Enhancing Character Posing by a Sketch-Based Interaction

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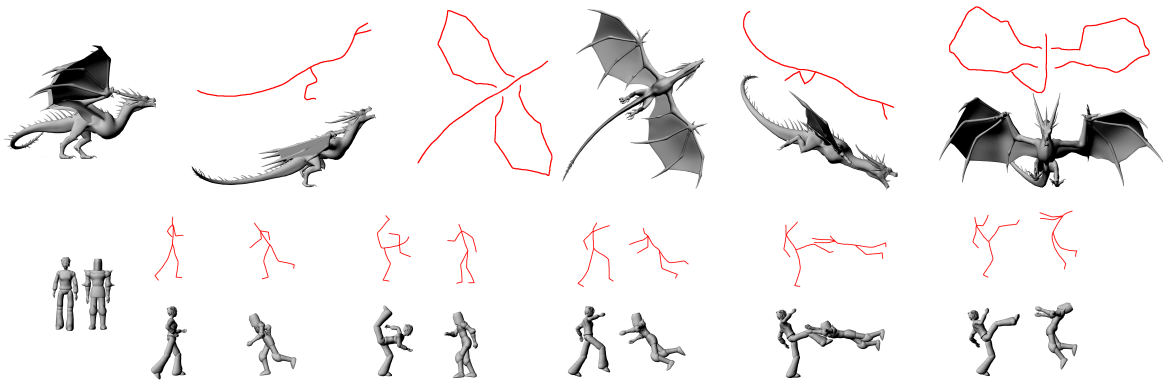

Figure 1: *Two animations created with sketches: the far left column is the chartacter at the resting pose; the red lines represent the sketches drawn by the user for both skeleton and outlines.*

Keywords: sketch-based posing

Concepts: •**Computing methodologies** → **Animation;**

1 Introduction

Sketch as the most intuitive and powerful 2D design method has been used by artists for decades. However it is not fully integrated into current 3D animation pipeline as the difficulties of interpreting 2D line drawing into 3D. Several successful research for character posing from sketch has been presented in the past few years, such as the Line of Action [Guay et al. 2013] and Sketch Abstractions [Hahn et al. 2015]. However both of the methods require animators to manually give some initial setup to solve the corresponding problems. In this paper, we propose a new sketch based character posing system which is more flexible and efficient. It requires less input from the user than the system from [Hahn et al. 2015]. The character can be easily posed no matter the sketch represents a skeleton structure or shape contours.

2 Methodology

Given a 3D character model and its rigging, the system proposed takes a sketch from the user as input. The sketch could depict the skeleton of the character or its outline, or even a combination of the two. The observation camera angle for sketching could be given by animator or estimated by pre-calculation of samplings from a spherical camera set-up around the character.

The input sketch is evenly sampled to make the point sets $Y = (y_1, y_2, \cdots, y_M)$; A subset of vertices $V = (v_1, v_2, \cdots, v_K)$ from the character mesh is extracted for finding the corresponding points. Currently it only includes two categories of points: (a) all the points around outlines (or feature lines); (b) all the vertices lying close to the projection of skeleton. Given a character posing parameters p on the joints, these selected mesh vertices will be deformed to $V(p)$. To match the two point sets V and Y and meanwhile deform V to Y as closely as possible (finding p), we formulate it as solving the following optimization problem:

$$\min_{\omega,p} \sum_{i=1}^{M}\sum_{k=1}^{K} \omega_{ki}\|y_i - v_k(p)\|_2^2 + \Phi(p) - \zeta \sum_{i=1}^{M}\sum_{k=1}^{K} \omega_{ki} \quad (1)$$

$$\text{s.t.} \sum_{i=1}^{M+1} \omega_{ki} = 1;\ \sum_{k=1}^{K+1} \omega_{ki} = 1;\ \omega_{ki} \in \{0,1\}$$

where $\omega = \{\omega_{ki}\}_{(K+1)\times(M+1)}$ is the correspondence matrix consisting of two parts: the upper-left $K \times M$ part defines the correspondence and the extra $K+1$th row and $M+1$th column are introduced to handle the outliers. The points in V and Y having no correspondence would be automatically determined as outliers. The third term is used to prevent treating too many points as outliers. Similar to [Hahn et al. 2015], the second regularization term is used to add further constraints for searching candidate solutions in limited space, such as sketch neighbour points corresponding to close mesh vertices from geodesic distance, constrain the deformations of mesh vertices within their viewing plane, etc.

Solving equation (1) directly is very difficult. Since the objective function consists of a linear discrete assignment problem for correspondence and a non-linear continuous problem for deformation, we can adopt an alternating strategy to solve the correspondence parameter ω and the rig parameter p. By fixing p, we relax the binary ω to be a continuous valued matrix in $[0,1]$ and as in [Chui and Rangarajan 2003] solve the relaxed subproblem by using *Softassign* and *deterministic annealing*. By fixing ω, the enery function can be solved using a Newton-Raphson scheme.

In conclusion, we proposed a more flexible method for character posing than similar methods proposed in the recent years. The animator could easily pose the character by sketching either skeleton lines or shape contours (as in figure 1).

SIGGRAPH '16, July 24-28, 2016, Anaheim, CA,
ISBN: 978-1-4503-4371-8/16/07
DOI: http://dx.doi.org/10.1145/2945078.2945134

References

CHUI, H., AND RANGARAJAN, A. 2003. A new point matching algorithm for non-rigid registration. *Computer Vision and Image Understanding 89*, 2, 114–141.

GUAY, M., CANI, M.-P., AND RONFARD, R. 2013. The line of action: An intuitive interface for expressive character posing. *ACM Transactions on Graphics (TOG) 32*, 6, 205.

HAHN, F., MUTZEL, F., COROS, S., THOMASZEWSKI, B., NITTI, M., GROSS, M., AND SUMNER, R. W. 2015. Sketch abstractions for character posing. In *Proceedings of the 14th ACM SIGGRAPH/Eurographics Symposium on Computer Animation*, ACM, 185–191.