HUMAN SHAPE AND POSE RECOVERY FROM MONOCULAR IMAGES USING STATISTICAL MODELS

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Abstract

In this work we investigate the use of Statistical Models in recovering human shape and pose from single images. From a set of aligned 3D scans we aim to construct a deformable human model that captures both the variation in human shape and pose as well as the correlation between them. By fitting this model to an image, a realistic human body model of the person on the image can be extracted. It is also possible to estimate other meaningful attributes such as height, weight, etc.

Surface encoding

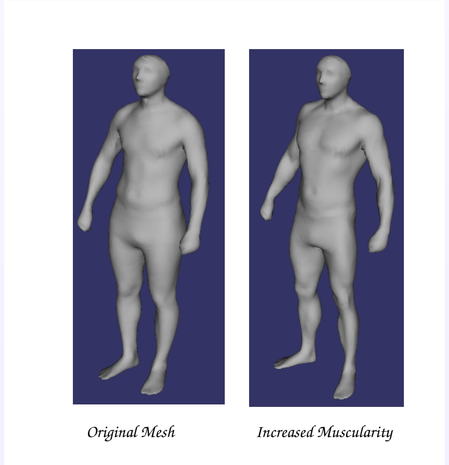
An important step in the construction of Statistical Model of the human model is to encode the 3D meshes to a rotation and translation invariant representation so that relevant differences between meshes can be extracted. In addition a mesh can be deformed in an intuitive way, preserving geometrical properties.
Encode a surface relative to its differential representation. **Laplacian co-ordinates**.

Statistical Model

To produce a model that can capture the variability of the human body parameters we follow these steps:

1. Transform parameter data to vector representation $X_i = [x_1 \ldots x_n]^T$.
2. Apply dimensionality reduction in the form of **PCA (Principal Component Analysis)**
3. Generate new models by specifying body parameters.

Use regression to find the relationship between the shape and several biometric measures such as height, weight, gender, age, etc.



References

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[2] A.Balan., M.J.Black.The naked truth: Estimating body shape under clothing. In Proc. ECCV,2008.

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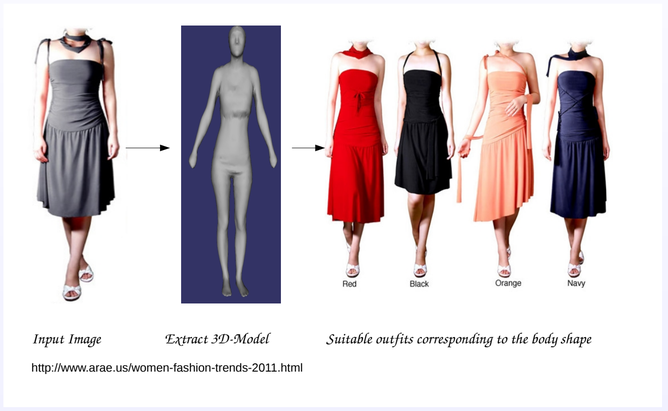
Motivation

Extracting accurate measurements of a human such as shape and pose has many potential applications including fashion for clothing retail, sports performance analysis, biomechanics and obesity assessment. The ultimate aim of this research is to develop a low-cost, widely available human body-shape and pose measurement technology.



Framework Layout

This Framework consists of three stages:

1. Encoding the surface of a mesh.
2. Learning how the surface varies based on human body parameters.
3. Generating new models by specifying body parameters and fitting to an image.

Input: Aligned scans of different people in different poses.

Image Fitting

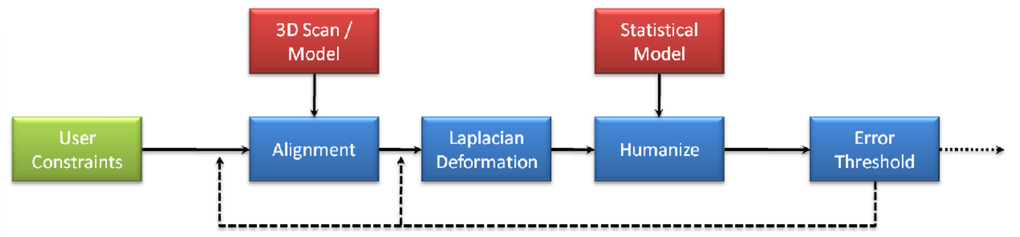
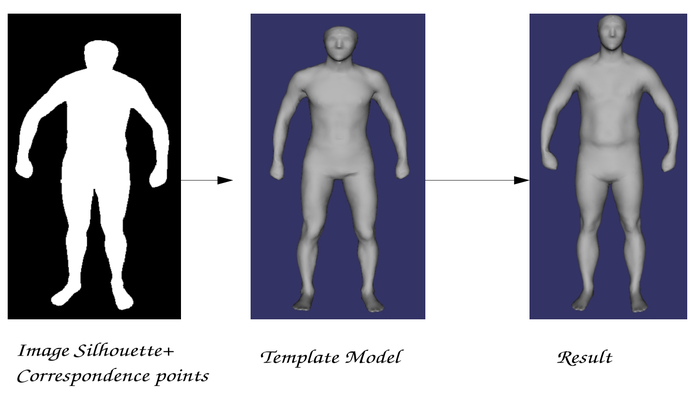


Figure 1: Overview of the fitting algorithm

1. Given a set of model parameters generate an instance of the model.
2. Project the model to the image.
3. Laplacian Deformation step using the user defined constraints.
4. Introduce the statistical model to the system to constrain the solution to a realistic body.
5. Minimize the fit function that measures the error in overlap of the projected model and the target image.

Silhouette Fitting Results



Results

An early implementation of the system has been tested on shape recovery from **image silhouettes**. Given a silhouette and a few correspondence markers the system is able to find the shape parameters that best explain the silhouette. The system assumes that the camera model is known and that a few correspondence points between the silhouette and the 3D model are given.
The system tries to find the optimal set of shape paremeters that best describe the silhouette using a gradient descent method. In addition the correspondence points are used in a Laplacian Deformation framework to further minimize the fit function error.

Conclusion and Future Work

The early implementation of the system for shape estimation has shown that Statistical Models can be used effectively in human body parameters estimation. In the future we aim at constructing a model that can estimate both shape and pose parameters in automated way without providing markers.Furthermore, it would be desirable to estimate these parameters for dressed subjects. Additional cues from images will also be investigated such as light, shadows and skin detection.

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