COS426 Precept3

Image Processing

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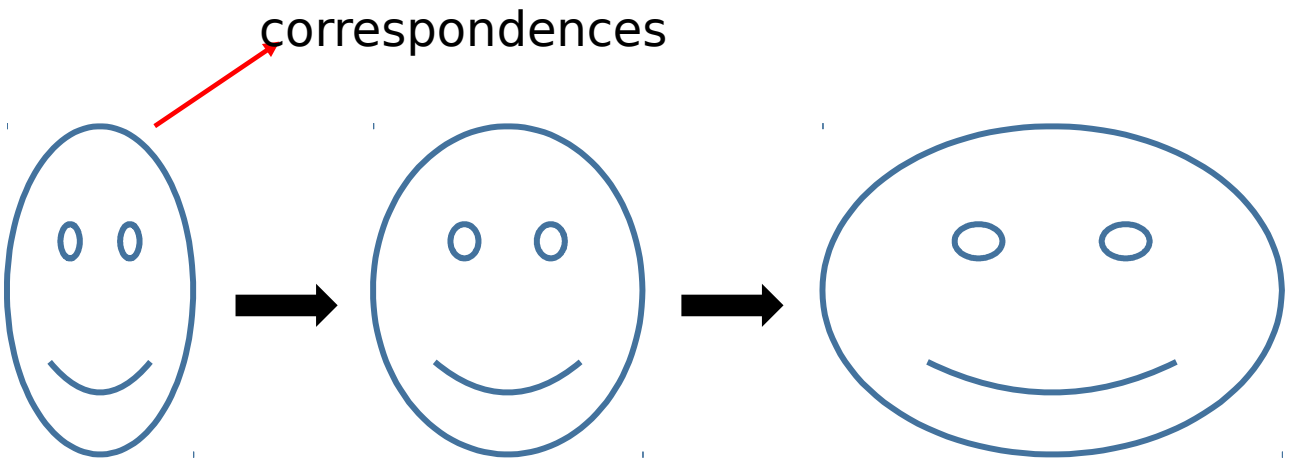
Morph

- Basic concepts
  - warp the background image to the foreground image
  - alpha = 0: show background
  - alpha = 1: show foreground
  - alpha is the blending factor / timestamp
- General approach
  - specify correspondences (morphLines.html)
  - create an intermediate image with interpolated correspondences (alpha)
  - warp the background image to the intermediate image
  - warp the foreground image to the intermediate image
  - blend using alpha

General approach



begin intermediate end

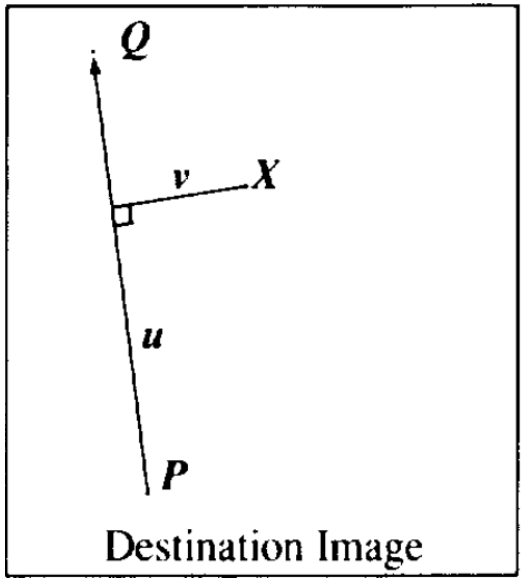
In our case, correspondences are morph lines.

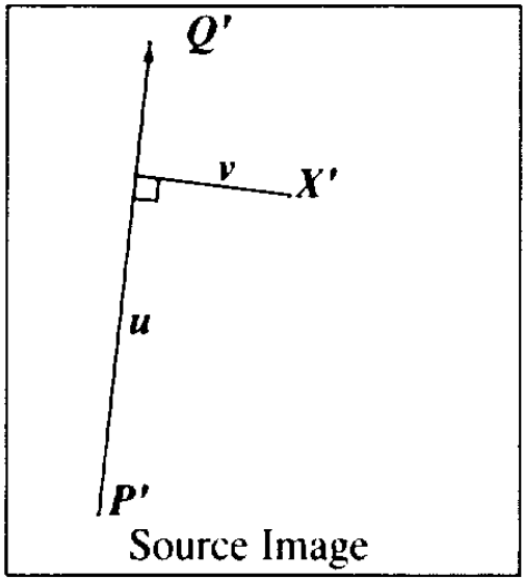
Morph

```
GenerateAnimation(Image0, L0[…], Image1, L1[…])
begin
    foreach intermediate frame time t do
        for i = 1 to number of line pairs do
            L[i] = line t-th of the way from L0 [i] to L1 [i]
        end
        Warp0 = WarpImage(Image0, L0, L)
        Warp1 = WarpImage(Image1, L1, L)
        foreach pixel p in FinalImage do
            Result(p) = (1-t) Warp0 + t Warp1

    end
end
```

