

# APPAREL FIT BASED ON VIEWING OF 3D VIRTUAL MODELS AND LIVE MODELS

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## Introduction

Consumers purchasing apparel online are unable to "try on" products. A consumer must determine his or her apparel size by interpreting information from size charts provided by a company. When consumers order customized products and they are not satisfied, especially after a long wait for delivery of the product, the results are what some researchers label cognitive cost and the actual premium cost (Piller, Schubert, Koch, & Möslin, 2005).

To prevent these problems, mass customization researchers emphasize the importance of developing well-designed software tools that consumers can use in the product selection process (Dellaert & Stremersch, 2005).

With the development of 3D body scanning and 3D virtual garment simulation technologies, online shopping is becoming more promising. However, little research has been done on the fidelity and accuracy of 3D virtual dressing software to prove that it can represent a real person in a garment so that the virtual try-on can be used reliably for apparel fit assessment.

### Research Purpose

The purpose of the research was (1) to investigate the fidelity and accuracy of a 3D virtual garment simulation tool in assessing fit on a 3D virtual model and on the participant real body through participant evaluation and (2) to evaluate the effectiveness of the tool for 3D online virtual clothing shopping for consumers.

Ferwerda (2003) presented a conceptual framework to explain functional realism for computer graphics. Measuring functional realism has two criteria: (1) accuracy and (2) fidelity.

When the computer graphic image is accurate, it means that its physically measurable property of the image is correct. When the image has fidelity, the image is true to the reality that the image is representing. Ferwerda's framework for functional realism in computer graphics is adapted as a framework for this study.

## Methodology

The methodology for this study was developed to replicate an online shopping experience. Thirty-seven participants were recruited from students and employees at the University of Minnesota. The age range of the participants was 18 to 35 years.

Two questionnaires and an interview were used to collect data for the study. Two types of fit evaluation questionnaires were used: one for fit evaluation of the virtual pants on the virtual model and one for fit evaluation on the body.

A 3D virtual garment simulation software package developed by a leading US company was selected.

Size 8 sloper patterns were revised as dress pants patterns and they were graded down and up to different sizes using the software. The test pants were constructed based on the patterns. A 60% cotton and 40% polyester blend twill gabardine in a medium grey color was selected as the fabric for the test pants. The test fabrics were tested in a professional textile testing lab using the FAST testing method, and the results were input into the software.

### Participant First Visit

Each participant was scanned wearing their bra and panties with a VITUS/smart 3D Body Scanner produced by Human Solutions. Virtual models were made from the participant's scan.

### Participant Second Visit

The participants returned to the lab for a second session to evaluate the fit of the virtual and real pants. The participants evaluated the fit of the selected pants simulation using the fit evaluation questionnaire on the virtual model.

The evaluation protocol conformed to the following order: overall fit, front waistband, back waistband, abdomen, hip, front thigh, back thigh, front crotch, back crotch, left side, right side, inseams, and hem.

After the participants evaluated the pants simulation on their virtual model, they were asked to change into a t-shirt and the test pants over their own bra and panties. The pants were evaluated by the

participants on their body in front of a full length mirror using the fit evaluation questionnaire on the body.

### Data Analysis Procedure

The quantitative data from the questionnaires were analyzed using descriptive statistics, two-way repeated measures ANOVA, independent t-test, and Chi-Square test. The data were analyzed using the Statistical Package for Social Studies.

The qualitative data obtained from participants' interviews was categorized and analyzed according to emerging themes using the content analysis techniques.

## Results

### Quantitative Data Results

The results of the two-way ANOVA showed that there was no significant main effect of participant major in the fit evaluation ratings of any of the fit factors ( $p > .01$ ).

There were no significant two-way interactions of the participant major and the fit evaluation type in the fit evaluation rating score of any of the fit factors ( $p > .01$ ).

There were significant main effects of evaluation type (i.e., fit evaluation on the virtual model and fit evaluation on the body) in the fit evaluation rating score of the four fit factors: overall fit, abdomen, back thigh, and front crotch.

There were no significant main effects of evaluation type at nine fit factors: front waistband, back waistband, hip, front thigh, back crotch, left side, right side, inseam, and hem.

All the fit factors that had significant mean differences between the two evaluation types had higher mean scores from the fit evaluation on the virtual model than the fit evaluation on the body; overall fit had a higher mean score by 0.78, abdomen by 1.00, back thigh by 1.46, and front crotch by 1.43.

This indicates that fit representations of the virtual simulation at those fit factors show better fitted appearance than the actual fit on the body.

### Qualitative Data Results

The participant responses from the interview supported the quantitative results. The general participant responses were that the visual information from the virtual model provided them with an overall idea and feel about the pants fit. They were especially impressed that the visual information of overall pants look or silhouette in relation to their body shape was very accurate.

