INVESTIGATING ON FABRIC AND SKIRT DRAPE IN CLOTHING CONSTRUCTION

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Abstract
This study aims to examine the behavior of fabric and skirt drape by experimental method through drape coefficient and drape profile analysis. Fabric coefficients and drape profiles were measured and recorded by Cusick method. Drape profiles of skirt were taken by a digital camera. The behavior of skirt drape also were examined by the 3D simulation software V-stitcher. The outcomes of this study can improve apparel design and fabric end-use applications. It also contributes to improve the prediction of garment drape for the apparel CAD system.
Key words: Fabric Drape, Garment Drape, Woven Fabrics and Clothing Construction

1. Introduction

Fabric drape is one of the important properties of flexible textile materials that directly related to the impression of appearance of a garment during wear. Fabric drapeability may be described as a degree of the deformation of fabric to orient itself into folds when the fabric partially supported by other objects. Different fabrics exhibit different drape behaviour and hence the garment silhouette made of different fabrics would be different on same garment style. Thus, selection of textile materials with properties suitable for the silhouette design of garment is very important.

In apparel industry, the main purpose of predicting fabric drape is to understand and to evaluate the aesthetic performance of final garment. A lot of studies of testing and predicting fabric drape have carried out over the years in textile and apparel industries. There are two approaches of measures and evaluation fabric drape. The first approach is measure the 2D bending behaviour of fabrics. A large circular specimen of fabric is located centrally on a fabric support, and drape coefficient can be derived by measuring the degree of fabric deformation in a vertical projection of the fabric [2]. The second approach for drape measure and simulation is based on 3D fabric evaluation. There were some software developed for simulation 3D drape of garment [1], [5].

At present, there is a few research work on studying the difference between fabric drape and garment drape [2]. In order to investigate such difference, we designed an experiment to record the drape profile of a circular fabric and skirt flared drape worn over a model.

We used simply structured fabrics of plain and twill weaves with various cotton and polyester fibre contents. The experimental results are in terms of drape coefficient and drape profile analysis. Skirt drapes worn over a model and 3D simulated over the same dimension virtual model are examined and compared in this study.

The outcomes of this study provide instructions for use fabrics and apparel design for end-use applications. The results will be useful for improving of prediction of garment drape for the apparel CAD system.

2. Objects of experimental

Specimen of fabrics

6 selected fabrics were simply structured plain and twill weaves with light weight and various fibre contents of cotton and polyester, typical of woven fabrics used in light clothing making. The details are shown in Table 1.

Table 1. Sample specifications

Sample	Weave	Weight (g/m^2)	Fibre content
1	Plain	144.08	100% Cotton
2	Plain	194.00	100% Cotton
3	Plain	98.45	35% Cotton, 65% Polyester
4	Twill	106.68	17% Cotton, 83% Polyester
5	Twill	135.20	100% Polyester
6	Plain	108.47	100% Polyester

The mechanical parameters include tensile, bending, shear, compression, and surface properties of six fabric specimens were measured by KES-F system. The parameters measured are listed in Table 2. Mean value of both warp and weft direction is used in bending and shearing properties. All the experiments were carried out in 20 ^{0}C and 65 RH conditions.

Skirts

A flared skirt style was selected for drape evaluation of all fabric specimens. Production pattern set of this skirt style was constructed with model dimensions listed in Table 3 and shown in Figure 1. 6 skirt specimens were made of 6 selected fabrics in high quality.

