A New Automated Workflow For 3D Character Creation Based On 3D Scanned Data

Alexander Sibiryakov, Xiangyang Ju and Jean-Christophe Nebel

University of Glasgow, Computing Science Department
17 Lilybank Gardens, G12 8QQ Glasgow United Kingdom
{sibiryaa, xju, jc}@dcs.gla.ac.uk

Abstract. In this paper we present a new workflow allowing the creation of 3D characters in an automated way that does not require the expertise of an animator. This workflow is based of the acquisition of real human data captured by 3D body scanners, which is them processed to generate firstly animatable body meshes, secondly skinned body meshes and finally textured 3D garments.

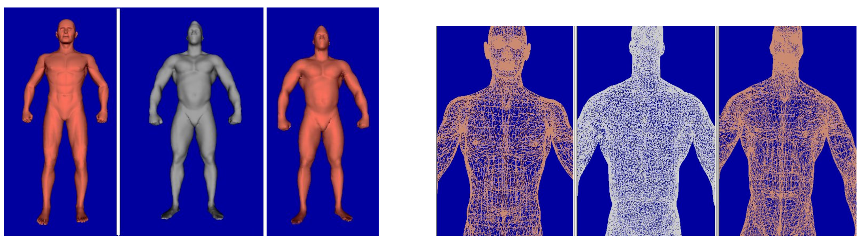
1 Introduction

From the dawn of human civilisation, story telling has been a key element of culture and education where human characters have been given a central role. Although story telling has been evolving beyond recognition with the advent of computer graphics and virtual reality, human figures still play a significant and irreplaceable part in narration. Creation and animation of these characters have been among the most difficult tasks encountered by animators. In particular the generation of animatable character meshes, which include modelling and skinning, is still a manual task requiring observation, skills and time and on which the success of the narrative depends on.

2 Creation of 3D models of humans from real data

On one hand a talented animator requires few weeks, if not months, to produce a convincing model of 3D human. On the other hand specific human models can be generated in hours by using any of the two main automatic or semi-automatic techniques: the deformation of generic 3D human models and 3D scanning. In the first case, a set of pictures [2,3] or a video sequence [1] is mapped on a generic 3D model, which is scaled and deformed in order to match the pictures. The main limitation is the similarity between the human model and the generated model depends on the viewpoint. The other way of generating automatically realistic humans is by using 3D scanners [6,7,12]. Models are more realistic, however they contain little semantic information, i.e. data comprises an unstructured list of 3D data points or mesh without any indication of what body component they represent.

The method we propose, detailed in [4], is a combination of the two previously described techniques: a generic 3D model is deformed in order to match 3D data. This is a two-step process: global mapping and local deformation. The global mapping registers and deforms the generic model to the scanned data based on global correspondences, in this case manually defined landmarks. The local deformation reshapes the globally deformed generic model to fit the scanned data by identifying corresponding closest surface points between them and warps the generic model surface in the direction of the closest surface (see Figure 1).



(a) (b) (c) (d) (e) (f)

Fig. 1. Generic model (a), 3D imaged body data (b) final conformed result (c), generic mesh (d), 3D imaged body mesh (e) and final conformed mesh (f).

3 Character skinning based on real data

The animation of 3D characters with animation packages is based on a hierarchic rigid body defined by a skeleton, which is a supporting structure for polygonal meshes that represent the outer layer or skin of characters. In order to ensure smooth deformations of the skin around articulations, displacements of vertices must depend on the motion of the different bones of the neighbourhood. The process of associating vertices with weighted bones is called skinning and is an essential step of character animation. That task requires time and artistic skills, since skinning is performed iteratively until a visually acceptable compromise is reached. Our solution is based on a more rational approach: instead of experimentally trying to converge towards the best skinning compromise, we offer to automatically skin a model from a set of 3D scanned postures which are anatomically meaningful [5] (see Figure 2).

The skinning process itself is based on the analysis of the motions of points between these different postures. Using the set of 3D points, we start by tracing each point from the reference posture and we obtain the 3D deformation of each point (range flow). Then the positions of the centre of each limb can be calculated in all the 3D models of the sequence and finally we analyse the motion of each point in its own local coordinate system and assign to each point of the 3D model a set of weights associated to each bone (see Figure 3). The vertex weights are calculated as coefficients in linear equations defining the motion of the vertex in joint coordinate system. In this system two bones defining the joint are considered as axes of a coordinate system. Vertex weights are considered as coordinates of vertex in that system.

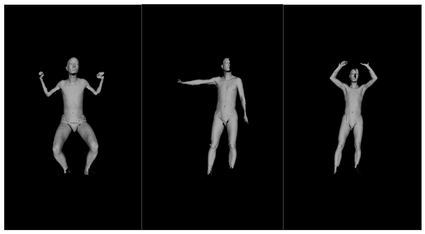


Fig. 2. Character scanned in different positions

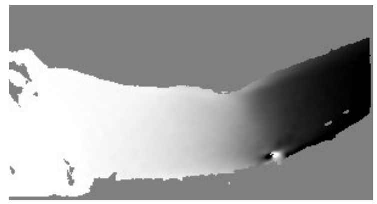


Fig. 3. Weight distribution

In recent papers [12,13] the postures are used to improve the skinning by fitting the skin deformation parameters to postures. Our method uses the postures for direct calculation of skin vertex weights. It can be considered as an extension of SSD (Skeletal Space Deformation) approach, where the weights are not necessary normalized and they can change their values depending on orientation of the bones.

