Automatic 3D Garment Modeling by Continuous Style Description

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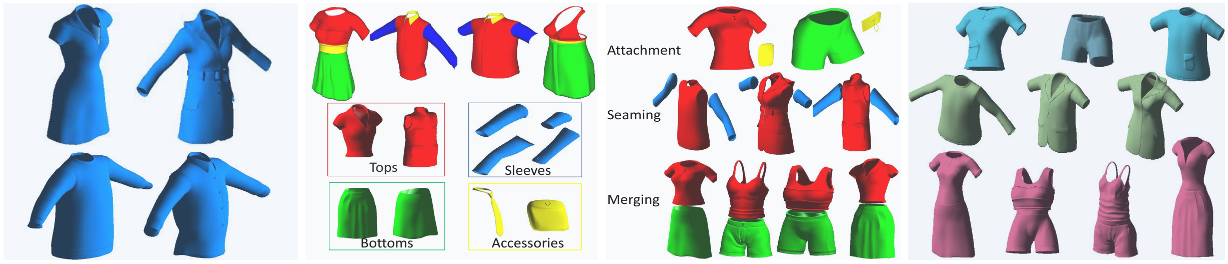


(a) Limited garments (b) Semantic segmentation (c) Probabilistic linkage (d) Various garments

Figure 1: *Traditional garment modeling method can only produce limited clothing data (a). With the challenge of content creation and the trend of apparel mass customization, an automatic method for 3D garment modeling is presented.*

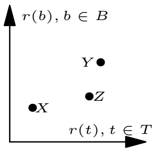
1 Introduction and Motivation

Manually modeling of 3D garment is highly time-consuming and professional expertise demanding, and can only produce limited garments (Fig.1(a)). The ability to create a diverse set of 3D garments is required with the trend of online fashion and apparel mass customization. This issue has been recently tackled with a fully automatic garment transfer algorithm [Brouet et al. 2012] based on pattern grading. Content creation techniques such as [Xu et al. 2012] introduce set evolution as a means for creative 3D shape modeling. However, current component assembly-based 3D shape modeling were just designed for discrete properties. An important observation is that style of many components garments can be characterized by the ratio of area and boundary length. Thus, we propose a simple but effective garment synthesis method that utilizes such a style description, instead of discretizing the style space. Results show that the method is able to produce various reasonable garments efficiently.

2 Synthesis by Continuous Style Description

We separate the process into three stages: semantic garment segmentation, probabilistic reasoning for component suggestion, and garment component stitching.

Given a small training set of input garment $\{G_i\}, i = 1, \cdots, n$ (Fig.1(a)), we apply a semi-supervised learning algorithm [Wang et al. 2012] to segment and decompose them into clusters T, B, S, A for the four typical garment components: tops, bottoms, sleeves and accessories respectively (Fig.1(b)). In a cluster, each model m is associated with a specific geometrical property $r(m)$ to describe its style, which is used to evaluate the quality of a composing result. Here, we adopt the ratio of mesh area and boundary length (see the inset). Intuitively, such a ratio (linearly transformed into $[0, 1]$) often captures the differences between jacket and T-shirt in tops, skirt and pants in bottoms, short and long sleeves, pocket and tie in accessories. As illustrated in the inset, X stands for a garment composed of jacket and pans, and Y is a garment composed of T-shirt and skirt.



Given a new garment Z with top and bottom components Z^t, Z^b on this 2D domain, the matchable probability of them (merging in Fig.1(c)) is defined as $P_{T,B}(Z) = \frac{1}{n}\sum_{i=1}^{n} \exp\left(-\frac{d^2_{T,B}(Z,G_i)}{2\sigma^2}\right)$, where $d_{T,B}(Z, G_i) = \left\|\left(r(Z^t) - r(G_i^t), r(Z^b) - r(G_i^b)\right)\right\|_2$ is the distance of Z, G_i on TB plane, and σ is set of 0.5 in our experiments. Similarly, we can define the probability of seaming $P_{T,S}$. For the probability of attachment, the above definition is extended into 3D as $P_{T,B,S}$. Based on the above definition, we seek for high matchable probability garments represented by tuple $G = (t, b, s, a), t \in T, b \in B, s \in S, a \in A \cup \emptyset$:

$$P(G) = P_{T,B}(G) * P_{T,S}(G) * P_{T,B,A}(G). \quad (1)$$

The terms involving non-existing part (e.g. the attachment component) are discarded in the above equation.

Finally, we adopt the method [Kalogerakis et al. 2012] to place the components into proper position, and stitch them.

3 Results and Conclusion

We have presented a variation synthesis approach on 3D garment modeling to enrich existing garments. The key idea of this work is a set of matching probability measurement between garment components. Our approach can applied to many applications, such as mass customization, garment prototype designing, and virtual clothing.

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