Table 3. Dimensions of model

Dimensions	Value (cm)
Waist height	117
Hip height	87
Knee height	52
Waist girth	61
Hip girth	88
Outside leg length	119
Front center leg length	118

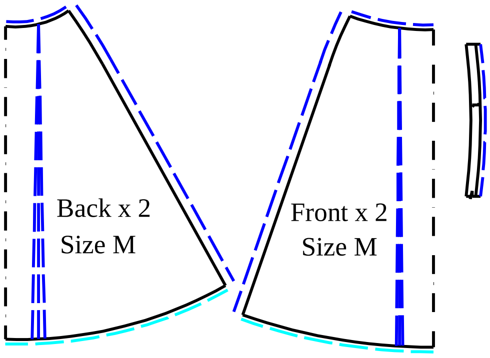


Figure 1. Production pattern set of skirt

3. Method of experimental

Method for measuring drape coefficient and profile of fabric specimens

Measuring drape coefficient of fabric specimens were based on the British Standard method BS 5058- 1973. The drapeability of fabric specimen was measured on Cusick equipment with 15 centimetre radius disk (Figure 2). Each fabric specimen was measured three times, from which we calculated the mean value of drape coefficient for each specimen.

Figure 2. Cusick equipment for measuring drape coefficients and profiles of specimen

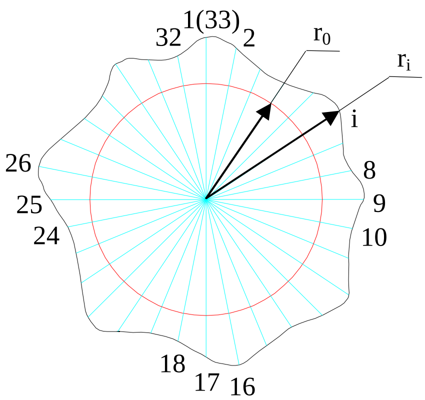


Figure 3. Vertical projections from a circular fabric

Drape profile of fabric specimens were recorded by scanning and imported in personal computer. The method for measuring the drape profile of the fabric specimen was modified based on X-Y coordinate system as stated below:

On the drape profile of the specimen from the top view, a circle with radius of 7.5 centimetres was drawn at position corresponding to disk position of Cusick equipment. The central angle of this circle was divided into 32 equal angles (Figure 3).

The drape profile is expressed on X-Y coordinate system as the fold's displacement curve. In this curve, X-axis represents the node position a from 1 to 33 corresponding to the angle position from 0 to 2π in radian and Y-axis represents the displacement of fold [r_i - r_0] with respect to the node i (r_0= 7.5 cm).

The data are processed by personal computer and then drape coefficients and displacement of fold for all nodes are computed.

Method for investigating skirt drape

For investigating 3D fabric drape, the experimental method involves wearing skirts over a model stand (dimensions are listed in Table 3). The specimens were allowed to wear freely on the stand for at least 15 seconds in order to obtain a stable drape. The front view, back view and side view of the drape profile of the specimen were taken by a digital camera at the distances that were shown in Figure 4.

