MODEL-BASED SEGMENTATION OF BODY FAT

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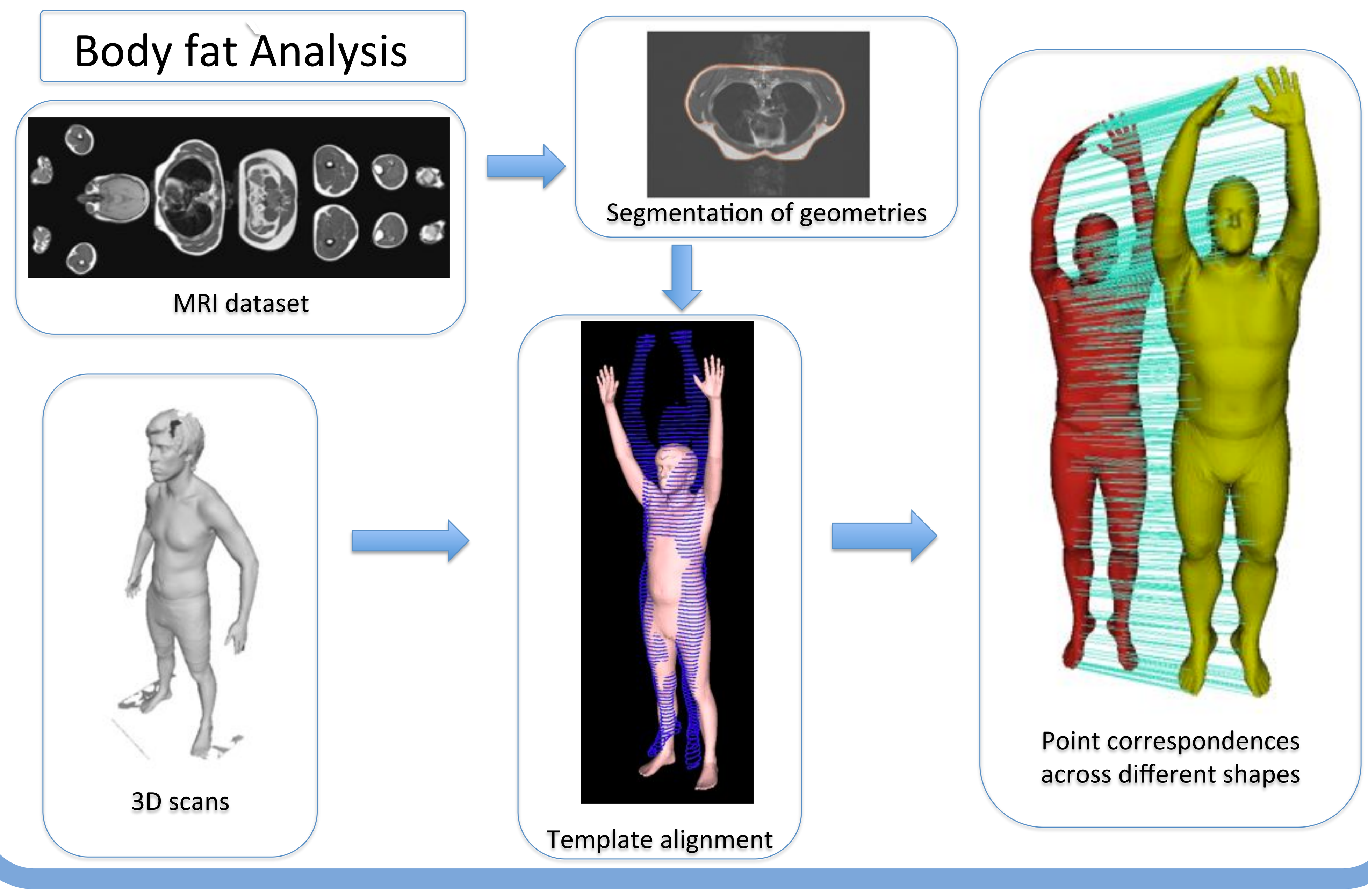
Abstract: It is known that body fat distribution is an important indicator of the cardiovascular and metabolic health. The modeling and analysis of the body fat distribution can lead to insights of diseases caused by obesity, and can allow us to design treatments for such diseases. There exists several techniques for the measurement of fat, such as the BMI, skinfold calipers and bioelectrical impedance etc., however these techniques do not measure the body fat distribution. Magnetic resonance imaging (MRI) can be used to quantify the body fat distribution. The fat tissue is however often segmented manually by clinicians, which can be laborious and time consuming due to the voluminous MRI data. A robust segmentation algorithm can be advantageous for the quantification of the body fat. Here, we propose the use of an articulated body model for the segmentation of the subcutaneous fat layer. This will allow us to model the body fat distribution and conveniently investigate the role of fat distribution in the human well-being.

