Real-time interactive motion stylization for mesh objects

Paul Lapides, Mario Costa Sousa, Ehud Sharlin
Department of Computer Science, University of Calgary*

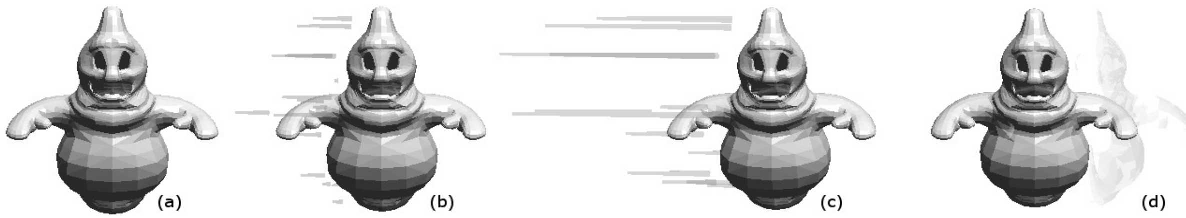

Figure 1: *Interactive real-time stylization at various speeds. (a) No stylization; object's motion is ambiguous. (b) & (c) Speed lines stylization is shown; object is moving with different velocities. (d) Object suddenly decelerates; a vibration stylization is generated.*

1 Introduction

Motion stylization is an illustration technique that conveys the sense of motion in a still frame. Various stylization techniques exist such as blurring, deformation, speed lines, and vibration lines. Our work explores speed lines and vibrations. In Non-Photorealistic Rendering (NPR), such stylization was presented by Masuch et al [1] with an approach to generate speed lines, arrows, and repeated contours using a polygonal 3D model along with keyframe data of an animation as input. Alternate approaches to stylize motion have also been proposed by learning motion patterns from a highly varied set of motion capture sequences [2] or by tracking the motion from traditionally animated cartoons and retargeting it onto 3-D models, 2-D drawings, and photographs [3]. We present algorithms that render speed line and vibration stylization in real-time. The motion of the object is interactively controlled by the user with a tangible interface that is tracked in 3-D. Our proposed approach allows a direct mapping from the user's motion to expressive animations. Following, our method supports does not require predefining the motion or the stylization rendered or illustrated together with the animation, and allows the stylization to be generated in real-time according to the user's unrestricted input. To the best of our knowledge, this is the first time that real-time speed line and vibrations stylization are generated and mapped online following interactive input based on motion tracking of the user actions.

2 Real-time Input

Our stylization algorithm runs in real-time and is controlled by the user. We use a Vicon motion capture system to track the position of a "wand" being moved by a user. The tip of the wand represents the position of the object and we obtain the velocity and acceleration of the object using the Euler forward method.

3 Speed lines

We begin the generation of our interactive speed lines with a mesh moving through space with some velocity. The normal of each face is pointing either in the direction of motion (leading) or away from it (trailing). Leading faces are not considered. Additionally, the normal of a trailing face must be at a sufficiently small angle to the velocity; faces that are nearly parallel are not considered. Each trailing face of the model has a certain number of speed lines coming from it, based on the density parameter. Each line being drawn is actually a truncated cone, wide end near to the face. Speed lines emanate from each trailing face in the negative direction of the motion.

The length of a line, thickness, as well as the distance, or gap. between the start of a line and the face is controlled by the speed. Fast moving objects have longer and thicker lines and larger gaps than slow moving objects. Minimum and maximum speeds must be specified to define a range of speeds where speed lines are drawn. The relationship between speed and line properties is non-linear. Small increases in speed map to large increases in line properties, generating a perceived exaggeration in the motion of the object (Figure 1b, 1c).

Each line has a random length and originates from a random location on a face. To maintain frame-to-frame coherency, a list of random numbers is generated a priori and accessed consistently during each frame render.

4 Vibrations

A visual vibration is generated when the object experiences a large change in velocity. The vibration is a new instance of the mesh moving from the same position and with the same velocity as the object was when the vibration was triggered. Once triggered, the vibration is independent of the object's position and velocity.

Only leading faces of the vibration's mesh are rendered. The vibration mesh is transparent, and faces that are parallel with the velocity are more transparent than perpendicular faces. The vibration is rendered for a very short time and it becomes more transparent as it nears the end of its lifespan, until it is invisible and is destroyed (Figure 1d).

* e-mail: paul.lapides@gmail.com, smcosta@ucalgary.ca, ehud@cpsc.ucalgary.ca

References

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