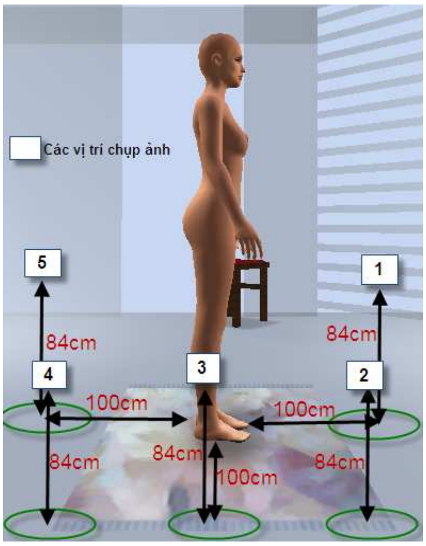


Figure 4. Position of camera

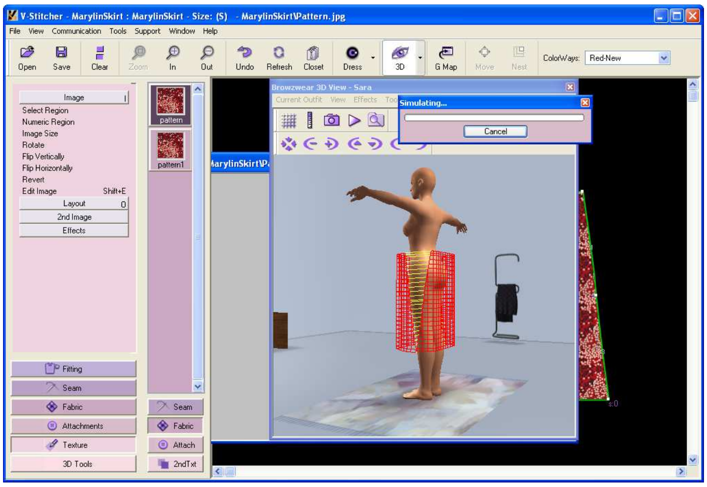


Figure 5. Screen of 3D simulation skirt drape on software V-Stitcher 4.3

Method for 3D simulating skirt drape

3D simulation software V- Stitcher 4.3 was used to get pictures of skirt drape. 6 skirt specimens were worn in turn over the virtual model that was the same dimension as the model stand. The screen of 3D simulation process are shown in Figure 5.

Table 2. Mechanical properties measured on the KES-F system

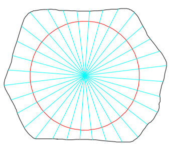
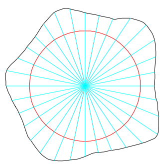
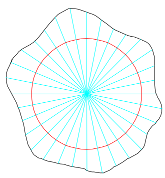
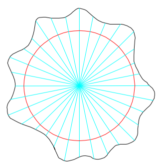
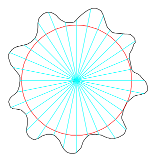
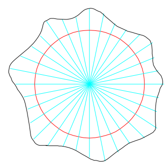
Property	Sample 1			Sample 2			Sample 3			Sample 4			Sample 5			Sample 6		
	Warp	Weft	Mean	Warp	Weft	Mean	Warp	Weft	Mean	Warp	Weft	Mean	Warp	Weft	Mean	Warp	Weft	Mean
LT	0.687	0.693	0.690	0.731	0.868	0.800	0.819	0.747	0.783	0.736	0.644	0.690	0.477	0.565	0.521	0.967	0.904	0.935
WT ($gf.cm/cm^2$)	10.67	14.77	12.72	11	11.2	11.1	3.58	8.90	6.24	3.38	8.90	6.14	8.15	7.03	7.59	2.92	4.83	3.88
RT (%)	39.19	33.79	36.49	50.27	51.39	50.83	67.44	65.19	66.31	70.93	66.68	68.81	69.53	70.14	69.84	76.01	73.12	74.56
EMT (%)	6.34	8.60	7.47	6.02	5.16	5.59	1.75	4.77	3.26	1.84	5.53	3.69	6.83	4.98	5.90	1.21	2.14	1.67
B ($gf.cm^2/cm$)	0.076	0.101	0.088	0.176	0.127	0.152	0.058	0.035	0.047	0.043	0.020	0.031	0.021	0.011	0.016	0.093	0.040	0.066
B (gf.cm/cm)	0.0984	0.1386	0.1185	0.1869	0.1321	0.1595	0.0657	0.0368	0.0513	0.0304	0.0141	0.0223	0.0093	0.0062	0.0077	0.0432	0.0168	0.0300
G (gf/cm.grad)	1.68	1.66	1.67	2.28	2.37	2.32	1.35	1.30	1.33	0.61	0.65	0.63	0.28	0.22	0.25	0.99	1.02	1.00
2HG (gf/cm)	4.55	4.25	4.40	3.93	3.47	3.70	2.97	2.53	2.75	0.49	0.42	0.45	0.27	0.11	0.19	0.68	0.68	0.68
2HG5 (gf/cm)	6.99	7.08	7.03	6.88	6.91	6.89	5.42	5.33	5.38	1.36	1.64	1.50	0.52	0.19	0.35	3.88	3.98	3.93
MIU	0.167	0.174	0.170	0.123	0.135	0.129	0.129	0.135	0.132	0.131	0.163	0.147	0.143	0.185	0.164	0.119	0.153	0.136
MMD	0.0290	0.0230	0.026	0.0687	0.0144	0.0415	0.0216	0.0181	0.0198	0.0097	0.015	0.0123	0.0111	0.0149	0.013	0.0129	0.0797	0.0463
SMD (μm)	8.55	7.30	7.92	8.08	2.35	5.22	5.59	2.90	4.25	2.52	2.66	2.59	5.68	6.20	5.94	3.10	4.41	3.75
LC			0.361			0.273			0.256			0.283			0.480			0.764
WC ($gf.cm/cm^2$)			0.250			0.207			0.102			0.216			0.078			0.030
RC			48.75			41.45			44.59			45.28			53.21			75.97
T_0 (mm)			0.680			0.438			0.397			0.594			0.405			0.275
W (g/m^2)			144.08			194			98.45			106.68			108.47			135.20

