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Giysi Beden Sistemi ve Bilgisayar Destekli Vücut Modellerinin Geliştirilmesi

Development of The Garment Size System and Computer-Based Body Models

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DEVELOPMENT OF THE GARMENT SIZE SYSTEM AND COMPUTER-BASED BODY MODELS

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ABSTRACT: The paper presents separated results of the anthropometric measurement performed within the scope of the *compound technological project* (STIRP) "Croatian Anthropometric System" (HAS) in the Republic of Croatia. The presented results apply to adult female population, whereby newly defined female body types taking account of the measurement of hip girth are emphasized. Based on the presented results the modeling of computer 3D body models for the total of seven defined body types and in all sizes was done in the experimental part of the work. The presentation of limiting, newly defined body types and limiting values for each body type is described. A basis for computer 3D body types suitable for the implementation in the CAD system intended for computer-controlled garment simulation and visualization was created.

Key words: anthropometric measurement of the body, size system, body types, 3D body models

GİYSİ BEDEN SİSTEMİ VE BİLGİSAYAR DESTEKLİ VÜCUT MODELLERİNİN GELİŞTİRİLMESİ

ÖZET: Bu çalışmada Hırvatistan'da yürütülmekte olan “Hırvat Antropometrik Sistemi (HAS)” projesi kapsamında gerçekleştirilen antropometrik ölçüm çalışmalarının sonuçları sunulmaktadır. Sunulmuş olan proje sonuçları, yetişkin bayan popülasyonuna uygulanmıştır. Kalça çevresi ölçüsü dikkate alınarak yeni tanımlanan bayan vücut tipleri vurgulanmıştır. Çalışmanın deneysel aşamasında proje sonuçlarına dayanılarak tanımlanmış 7 vücut tipi ve tüm bedenler için 3 boyutlu vücut modellerinin bilgisayarda modellenmesi gerçekleştirilmiştir. Yeni tanımlanmış vücut tipleri ve her bir vücut tipi için sınırlayıcı değerler açıklanmıştır. Bilgisayar kontrollü giysi simülasyonuna yönelik tasarlanmış CAD sistemlerinde uygulanması elverişli olan 3 boyutlu vücut tipleri için temel bir prensip yaratılmıştır.

Anahtar kelimeler: Antropometrik vücut ölçümü, beden sistemi, vücut tipleri, 3 boyutlu vücut modelleri

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1. INTRODUCTION

It can be said generally that the interest in the development and improvement of the size of clothes is ever present. Anthropometric surveys related to the study of body proportions of the population, either using the conventional measuring method of measuring or using a 3D body scanner ensures consistency of this trend.

At the end of the 70-ies of the last century the International Organization for Standardization – ISO issued a number of standards which presented the beginning and the basis for the unique size designation system of garments and footwear worldwide. By updating ISO 3635 standard and by issuing ISO 8559 and ISO 9407 standards the foundations of the unique definition of human body measurements for the needs of the clothing and shoe making industry as well as for the implementation of anthropometric measurements and size designation system have been laid. The European Union or its Committee for Standardization – CEN) constantly work on new size designation systems of clothes and footwear which are based on the above mentioned ISO standards. The standards EN 13402-1, 13402-2 and 13402-3 define the primary and secondary measurements, the methods of their measurements and standard measurements as well as the method of garment size designation for individual types of clothing and footwear [1-3].

As the basic starting point of a new method of garment and footwear size designation in the Republic of Croatia a new designation system and method defined in the European standards 13402-1, 13402-2, 13402-3 with a national supplement containing several specificities related to single garment types is under preparation. These specificities were established by anthropometric measurements within the scope of the compound technological project Croatian Anthropometric System and they are necessary in order to fulfill customer demands in the Republic of Croatia [4].

There are two types of control measurements which define garment size: primary and basic measurement and one or several secondary measurements. The most frequently used primary measurement is bust girth in the case of garment size designation for women and men, and in children it is body height.

