Body Capture and Marker-based Garment Reconstruction

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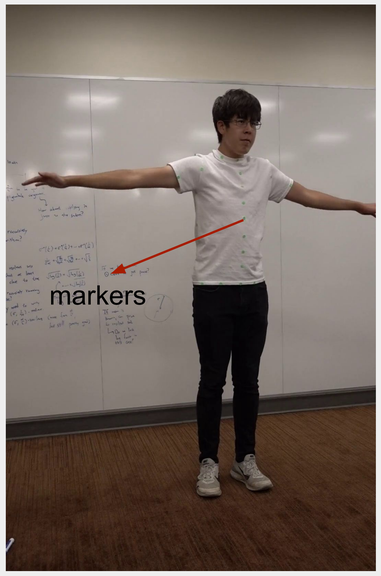
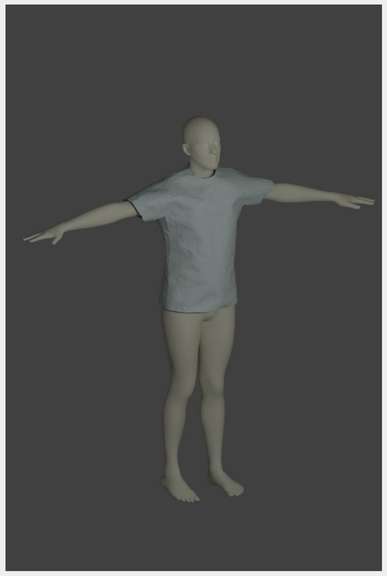
Overview

In this work, given videos of a moving person from different views, we present a marker-based method to get a 3D animation for both the person and the garment.

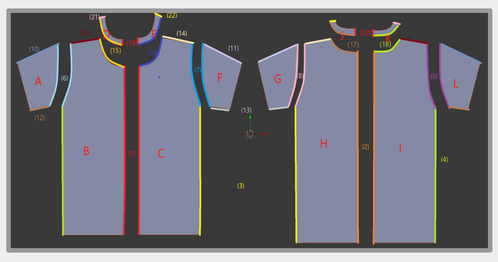
Markers: on-garment small stickers with special colors.





Step1: Garment Digitizing

Mesh Generation: Given a garment, we first generate the 2D pattern either using a design software, or by triangulating the boundary of scanned garment pieces.

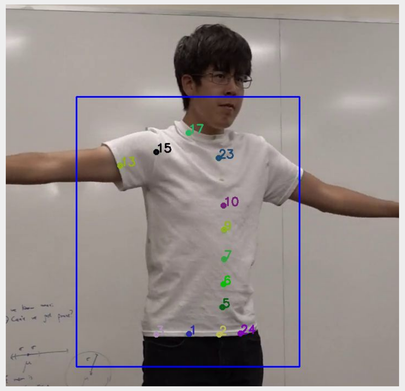


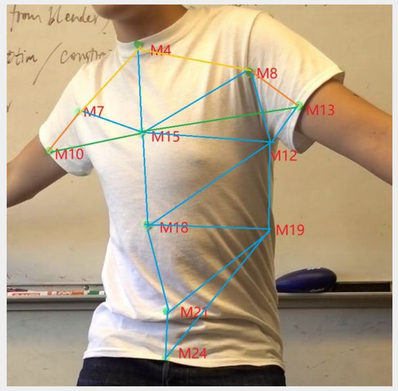
Garment Stitching: Given the 2D design pattern of a garment, we build a user-friendly GUI to interactively generate a 3D mesh for the stitched pieces.

This is done by iteratively finding the optimal rigid body transformation between pieces, then transform and merge the pieces together.

Step2: Marker Tracking

Markers help us know the garment's position and geometry in the video. In this stage, we build a blob detector and a multi-object tracker to identify and track the markers across frames.



