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Creation of a hybrid human model by combining human morphology, musculoskeletal structure and fat/muscle composition

Ruolin Wang [1*], Kim Phuc Tran [1], Xianyi Zeng [1]

1Univ.Lille, ENSAIT ULR 2461-GEMTEX–Génie et Matériaux Textiles, F-59000 Lille, France;
* ruolin.wang.etu@univ-lille.fr

The progress of network and computer technology has driven the continuous development of clothing e-commerce, more and more consumers choose to purchase clothes online. The realization of virtual fitting technology and personalized clothing customization has also become possible. 3D human body modeling is an important research content. At present, 3D human body modeling mainly relies on 3D body scanning or manual design by professional modeling designers through modeling software. However, the human musculoskeletal structure and body composition are not systematically taken into account in the current 3D geometric models, making it difficult to accurately take important measures and recognize body shape on a 3D human model. Although many methods have been used to generate 3D human body models in recent years, most of them focus on estimating the posture of the human body, and little attention is paid to whether the reconstructed human model contains the body composition. Accurate and realistic 3D human modeling and measurements are important foundations for applications such as virtual fitting and personalized clothing customization. Therefore, this article focuses on the reconstruction of 3D human body models and rapid measurement of human body dimensions.

This study proposes a hybrid modeling method for 3D human body reconstruction, which can recover soft human models with semantic structure and physiological rationality from scan data and individual biological information. Our method consists of three core modules: firstly, a body type classification module based on 3D convolutional neural network (3D-CNN) is used to pre-classify the input scans to provide structural priors for subsequent fitting. Secondly, a human body fitting framework based on SMPL is constructed to achieve accurate alignment and non-rigid deformation between scanned point clouds and parameter models by jointly optimizing Chamfer distance, L2 landmark loss, and Gaussian Mixture Model (GMM) priors. Finally, a multi-layer perceptron (MLP) architecture that integrates attention mechanism and multi-scale features is introduced to combine BIA data, anthropometric parameters and scan features to achieve personalized soft models.

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