Introduction

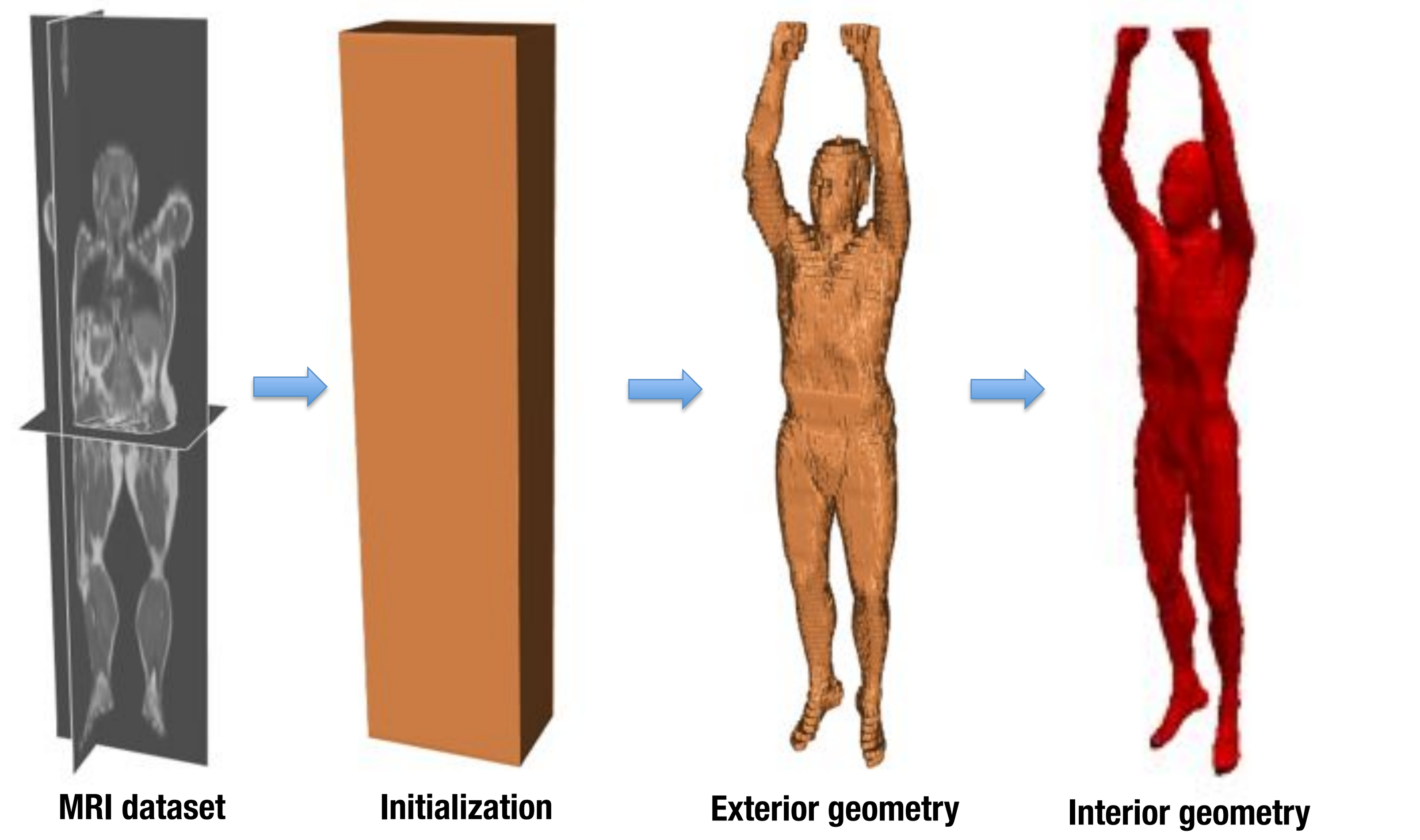
Obesity can have adverse effects on metabolic health.