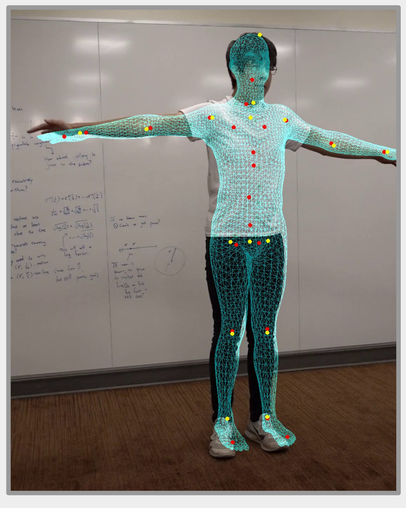


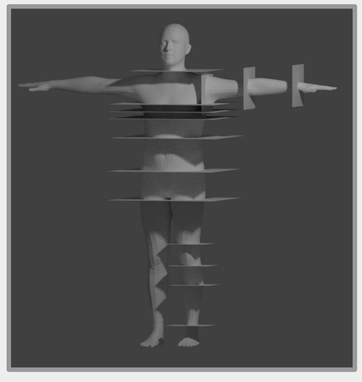
Given the camera parameters, we can finally obtain the 3D marker positions in the video.

Step3: Body Capture

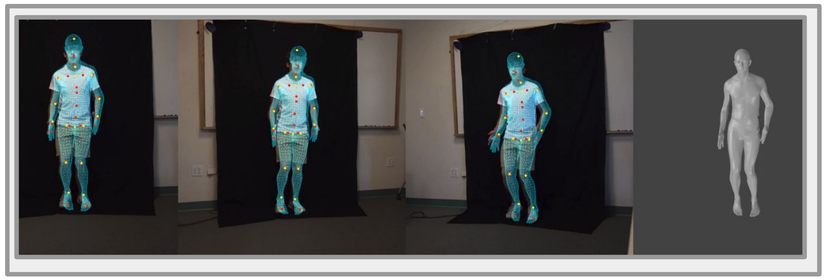
To create an animation of a clothed person, we use the SMPL body model [1] as a animatable template and run conjugate-gradient optimizations on it to obtain parameters for both **shape** and **pose**.

Body Shape: We use a tape to get the person's height and girth measurements at different body positions as constraints.



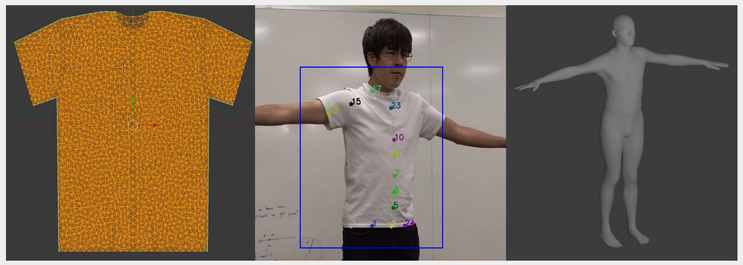


Body Pose: We first use the method described in [2] to obtain the 2D joint positions, then run a 3D mutli-view probabilistic optimization proposed by [3] to reconstruct the 3D joints, which are used as constraints.



Step4: Garment Reconstruction

Finally, we virtually "**wear**" the garment on the person. Given the following inputs:



We reconstruct the worn-garment by solving a bounded optimization problem, targeting at several goals:

Smoothness: We penalize stretching, compressing or bending using virtual springs.

Marker Positions: We minimize the distance between the markers on mesh and their 3D locations.

Body Surface: We adopt a level-set approach to discourage the garment from penetrating the body.

References

[1] M. Loper, N. Mahmood, J. Romero, G. Pons-Moll, M. J. Black. SMPL: A Skinned Multi-Person Linear Model. SIGGRAPH Asia, 2015.

[2] A. Newell, K. Yang, and J. Deng. Stacked hourglass networks for human pose estimation. In ECCV, 2016.

[3] G. Pavlakos, X. Zhou, K. G. Derpanis, and K. Daniilidis. Harvesting multiple views for marker-less 3D human pose annotations. CVPR, 2017.