4. Results and discussion

Drape coefficient and profile analysis on a circular fabric

The mean of drape coefficients and drape profile for all specimens are shown in Table 4.
These results showed that the fabric specimen 5 has the smallest value of drape coefficient and the fabric specimen 1 has highest value. This signifies specimen 5 has best drapeability and specimen 1 has lowest drapeability. This notice completely corresponded to shape of drape profile shown in Table 4. The result of compare drape coefficient of 6 specimens completely corresponded to their shear properties involve shear stiffness G, hysteresis of shear stress at 0.5° 2HG and hysteresis of shear stress at 5° 2HG5. This result is the same as some previous studies.

Table 4. Drape coefficient and profile of fabric specimens

Specimen	1	2	3	4	5	6
Drape coefficient (%)	36.02	35.13	33.86	23.12	13.74	29.24
Drape profile						

Fold's displacement curve for representing the drape profile of specimens in X- Y coordinate system are shown in Figure 6. The results of drape profile showed the shape of fold wave, wave width and height, distance between waves for all specimens. Fold waves of fabric drape have shape of sin curve.
Specimen 1 has nonregular fold wave at all side views. Fold wave of specimen 1 and specimen 2 have bigger step and height. This showed that flared skirt made of this fabric specimen has less number of fold wave and larger flare. Specimen 5 has the most regular fold wave. Wave of this specimen has small wave step and high. This predicts nice fold wave of flared skirt.
The data listed in Table 5 showed that there is a particular relation between average displacement of fold and drape coefficient of specimens.

Table 5. Drape coefficient and parameter of drape profile of fabric specimens

Sample	Average displacement of fold	Drape coefficient (%)
1	2.87	36.02
2	2.81	35.13
3	2.88	33.86
4	2.08	23.12
5	1.31	13.74
6	2.47	29.24

