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Telling a Story with Automated Motion Synthesis

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The story of a chair and a table that meet on the dance floor is brought to life with the help of automated motion-synthesis tools.

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1 Introduction

By at least some measures, recent progress in the area of *automated motion synthesis* has been remarkable: a variety of creatures, both on land and in water, have been made to walk, waddle, wiggle, bounce, bound, and slither automatically. Yet, viewed from a broader perspective, this progress seems illusory: there is little evidence that automated motion synthesis can be used to express emotion and to tell a story, which are the real success criteria for creative animation. Our goal was to provide some evidence to this effect. We scripted a story, described next, in which the variation and quality of character motion are crucial, and then sought to create the motion in each cut solely by automatic means.

2 The Story

... The dance floor is empty except for the presence of a chair and a small—some would say attractive—end table. The chair, a bit oafish but ever the optimist, has had his eye on the table for the entire night, and now they are alone. The quiet is broken as the next song begins and the unmistakable theme of "Stayin' Alive" is heard. The end table, aloof but well aware of the chair's attentions, has a game in mind. She begins to dance, inviting imitation. The chair, like many a Travolta wannabe before him, takes up the challenge. Undeterred by her skill, he mimics her moves with some lumbering steps of his own. As the tempo increases, the chair manages to keep up: in fact, he thinks he is doing rather well. Soon, however, the end table grows tired of the game. She raises the stakes, demonstrating an athletic pirouette. The chair, obviously shaken, is not prepared to give up easily, having come this far. His pirouette has all the elegance of a car crash, but it's good enough, he hopes, to maintain her interest. Finally, it is the table's move again. She chooses a forward diving somersault, showing off years of dance and gymnastics training. The chair collects himself: this is no time to be faint of heart. He crouches and then throws himself into the move, jumping up and twisting for all he is worth. But it is not to be and he falls on his face, defeated. As the song finishes, the table struts away without so much as a backwards glance.

3 Tools

Our particular approach to automated motion synthesis is described in detail elsewhere [1]. Here we consider only the inputs required by our system.

One input comprised the physical models for the characters. For the end table we used a compact, symmetric mass-spring lattice. The chair was modeled by adding a back and supporting springs to the top of the cube. The other input consisted of objective functions for each of the 11 different motions required by our script. Through previous experimentation, we had developed a set of about 20 objective-function terms that measured such motion characteristics as average distance traveled, maximum height cleared, rotation about an axis, average symmetry of a gait, average asymmetry of a gait, contact with the ground, etc. We were able to construct an objective function for each of the desired motions using combinations of these terms. Usually our search algorithm found a motion that was near-

optimal with respect to the given objective function. However, at the beginning we frequently underspecified the objective functions, which led to unusual and unexpected motions. One or two of these were included in the animation (e.g., the table's shimmy-like rotation is an underspecified pirouette), but most were not. After some experience, our skill at specifying objective functions increased, and our efficiency improved.

4 Conclusion

From conception to final editing took five days, most of which were spent waiting for our computers to report results. Although modest in scope, the resulting animation is something that we could not have produced on our own in any other way, given our profound lack of artistic and animation skills. Based on this experience, we remain optimistic that automated motion-synthesis techniques can lead to useful tools for the animator.

References

[1] J. Christensen, J. Marks, and J. T. Ngo. Automatic motion synthesis for 3D mass-spring models. *Visual Computer*, 1996. To appear.