Body fat distribution as an indicator of well-being.

We can align a body model to the outer skin surface and the inner fat surface, which gives a more accurate measurement of the body fat.



Segmentation



Segmentation of MRI data using deformable model, i.e minimization of the energy functional (T. F. Chan and L. A. Vese, 2001)

$$E(\mu_1,\mu_2,\psi) = \int_\Omega (I(\mathbf{x})-\mu_1)^2 H(\psi)d\mathbf{x} + \int_\Omega (I(\mathbf{x})-\mu_2)^2(1-H(\psi))d\mathbf{x} + \nu \int_\Omega |\nabla H(\psi)|d\mathbf{x}$$

in which μ_1 and μ_2 are the mean intensities inside and outside the contour or surface represented using the level set function, $\psi(\mathbf{x})$

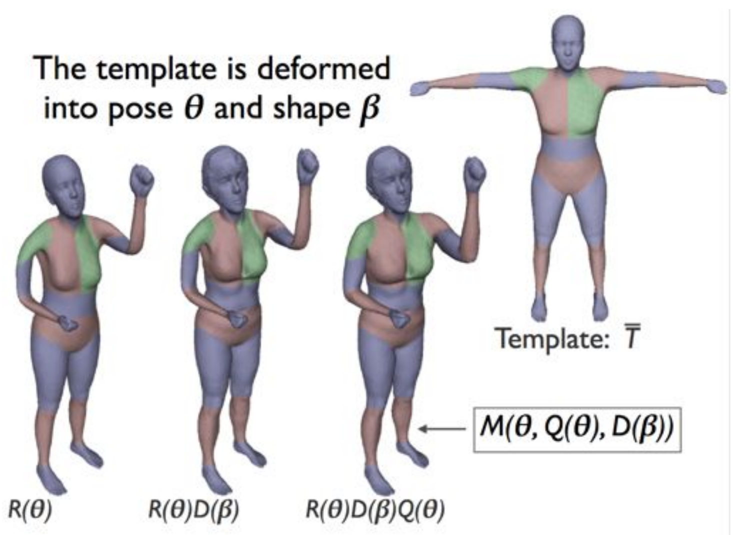
The exterior geometry is used as initialization to segment the interior geometry