This paper presents part of investigation results for the Croatian female population, whereby two new types of female body are defined: especially narrow hips and especially broad hips. For the purposes of the new, proposed types of female body computer-controlled 3D body types were modeled in the experimental part of the paper as the basis for computer-controlled 2D pattern construction in accordance with ISO 8559, 3D garment simulation and visualization and testing of garment fit [5,6].

2. DETERMINATION OF TYPES OF FEMALE BODY

EN predicts body heights from 156 cm to 188 cm with the possibility of greater intervals. In accordance with the previously determined groups of body height it can be concluded that based on the measurements within the scope of STIRP HAS, a part of the female population of the Republic of Croatia has body height from 152 to 184 cm. Therefore, it is necessary to enlarge EN 13402-3 for one height interval, which is also allowed because it has "open borders on both sides". In the previously mentioned standards the interval between individual statures is determined as 8 cm. On the above said basis five different body heights were determined (Table 1). Since each stature actually contains the interval of the half of the previous stature to the half of the next one, the actual body height ranges from 148/ to 188 cm [4].

Table 1: Standard body heights for size designation in cm for women

Female body height in cm with an interval of 8 cm					
Height	152	160	168	176	184
Interval	148-156	156-164	164-172	172-180	180-188

When designating sizes of female garments the most frequent primary measurement is bust girth. On the basis of the measurements made within the scope of STIRP HAS it was found that there is a part of the female population in the Republic of Croatia whose hip circumference in relation to bust circumference is greater or smaller than those defined by EN standard 14301-3. Therefore, two new female body types were proposed: a0 and e0.

Table 2: Standard measurements of hip, bust and waist measurements in cm according to women's body type

Hips type a0

Hips	72	76	80	84	88	92	96	100	104	108	112	117	122
Interval Hips	70-74	74-78	78-82	82-86	86-90	90-94	94-98	98-102	102-106	106-110	110-115	115-120	120-125
Bust	76	80	84	88	92	96	100	104	110	116	122	128	134
Waist	60	64	68	72	76	80	84	88	94	100	106	112	118

Hips type A

Hips	76	80	84	88	92	96	100	104	108	112	117	122	127
Interval Hips	74-78	78-82	82-86	86-90	90-94	94-98	98-102	102-106	106-110	110-115	115-120	120-125	125-130
Bust	76	80	84	88	92	96	100	104	110	116	122	128	134
Waist	60	64	68	72	76	80	84	88	94	100	106	112	118

Hips type B

Hips	80	84	88	92	96	100	104	108	112	117	122	127	132
Interval Hips	78-82	82-86	86-90	90-94	94-98	98-102	102-106	106-110	110-115	115-120	120-125	125-130	130-135
Bust	76	80	84	88	92	96	100	104	110	116	122	128	134
Waist	60	64	68	72	76	80	84	88	94	100	106	112	118

Hips type C

Hip	84	88	92	96	100	104	108	112	117	122	127	132	137
Interval Hip	82-86	86-90	90-94	94-98	98-102	102-106	106-110	110-115	115-120	120-125	125-130	130-135	135-140
Bust	76	80	84	88	92	96	100	104	110	116	122	128	134
Waist	60	64	68	72	76	80	84	88	94	100	106	112	118

Hips type D

Hips	88	92	96	100	104	108	112	117	122	127	132	137	142
Interval Hips	86-90	90-94	94-98	98-102	102-106	106-110	110-115	115-120	120-125	125-130	130-135	135-140	140-145
Bust	76	80	84	88	92	96	100	104	110	116	122	128	134
Waist	60	64	68	72	76	80	84	88	94	100	106	112	118

Hips type E

Hips	92	96	100	104	108	112	117	122	127	132	137	142	147
Interval Hips	90-94	94-98	98-102	102-106	106-110	110-115	115-120	120-125	125-130	130-135	135-140	140-145	145-150
Bust	76	80	84	88	92	96	100	104	110	116	122	128	134
Waist	60	64	68	72	76	80	84	88	94	100	106	112	118