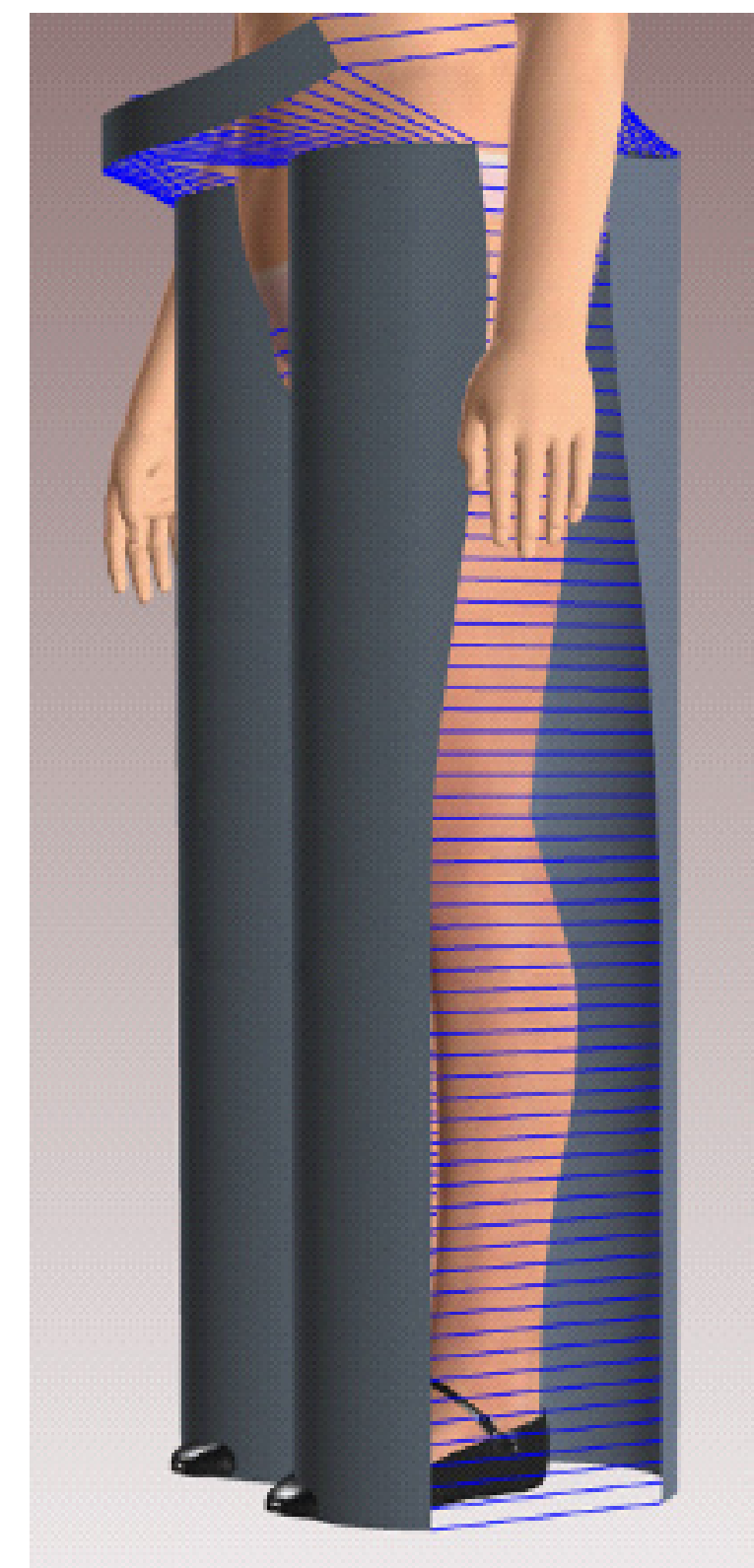
However, participants commented that there were some aspects of the virtual simulation that made the pants fit image inaccurate. The main inaccuracy in the visual information found was that the virtual simulation did not give correct information about fabric texture. The fabric on the virtual model was draped smoothly and did not accurately represent wrinkles that were found with the test pants on the body.

Additionally, the visual information on the degree and the location of tightness and looseness was noted as not accurate.

## Discussions and Conclusion

The results led to the conclusion that the overall accuracy of the virtual simulation tool was moderately good but not to the extent that the participants could perform all the aspects of the meaningful task of the fit evaluation that were important. This indicates that the fidelity of the virtual simulation tool was moderate as well.

This study revealed many important aspects of 3D virtual garment simulation technology, offering valuable information about the technology for both apparel and computer graphics researchers. The study is especially meaningful because the evaluation of the virtual garment simulation technology was tested from the perspective of the traditional apparel field. This is in contrast to more traditional research involving software development where due to the background of the computer scientist, an understanding of the perspective of the garment industry is limited.



Virtual Garment Simulation Process



Virtual Pants

Real Pants

Both the limitations and the positive aspects of the tool were identified in this research. These findings will help computer scientists in developing and improving the 3D virtual garment simulation technologies. Designers and merchandisers who use this type of technology in the apparel industry would be able to make full use of the benefits of the technology while taking its limitations into consideration. Ultimately the improved technology implemented in online shopping websites will help clothing consumers to make satisfactory and reliable online purchase decisions.

## Bibliography

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