Warp Image

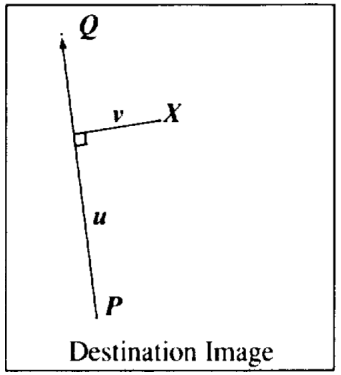


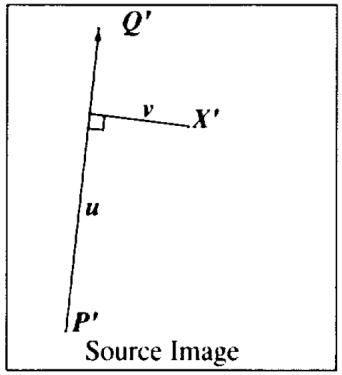


For each pixel X in the destination
  $DSUM = (0,0)$
  $weightsum = 0$
  For each line $P_i Q_i$
    calculate u,v based on $P_i Q_i$
    calculate X'_i based on u,v and $P_i' Q_i'$
    calculate displacement $D_i = X_i' - X_i$ for this line
    $dist$ = shortest distance from X to $P_i Q_i$
    $weight = (length^p / (a + dist))^b$
    $DSUM \mathrel{+}= D_i * weight$
    $weightsum \mathrel{+}= weight$
  $X' = X + DSUM / weightsum$
  destinationImage(X) = sourceImage(X')

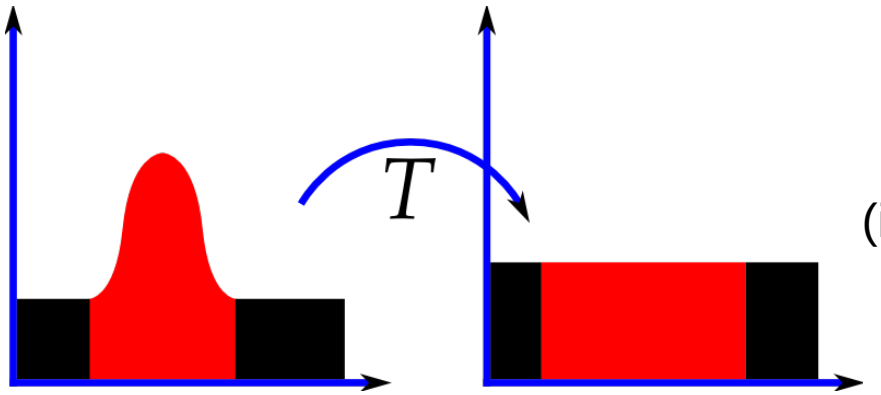
Warp Image

- $u = \frac{(X-P)\cdot(Q-P)}{||Q-P||^2}$
- $v = \frac{(X-P)\cdot Perpendicular(Q-P)}{||Q-P||}$
- $X' = P' + u \cdot (Q' - P') + \frac{v \cdot Perpendicular(Q'-P')}{||Q'-P'||}$
- $dist = shortest\ distance\ from\ X\ to\ PQ$
  - 0 <= u <= 1: dist = |v|
  - u < 0: dist = ||X – P||
  - u > 1: dist = ||X – Q||
- $weight = (\frac{length^p}{a+dist})^b$
  - we use p = 0.5, a = 0.01, b = 2





Histogram Equalization



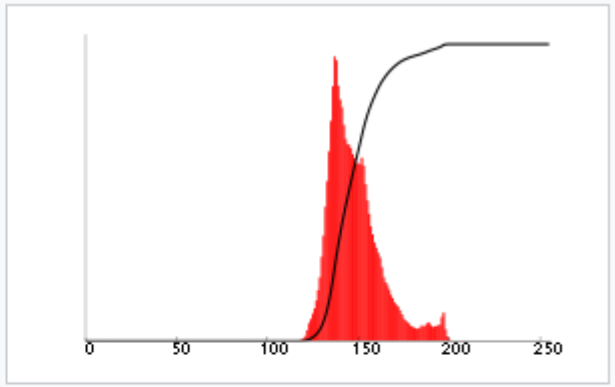
$$h(v) = \text{round}\left(\frac{cdf(v) - cdf_{min}}{(M \times N) - 1} \times (L - 1)\right)$$

(if L != 255 you need to multiply that as well)

h(v) = new pixel value
Cumulative Distribution Function(cdf) of X = p(X<=v)
(how many values <= v are in the image?)
L= # of bins
M, N = image dimensions

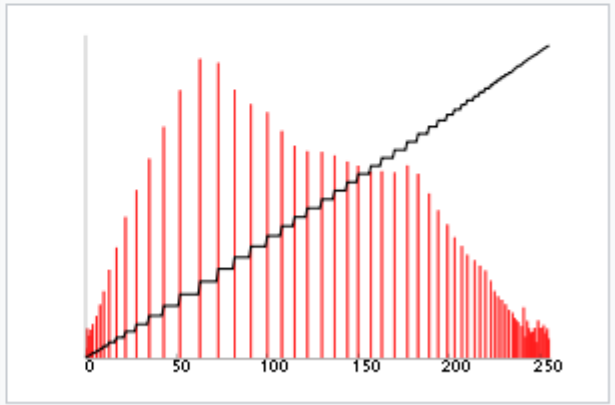
Goal is to have smallest value = 0, largest = 255

An unequalized image



Corresponding histogram (red) and cumulative histogram (black)

The same image after histogram equalization



Corresponding histogram (red) and cumulative histogram (black)

Q&A