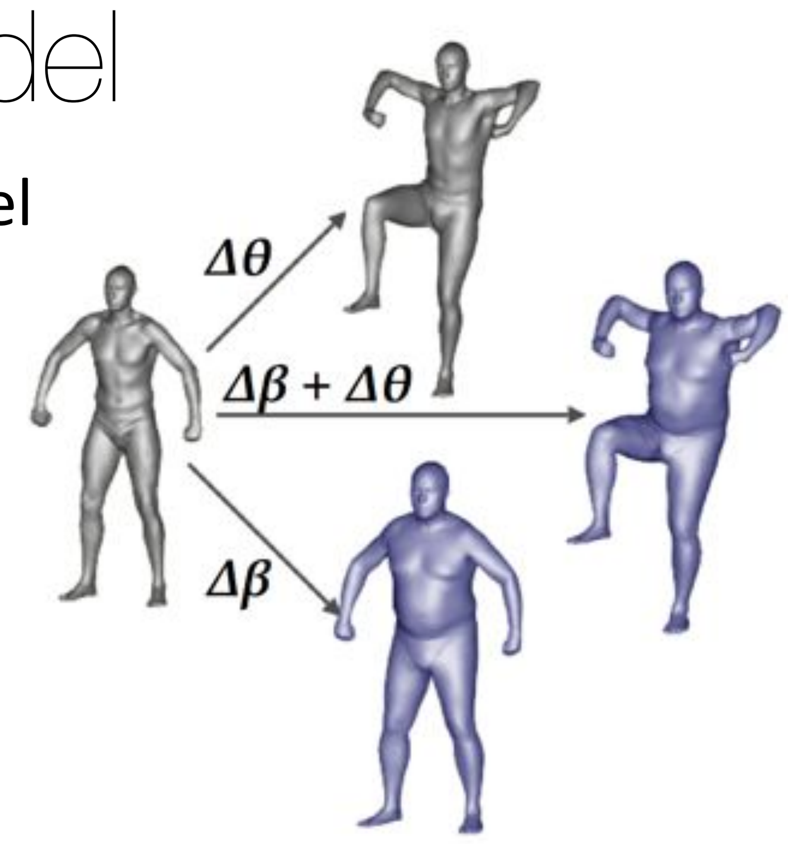
Body Model

A factored 3D body model

θ : body pose

β : body shape



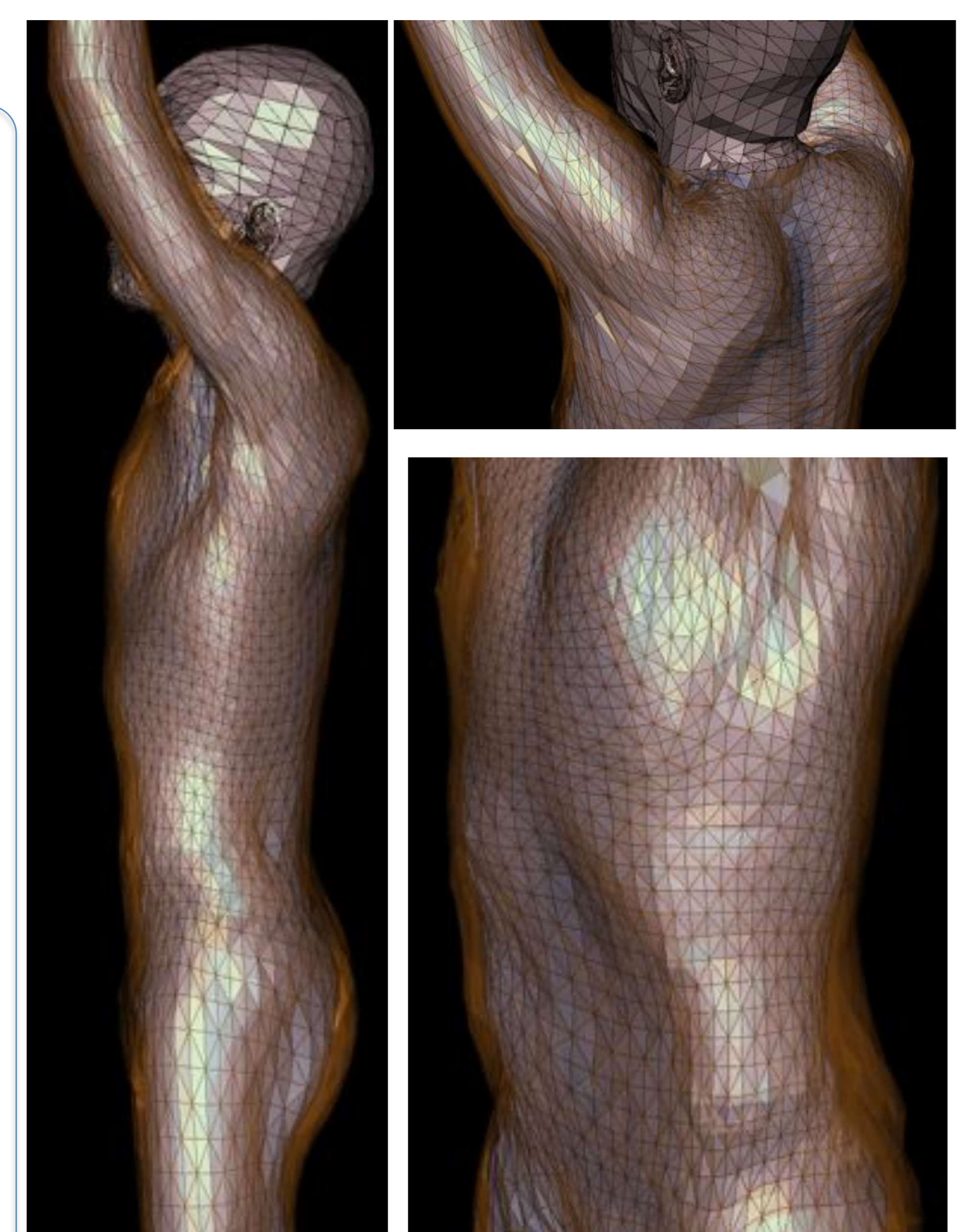


SCAPE Model

(D. Anguelov, P. Srinivasan, D. Koller, S. Thrun, J. Rodgers, J. Davis, 2005)

