Skinning Weights Optimization through Data-Driven Approaches: Determining the Training Dataset

Alejandra POLANCO [1], Yoann LAFON [1], Georges BEURIER [1], Junfeng PENG [2], Xuguang WANG [1]
[1] Univ Lyon, Univ Gustave Eiffel, Univ Claude Bernard Lyon 1, LBMC UMR_T 9406, Lyon, France;
[2] Digital Human Modelling Laboratory, Decathlon Sportslab, Lille, France

Abstract

Skinning methods that employ skeleton-driven deformation for predicting human skin shapes in different postures are widely utilized in computer graphics applications, but also in ergonomics-related applications for products and clothes development. In these methods, a hierarchical bone structure is used to drive the transformation between postures of the vertices compositing the skin mesh. The vertices are influenced by the underlying bones according to their skinning weights. The skinning weights can be defined from manual painting, purely geometric methods, or solving heat diffusion equations among others. Data-driven approaches use large amounts of data to determine the skinning weighs: 64000 multi-pose and multi-identity body scans were used in [1], 1786 multi-pose meshes from 40 subjects and 3800 multi-identity meshes were used in [2], and 237 meshes from 50 subjects were used in [3]. Even though it's well-known that numerous training skins are required to produce accurate results, the sensitivity of the results to the amount and type of training data has not been investigated. For this reason, this work studies the influence of the composition of the training dataset (numbers and type of subjects and postures) on the determination of the skinning weights. The quality of the skinning weights was performed by analyzing the predicted skin shapes and 3D scans in the final postures considered as ground truth data. The results of this study can be of interest for the definition of databases used to develop data-driven models to predict shapes in new postures; especially considering the costs associated with data collection campaigns.

References:

1. Xu, H., Bazavan, E., Zanfir, A., Freeman, W., Sukthankar, R., Sminchisescu, C.: Ghum & ghuml: Generative 3d human shape and articulated pose models. In: IEEE/CVF Conference on Computer Vision and Pattern Recognition, on Proceedings, pp. 6184-6193, virtual (2020).

2. Loper, M., Mahmood, N., Romero, J., Pons-Moll, G., Black, M. J.: SMPL: A skinned multi-person linear model. ACM transactions on graphics 34(6), 1-16 (2015).

3. Allen, B., Curless, B., Popović, Z., Hertzmann, A.: Learning a correlated model of identity and pose-dependent body shape variation for real-time synthesis. In: 2006 ACM SIGGRAPH/Eurographics symposium on Computer animation, on Proceedings, pp. 147-156, Goslar, Germany (2006).