Outline

• Image transition
• Cross-dissolving
• Image morphing
  • Mesh-based morphing
  • Feature-based morphing

What is Image Morphing

• Objective:
  • Generate fluid transition between two images
• Application:
  • Special effects

Image Transition

• A sequence of images are needed to show the transition between the two images
• Parameter \( t \) controls position of the transition
  • \( t=0 \) : source image
  • \( t=1 \) : target image
  • \( 0<t<1 \) : intermediate images to be generated

Cross-Dissolving

• Blend two images using alpha compositing:
  • Set alpha for bottom (source) image to 1
  • Alpha for top (target) image varies from 0 to 1
  • Software implementation:
    • result(u, v) = (1-\( t \)) * source(u, v) + \( t \) * target(u, v)

Cross-Dissolving Results
Image Morphing
- Combine image warping & cross-dissolving
- Use warping to change the shape
- Use image composition to change color
- Problems involved:
  - How to generate intermediate images through warping?

Mesh-based Morphing
- Proposed by G. Wolberg in 1990
- Basic idea:
  - Break the images into a grid of quadrilaterals.
  - Deform the quadrilaterals to match the source and the target.
- Steps:
  - User specify a set of corresponding points.
  - The algorithm generate a grid mesh.
  - Each pixel is warped using the 3 closest grid points.

Corresponding Grid Points

Pros and Cons
- Fast and intuitive
- Efficient algorithms exist for computing the mapping of each pixel from the control grid
- Need to specify the number control points to use in advance.
- Points left unmodified are still used by the warping algorithm.
- Moving mesh points around may not always provide the desired effect.

Feature-Based Morphing
- Proposed by Beier & Neeley in Siggraph 1992
- Use in Jackson’s MTV “Black & White”
- Basic steps:
  - Use line segments to define features in both source & target images
  - Interpolate line segments for the intermediate frames
  - Warp both source & target images to the intermediate frame
  - Blend between the warped results

Define Control Lines
- Draw control line segments along the key features of the source and target images
- Corresponding features should be show using corresponding control lines
**Interpolate Control Lines**
- For a given intermediate frame $t$:
  - Calculate the position of control line segments in frame $t$
  - Can be done by linearly interpolating between the positions of corresponding line segments in source & target images

**Warp from Source**
- Warp source image to intermediate frame:
  - Apply backward warping
  - Use control lines defined in both intermediate frame & the source image
  - The result distorts the source image to the shape defined by the control lines in the intermediate frame

**Warp from Target**
- Warp target image to intermediate frame:
  - Use the same technique
  - The result distorts the target image to the shape defined by the control lines in the intermediate frame
  - Key features line up with the warping results obtained from the source image

**Blend between The Two**
- Blend the two warped images using the over operator
  - i.e., apply cross-dissolving on the warped images
  - The alpha value used depends on the parameter $t$

**Pseudocode for Morphing**
```plaintext```
for ( each intermediate frame t ) {
  for ( each pair of control line segment i ) {
    L_inter[i] = (1-t)*L_src[i] + t*L_tgt[i];
  }
  for ( each pixel P in intermediate image t ) {
    P_src = warping(L_inter, L_src, P);
    P_tgt = warping(L_inter, L_tgt, P);
    inter_img[t](P) = (1-t)*src_img(P_src) + t*tgt_img(P_tgt);
  }
}
```

**Morphing Results**
$t = 25$
$t = 5$
$t = 75$