Model Alignment

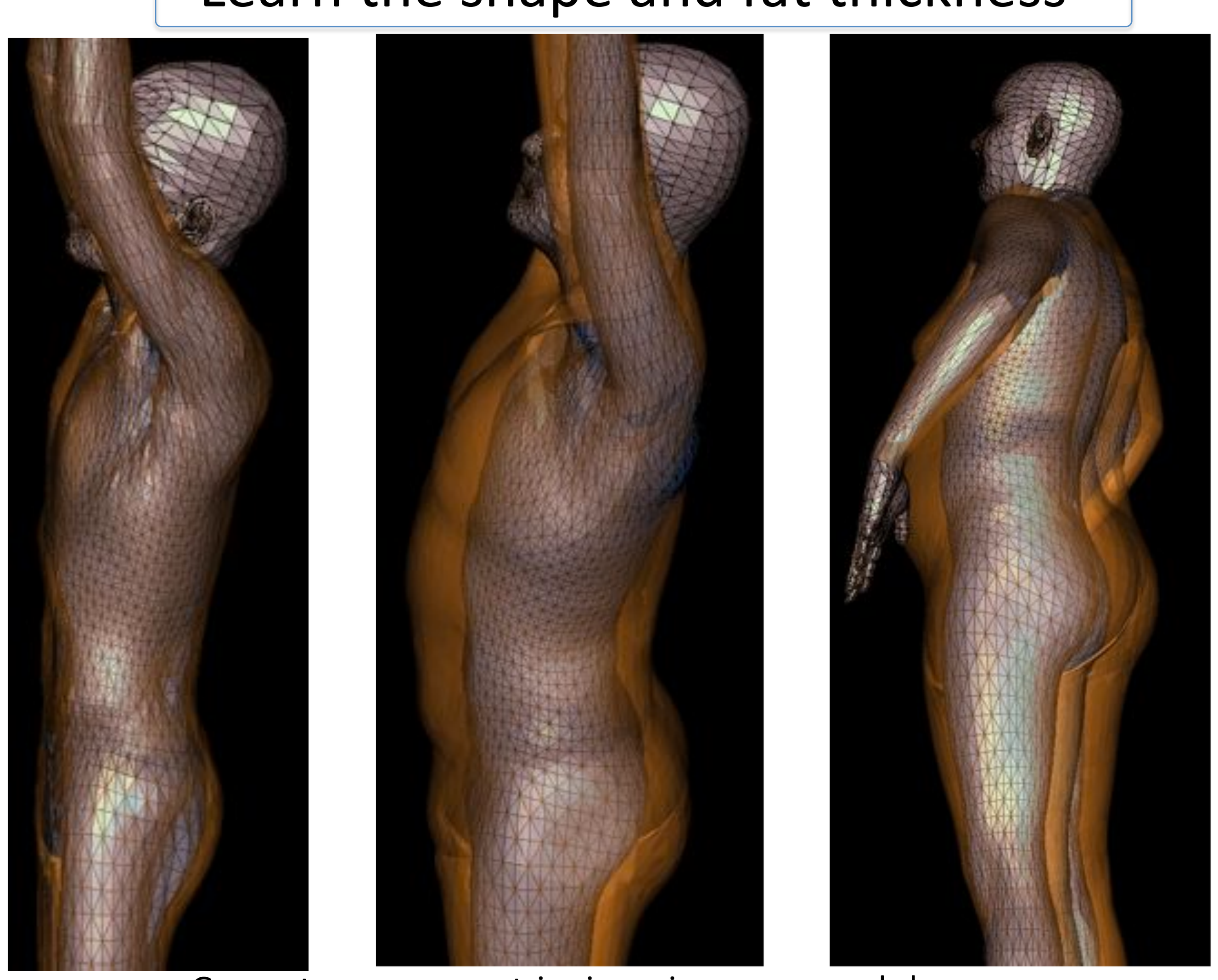
Alignment of template to segmented geometries. For the left image: Data points (Blue), initialization (pink), Middle: Shape fit to external surface, Right: Shape fit to internal fat surface



Geometries depicting fat layer

Future Research

Learn the shape and fat thickness



Generate new geometries in various poses and shapes

Body Fat Analysis