Hips type e0

Hips	96	100	104	108	112	117	122	127	132	137	142	147	152
Interval Hips	94-98	98-102	102-106	106-110	110-115	115-120	120-125	125-130	130-135	135-140	140-145	145-150	150-155
Bust	76	80	84	88	92	96	100	104	110	116	122	128	134
Waist	60	64	68	72	76	80	84	88	94	100	106	112	118

Based on the measurements made within the scope of STIRP HAS seven female body types were determined, Table 2, which are based on the difference between bust circumference and hip circumference:

Type a0 – especially narrow hips
Type A – very narrow hips
Type B – narrow hips
Type C – normal hips
Type D – broad hips
Type E – very broad hips and
Type e0 – especially broad hips

3. COMPUTER-CONTROLLED MODELING OF 3D BODY MODEL FOR DETERMINED BODY TYPES

The measurements determined for each test person were implemented in the CAD system intended for the computer-controlled 2D/3D garment construction and simulation. The values of the measurements mentioned in Table 2 for each female body type served as a basis for computer modeling of 3D body type, for each body type, in the interval of the determined measurements. In this way a total of 13 body types for one stature or a total of 65 models for all statures of the specific body type were modeled. In this context each 3D body model shows the body measurements and shape of each garment size. For this purpose the CAD system of the Optitex Company was used to model 3D body types which were systematically organized into the database according to body types and sizes. In this way avatars were obtained for each size of each body type which can be further used in the process of garment pattern adaptation using the 2D/3D CAC system of the garment construction preparation [7,8].

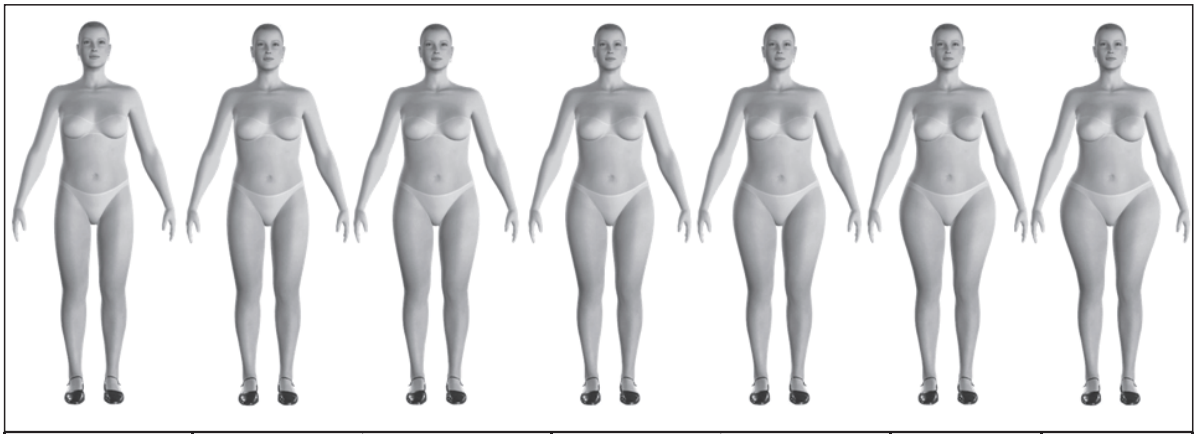
4. RESULTS AND DISCUSSION

Figure 1 shows seven separate 3D body models, whereby each represents one body type.

Each of them represent the average values of determined measurements of bust circumference, waist circumference and hip circumference mentioned in Table 2. Bust circumference and waist circumference are equal in all models, and the difference of the body physique is shown in hip circumference. Figure 2 shows body models modeled for limiting, newly defined body types a0 and e0 of the same stature. The models showing or visualizing body appearance of limiting measurement values mentioned in Table 2 are shown for each of two body types.

