Interesting Application with Image Transformations

Morphing

Image Morphing

Generates "Tween" Views

Images from Xmorph by Michael J. Gourlay
(checkout: http://www.colorado-research.com/~gourlay/software/Graphics/Xmorph/)
Morphing

Generating Tween Views

• User sets number of Tween views ‘N’
  - step = 1/(N-1)
    - (Assume N will includes the source and destination image, ie, tween0 = source, tweenN = destination)
  
• We have to determine what the polygon looks like at each “Tween” view
  
• We have to determine how to “color” that polygon at each “Tween” view
Generating Tween Views

- Quad to Quad Mapping
  - Control Points
    - $c_i = a_i + (b_i-a_i)t$
    - where
      - $t = j/(N-1)$ (j is the "jth" tween view, $j = 0$ to $N-1$)

-- Diagram showing control points $a_i$, $c_i$, $b_i$, and mapping for $A^{-1}$ and $B^{-1}$

Generating Tween Views

- For each Tween "j"
  - Calculate projective transform "$A^{-1}$" using points $a_i$ and $c_i$
  - Calculate projective transform "$B^{-1}$" using points $b_i$ and $c_i
Generating Tween Views

- Perform two image transform
  - Resulting in two quadrilaterals $AC, BC$
- Calculate $C$'s intensity by blending the two (dissolve)
  - $C(x,y) = AC(x,y) + (BC(x,y) - AC(x,y)) \times j/N$

Morphing
Morphing

- For each “Tween” view
  - Perform “warping” and “dissolve” procedure for each polygon
  - Use a standard 2D scan-convert polygon technique + bi-linear or bi-cubic sampling of source polygon

Results

“Tween” Views
Results

Generates "Tween" Views

• The technique is fairly simple
  - This is the 1st order approach
  - You can use better interpolation techniques (such as splines) to make it look smoother

• The hard part is setting the control points

Image Morphing
Image Morphing Limitation

- Can’t change the view point
- May cause distortion

View Morphing

- A technique to generate all in-between views of two images taken from different viewpoints
Parallel Camera

Key to View Morphing

- Pre-warp the images!
Three steps for view morphing

Comparison

Image Morphing

View Morphing
Summary

- Geometric Image Transforms
  - Types of 2D Transforms
    - Affine/Projective
- Sampling
  - Intro to Fourier Transform
    - Fourier Pairs
    - Some interesting Properties
    - Convolution
  - Sampling and the frequency domain
    - Nyquist Rate
  - Sampling, Filtering, and Reconstruction
  - Spatial Domain Filters