4 Textured 3D Garment generation from real data

Three main strategies have been used for dressing 3D characters. Garments can be modelled and textured by an animator: this time consuming option is widely spread in particular in the game industry where there are only few characters with strong and distinctive features. A simple alternative is to map textures on body shape of naked characters, however that technique is only acceptable when characters are supposed to wear tightly fitted garments. Finally garments can be assembled: patterns are pulled together and seamed around the body. Then physically based algorithms calculate how garments drape when resting. This accurate and time-consuming technique (requiring seconds [8] or even minutes [10] depending on the required level of accuracy) is often part of a whole clothing package specialised in clothes simulation.
Among these strategies, only the third one is appealing since it provides an automated way of generating convincing 3D garments. However since we do not intend to animate clothes using a physically based animation engine and we do not have direct access to clothes pattern, that strategy does not impose itself as the best solution.
Instead we offer to use the following innovative technical solution: the generation of 3D garments is done by capturing a same individual in a specific position with and without clothing (see Figure 4). Generic garment meshes are conformed to scans of characters wearing garment to produce 3D clothes. Then body and garment meshes can be superposed to generate the 3D clothes models (see Figure 5).
Each 3D outfit is connected to a set of texture maps providing style and appearance. The process of texture generation is the following: using the given flatten mesh of a generic mesh and a set of photos which will be used as texture maps, users set landmarks on the photos corresponding to predefined landmarks on the flatten mesh. Then a warping procedure is operated so that the warped images can be mapped automatically on the 3D mesh (see Figure 5). Moreover areas where angles should be preserved during the warping phase – i.e. seams defining a pocket - can be specified.

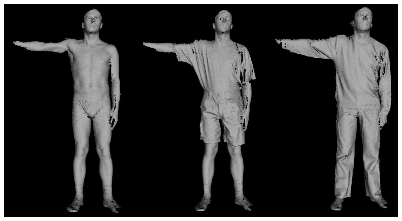


Fig. 4. Model scanned in different outfits

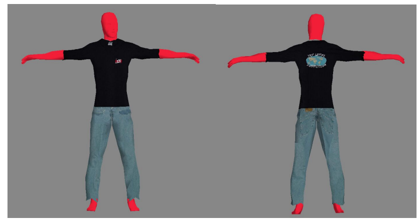


Fig. 5. Textured model

5 Conclusion

We presented an automated workflow for the creation of 3D characters based on scanned data. The creation process does not require expertise and skills of animators, since any computer literate person can generate of a new character in a couple of hours. This workflow is currently in use in the development of the intuitive authoring system allowing non-computer specialist to create, animate, control and interact with a new generation of 3D characters within the V-Man project [9].

References

1. N.D'Apuzzo, R.Plänkers, A.Gruen, P.Fua and D.Thalmann, Modeling Human Bodies from Video Sequences, Proc. Electronic Imaging, San Jose, California, January 1999.
2. V.Blanz and T.Vetter, A Morphable Model for the Synthesis of 3D Faces, SIGGRAPH'99 Conference Proceedings, pp 187-194, 1999
3. A.Hilton, D.Beresford, T.Gentils, R.Smith and W.Sun, Virtual People: Capturing human models to populate virtual worlds, CA'99 Conference, May 1999, Geneva, Switzerland
4. Xiangyang Ju and J. Paul Siebert, Individualising Human Animation Models, Proc. Eurographics 2001, Manchester, UK, 2001.
5. J.-C.Nebel and A.Sibiryakov, Range flow from stereo-temporal matching: application to skinning, IASTED Int. Conf. on Visualization, Imaging, and Image Processing, Spain, 2002.
6. R.Trieb, 3D-Body Scanning for mass customized products - Solutions and Applications, Int. Conf. of Numerisation 3D - Scanning, 24-25 May 2000, Paris, France.
7. P.Siebert, S.Marshall, Human body 3D imaging by speckle texture projection photogrammetry, Sensor Review, 20 (3), pp 218-226, 2000.
8. T. Vasilev, Dressing Virtual People, SCI'2000 conference, Orlando, July 23-26, 2000
9. V-MAN project website: http://vr.c-s.fr/vman/
10. P.Volino, N.Magnenat-Thalmann, "Comparing Efficiency of Integration Methods for Cloth Animation", Proceedings of CGI'01, Hong-Kong, July 2001
11. S. Winsborough, An insight into the design, manufacture and practical use of a 3D-Body Scanning system, Int. Conf. of Numerisation 3D - Scanning, 24-25 May 2000, Paris, France.
12. B. Allen, B. Curless, Z. Popovic, Articulated body deformation from range scan data. SIGGRAPH'02 Conference Proceedings, pp. 612-619, 2002
13. A.Mohr, M.Gleicher, Building Efficient, Accurate Character Skins from Examples, SIGGRAPH'03 Conference Proceedings, pp 562-568, 2003