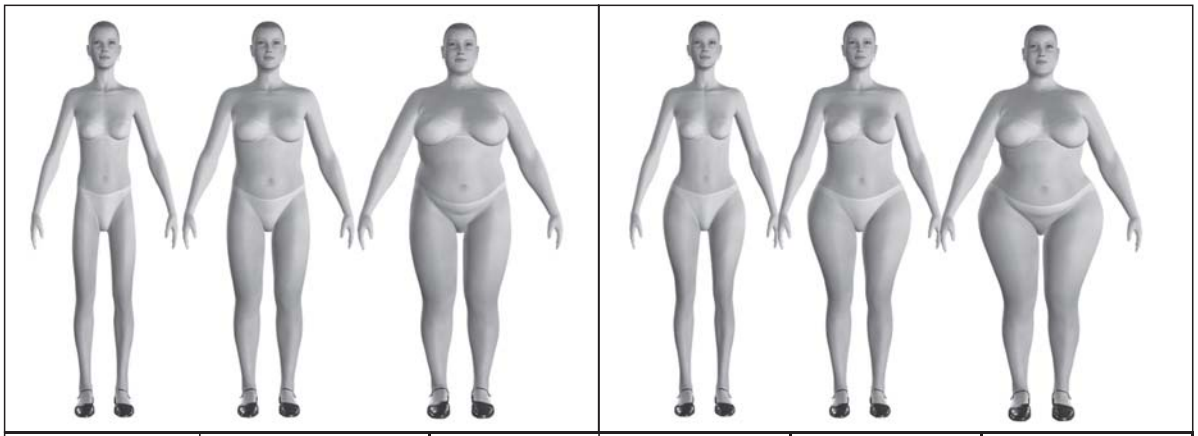
Figure 3 shows three body models of type C whereby limiting measurement values were selected.

For newly defined body types a0 and e0 the modeling of 3D body model for various statures in accordance with the values of body heights shown in Table 1 was performed. Figure 4 shows body models for type a0 of the same values of bust circumference, waist circumference and hip circumference according to Table 2 for body heights defined in Table 1. Analogously Figure 5 shows body models for type e0 also of the same values of bust circumference, waist circumference and hip circumference according to Table 2 for body heights defined in Table 1.



Type a0	Type A	Type A	Type B	Type C	Type D	Type e0
Ob = 96	Ob = 100	Ob = 104	Ob = 108	Ob = 112	Ob = 117	Ob = 122

Figure 1: Computer-based models of female body modeled according to average values of the measurements of each body type (Ob = hip circumference)



Ob=72cm	Ob=96cm	Ob=122cm	Ob=96cm	Ob=122cm	Ob=152cm
Hips type a0, Tv = 168			**Hips type e0, Tv = 168**		

Figure 2: Computer-based models of female body modeled for body types a0 and e0 with limiting values of the measurements of hip circumference

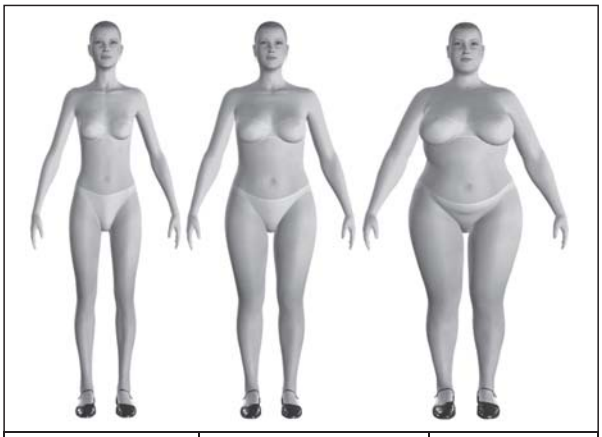


Figure 3: Computer-based models of female body modeled for body type C with limiting values of the measurements of hip circumference

