Virtual Fitting: Real-Time Garment Simulation for online shopping

Xuaner Zhang and Lam Yuk Wong
Department of Electrical and Computer Engineering, Rice University *

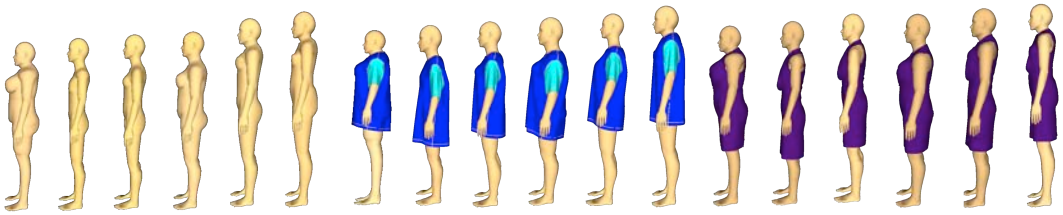

Figure 1: Learned garments on different body shapes. *(left): 6 different female body shapes. (middle): An extra-large T-shirt learned to deform differently on the 6 body shapes. (right): A medium-sized dress learned to deform differently on the 6 body shapes.*

Abstract

Without physically trying on a garment, online clothes shoppers are unable to decide the best size or color, and therefore are more likely to purchase clothes that do not fit. A solution to this online fit problem is virtual fitting. Using 3D modeling to help customers visualize how garments look on them requires garment simulation in real time. This paper proposes an innovative approach that utilizes machine learning to meet this real-time requirement and can be applied to virtual fitting systems.

Keywords: Real-time garment simulation, virtual fitting, machine learning, physically-based simulation

1. Introduction

To assist online clothes shoppers to choose the best fit, we want to simulate how a garment deforms according to the user's body shape in a fast and accurate manner. Physically Based Simulation (PBS) has been the major technique to authentically simulate garment deformation. However, PBS is a compute-intensive process that cannot well serve the needs of real-time applications. DRAPE [1] introduces learning into computer animation to speed up garment simulation. DRAPE automatically reshapes a garment and deforms it to fit any body model. However, clothes are not infinitely sized and customers do not always want the size that fits them best. To realize virtual fitting for online clothes shopping, we propose an innovative way based on PBS to keep a certain degree of accuracy, and to integrate statistical methods such as neural machine learning to significantly speed up the simulation.

2. Technical Approach

Unlike DRAPE, our method dresses a garment on any body model without reshaping the garment. For each garment size, we use PBS to simulate garment deformation on a set of training body models and we apply learning to derive a mathematical deformation rule that characterizes how the garment physically deforms on different body shapes. Given any arbitrary body shape, garment simulation can be easily, instantly and accurately computed using the learned deformation rule. In a virtual fitting system that uses our method, a customer will input her customized body model and the system will simulate how a selected garment deforms on the body model realistically and in real time.

3. Implementation

Our body dataset consists of roughly 70 training and 10 testing body shapes of Asian females, with small-, medium-, and large-sized bodies equally distributed. Given a 2D pattern of a garment, we build our garment dataset by conducting PBS on each of the training bodies. To reduce the high dimensionality of the 3D objects, we perform Principal Component Analysis on each of the objects. Then, we implement a 2-layer network to learn the general deformation rule that maps the body input to the deformed garment output. Our method provides plausible prediction of garment simulation on body shapes. However, interpenetration may occur when the learned garment is overlaid on the body. We referred to DRAPE to remove the interpenetration.

4. Results and Future Work

In order to test our method, we created one extra-large T-shirt and one medium-sized dress, used our algorithm to compute the two garments' deformation rules and applied the rules to 9 testing body models, with small-, medium-, and large bodies equally distributed. Figure 1 shows the results of our method on some of the testing body models. Both the T-shirt and the dress on the same body have the same contour as the body underneath them. We implemented our method in MATLAB and ran the program on a normal desktop. The average time for both T-shirt and dress simulation is less than 2 seconds.

Besides run time, we also defined and calculated two error measures to compare our results with PBS results quantitatively: 0.56cm and 0.99cm for T-shirt and dress respectively in terms of position and 1.37cm and 2.20cm for T-shirt and dress respectively in terms of shape. The promising experimental results show that the proposed method can achieve garment simulation in real time. The method is also highly scalable and can extend to any type of garment. We currently focus on improving the accuracy of the learned garment deformation and extending to other body poses and other garment types.

References

GUAN, P., REISS, L., HIRSHBERG, D. A., WEISS, A., AND BLACK, M.. J.. 2012. DRAPE: Dressing Any Person. *ACM Transactions on Graphics 31*, 4 (July), 35.

* e-mail: {xz18, lw11}@rice.edu

SIGGRAPH 2014, August 10 – 14, 2014, Vancouver, British Columbia, Canada.

ACM 978-1-4503-2958-3/14/08