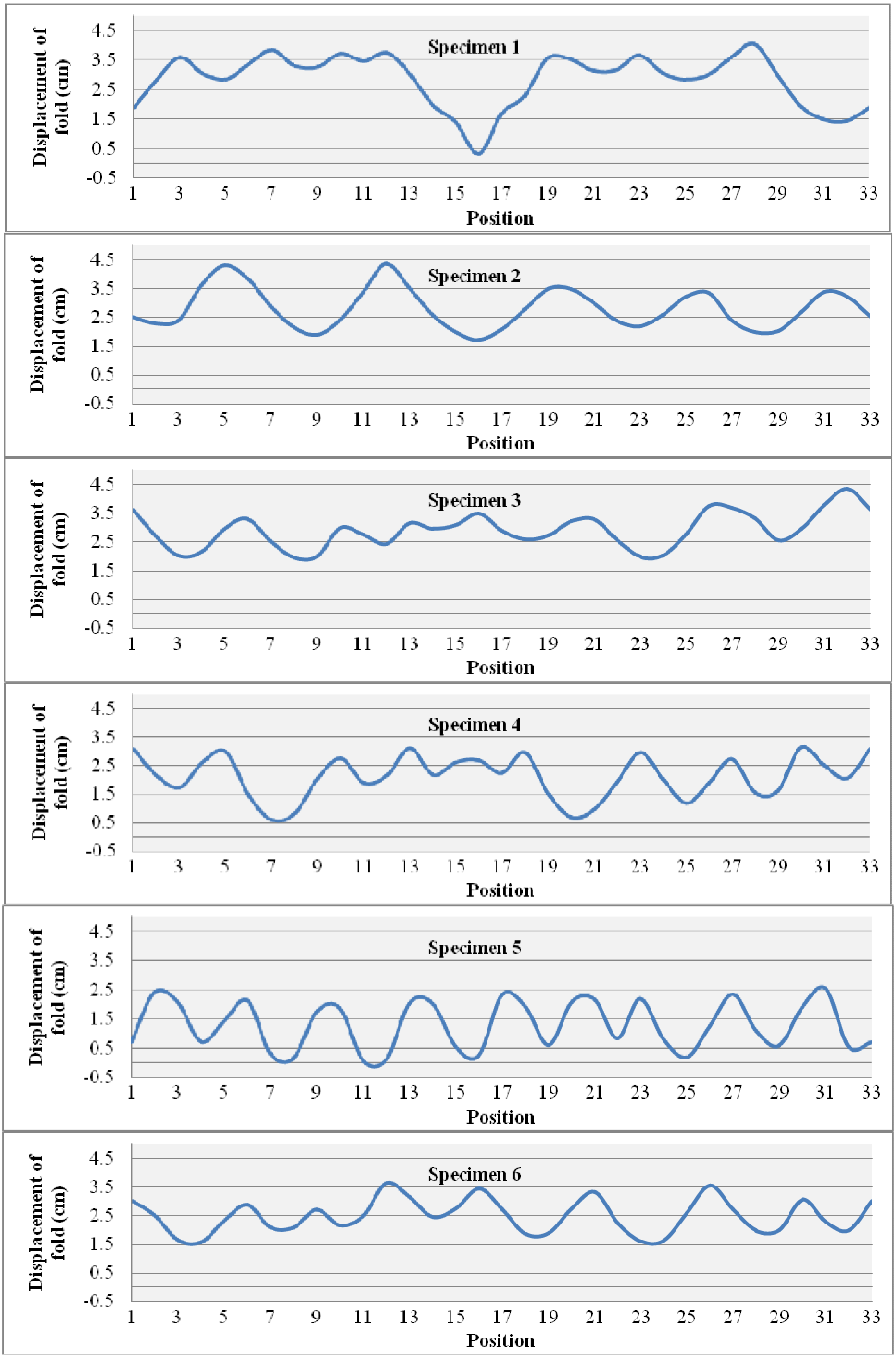


Figure 6. Fold's displacement curve for the drape profile of specimens

Compare skirt drape on the model and simulated

The results of examine skirt drape as they were worn over model stand and simulated by 3D simulation software V- Stitcher 4.3 were shown in from Figure 7 to Figure 12. The upper pictures were the result as skirt were worn over model stand at front, side and back view in turn. The lower pictures were the results of simulation.

The pictures showed that there was a particular correspondence between them in position of fold wave for specimens except specimen 1. Fold waves of skirt specimen are bigger and deeper than simulated skirt specimen. The skirt specimens are softness while simulated specimens don't achieve softness like this.

Figure 7. Skirt drape of specimen 1

Figure 8. Skirt drape of specimen 2

Figure 9. Skirt drape of specimen 3

Figure 10. Skirt drape of specimen 4

Figure 11. Skirt drape of specimen 5

Figure 12. Skirt drape of specimen 6

5. Conclusions

In this paper, we have reported an experimental investigation into the fabric drape coefficient and profile. We have analyzed the difference between skirt drape as worn over model stand and as 3D simulated in software V- Stitcher 4.3.

Our investigation of fabric drape and skirt drape has a significant value for both the textile and apparel industries because it provides a more realistic fabric drape study with respect to skirt. We believe that the results of this study can be applied to improve simulation of garment drape in the apparel industry.

6. References

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