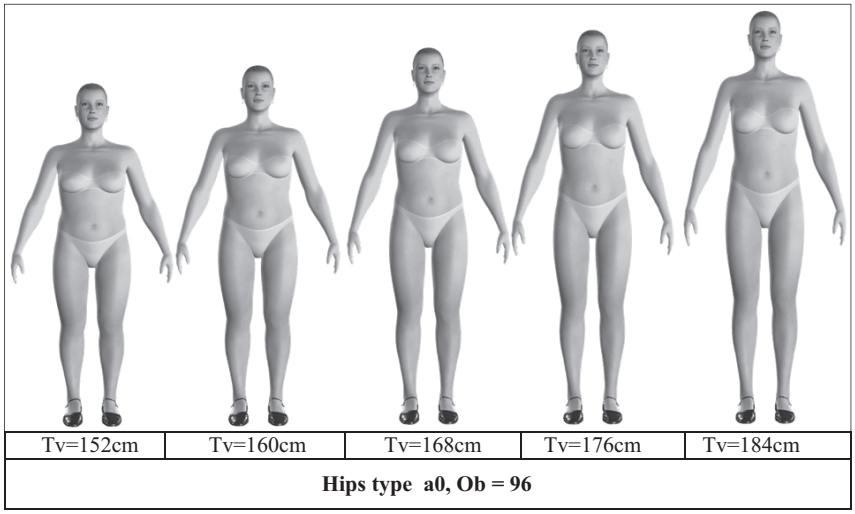


Figure 4: Computer-based models of female body modeled for body type a0 of the same values of circumference measurements for the defined interval of the stature

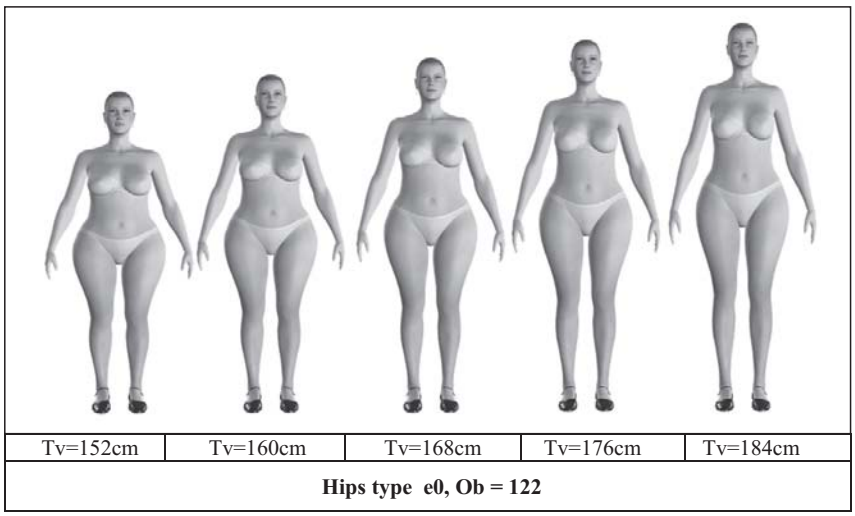


Figure 5: Computer-based models of female body modeled for body type e0 of the same values of circumference measurements for the defined interval of the stature

5. CONCLUSIONS

The paper presents part of the results of the anthropometric measurement of the Croatian population which was made within the scope of the project STIRP HAS, and the part of the paper applying to the definition of new types of female body a0 – especially narrow hips and e0 – especially broad hips as a specificity of the part of the female population. The presented results of anthropometric measurements served as the basis for computer-based modeling and creation of the basis of 3D body model for each size of a specific body type. In this way a basis of 3D body models was created with the possibility of the implementation in the CAD system for 3D garment simulation and testing garment fit.

Computer-based 3D body models modeled according to defined types of female body contribute to the visualization of each body type and in this context they make a contribution to the processes of designing garment collections appropriate to each body type. The use of computer-based 3D body types implemented in the CAD system of construction preparation for the purposes of simulation and control and correction of garment patterns presents the development trend in this field. The importance of their use for the manufacturer lies in shortening the time in the construction preparation up to 50% of the totally necessary time for the development of a garment model. It is also not necessary to make several prototypes of the real model because all alterations of the pattern are performed by the computer until the optimal garment fit has been achieved. In this way material, power, labor and other cost savings are achieved which result from the real manufacturing process. Finally, the garment developed using the innovative computer technology will have the quality which will make it competitive on demanding western markets.

Future work will include modeling computer-controlled men's and children's body types, also based on the results of the anthropometric measurement made within the scope of the national STIRP HAS project.

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