1,08 2,47 0,45	1,02 1,06 1.70	0,85 0,76 0,97	0,18 1,42 0,34
Semi closely fitting	6,0…10,0	7,0…11,0	7,0…8,0	3.04 2,37 3,84	2,84 2,83 0,76	1,68 3,64 0,67	2,04 1,30 2,53	1,04 1,38 0,26	1,28 2,14 0,17
Loosely fitting	10,0…14,0	11,0…14,0	8,0…10,0	4,24 3,36 5,65	5,55 3,94 0,93	2,39 4,86 0,89	3,04 2,26 3,60	3.65 2,74 0,73	2,19 3,26 0,39

Conclusion

In order to improve the breast model as volume fitting stretch model of sport bra and therefore to improve design efficiency, and make it possible for the common user to design professionally, we developed breast model on volume fitting stretch model of sport bra intelligent design system. As the process of volume fitting breast model of sport bra design is a creative thought process, and breast model as volume fitting stretch model of sport bra is a kind of flexible objects, it is a hard work to express and digitize the knowledge of design. In this paper we constructed the 3D of breast model throw stretch cloth of a volume fitting stretch model of sport bra with basic concepts breast model surface patches, established the relations between the breast model styles and the parameters of the dimensional volume fitting stretch model of sport bra of woven stretch cloth. By setting up the knowledge base with object oriented technology and there mechanism, we accomplished the breast model volume fitting stretch model of sport bra intelligent design. The finite-element approaches show significant promise in the area of motion simulation of the breast model due to its inherent geniality in dealing with arbitrary shapes of breast model, materials, and contact surfaces.

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