Texture Mapping for Cell Animation

Wagner Toledo Correa
Robert J. Jensen
Craig E. Thayer
Adam Finkelstein
Animation History

- French Brothers Auguste and Louis Lumiere developed the technology for recording of sequential images on a flexible film base. (1895)

- By mid-1910s animation production in US already dominated by the techniques of cel and paper.
Process of cell animation

Many animators would be needed to create and check frames for anomalies.

Backgrounds would be painted with rich textures, but animated characters would only be painted in flat colors.

How could animators draw rich textures on the animated characters themselves?
Key Words

- Silhouette, the outline, is often one of its most striking features, which represents the contour and basic shape of the model.

- Image warping refers to the application of spatial transformations to image arrays.

- Foreshortening makes one part of an image appear closer than another part of it.
Key Words Cont.

- **Edge** – edge adjacent to one polygon in the mesh

- **Silhouette edge** – edge shared by one front facing and one back facing polygon relative to camera

- **Occlusion** describe the manner in which an object closer to the view port masks (or occludes) an object further away from the view port.
Process for Mapping

- Animator hand draws image
- Graphics animator creates a crude 3-D model
- Image is distorted within the viewing frustum of camera using
- Gestures are hand drawn in 2-D
- Image and expressions are merged
Silhouette Detection scheme

- Build tri color (R,G,B) polygon mesh using Guoraud shading without lighting and anti-aliasing.

- We use \((u,v,id)\). \(U\) and \(V\) represent the parametric coordinates of a vertex.

- When a pixel on the \(uv\) image corresponds to a pixel on the surface of the model the pixel is considered covered.

- Boundary a line joining two pixel corners adjacent to each other.
Specifying Markers

CLASSIFY(G)
1 for every boundary between two neighboring pixels
2 p1 pixel closer to the camera
3 p2 pixel farther from the camera
4 if p1.color != p2.color
5 e ADD EDGE(G, p1, p2)
6 if p1 is an extremum
7 e.type corresponding kind of border edge
8 else
9 e.type silhouette edge
Silhouette Detection
Scheme Cont.

- Model Markers, feature curves, are used to mark the location where 2-D gestures will be merged with 3-D image.

- Drawing Markers mark the location on the 2-D drawing of gestures.

- Generate directed graph from vertices and classify edges.

- Curve Fitting.
Depth Preservation
Warp

- \( x(t) = (p - M(t)) \ ^{x}m(t) \)
- \( y(t) = (p - M(t)) \ ^{y}m(t) \)
- \( q(t) = D(t) + x(t) \ ^{x}d(t) + y(t) \ ^{y}d(t) \)

\[ q = \frac{\int_0^1 c(t) q(t) \, dt}{\int_0^1 c(t) \, dt} \]
Depth Preservation
Warp Cont.

- Controlling speed of fall off.
- Multiple pairs of markers
- Forward mapping
- Inverse mapping

\[ c(t) = \frac{1}{\epsilon + d(t)^{\frac{f}{f}}} \]

\[
q = \frac{\sum_{i=1}^{m} \left( w_i \int_{0}^{1} c_i(t) q_i(t) \, dt \right)}{\sum_{i=1}^{m} \left( w_i \int_{0}^{1} c_i(t) \, dt \right)}
\]
Controlling the Warp

- Specifying value of $\epsilon$
- Specifying value of $f$
- Using extra markers
- Ordinate direction adjustment
Results
Limitations

- Cloth is not represented well
- Drawings that don’t correspond well to 3-D models
- Hair or fur
Credits

- History of Animation. Cline, Elisse anne
- A survey of silhouette detection techniques for non-photorealistic rendering. Wang Ao-yu2, Tang Min1, 2, Dong Jin-xiang