CS6640 Week 10

Grade: (1) $Q_1\ Q_2 \ldots Q_k \rightarrow Q_1'\ Q_2' \ldots Q_{k-1}'$

drop lowest

$A_1\ A_2 \ldots A_\ell \rightarrow A_1'\ A_2' \ldots A_{\ell-1}'$

$P_1\ P_2 \ldots P_m \rightarrow P_1'\ P_2' \ldots P_{m-1}'$

(2) Convert letters to points

$A \rightarrow 4$

$A- \rightarrow 3.7$

$\vdots$

(3) Average $\quad \bar{Q}, \bar{A}, \bar{P}$

(4) Weight $\quad G = .2\bar{Q} + .45\bar{A} + .45\bar{P}$

L = convert G to letter

P3 postponed

A5 Q2: look at cpstruct1.basePoints (x,y) and use impixelinfo to get r,c in image to determine relationship between cpselect x,y (and u,v), and r,c (and (vw,cw))

Questions?

CS6640 Features
Week 10

Objects have features

* point features
* area features of point set
* neighborhood features

Shape parameters

extract statistics of point set:

* area
* perimeter
* Max Diameter
* Min Diameter
* convex area
* Bounding Rectangle area
* convex perimeter

functions of those:

* form factor
* roundness
* aspect ratio
* solidity
* extent
* compactness
* convexity

p. 237
Table 9.1

Matlab:
regionprops

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A6.1 CS6640-single-params

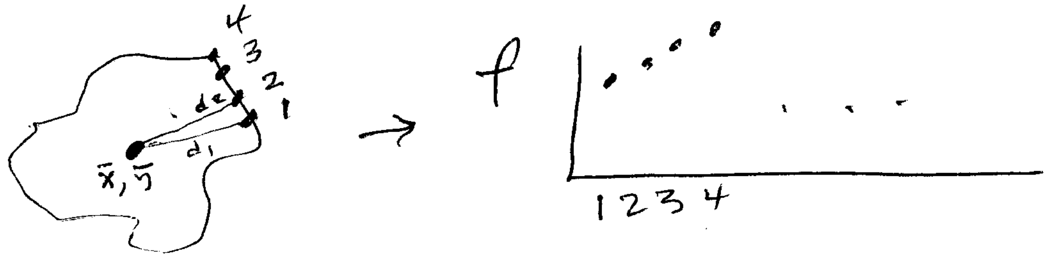
* create a set of shape parameter vectors for desired shapes

$$P:\ \begin{array}{cc} & \begin{matrix}1 & 2 & \cdots & 8\end{matrix} \\ \begin{matrix}1\\2\\ \vdots \\ n\end{matrix} & \left[\begin{matrix} \quad & \quad & \quad & \quad \\ & & & \\ & & & \\ & & & \end{matrix}\right] \end{array}$$

* for given binary image, classify each connected component according to closeness to shape vector

Radial Fourier Expansion

Signature: representation of shape boundary as 1D function



Given boundary points, $B = \{x_i, y_i\}$, and $\bar{x}, \bar{y}$ for B; define:

$$f(k) = \left| \bar{B}_k - \begin{bmatrix} \bar{x} \\ \bar{y} \end{bmatrix} \right|$$

Then normalize f:

$$f = f / \max(f)$$

Now, get Fourier amplitude:

```
F_amp = abs(fft(f));
```

Keep highest magnitude coefficients:

```
[vals, indexes] = sort(F_amp, 'descend');
Fr = F;
Fr(indexes(51:end)) = 0;
```

Reconstruct curve:

```
fr = real(ifft(Fr));
```

What is shape representation:

To be rotation invariant:

F_s = F_amp.^2; (book)

but may prove difficult.: use F_s = F_amp.j

Use F_s as the shape representation vector

Statistical moments

from statistics, n^{th} moment:

$$m_n = \int_{-\infty}^{\infty} x^n p(x)\,dx$$

m_0 is area $\equiv \int_{-\infty}^{\infty} p(x)\,dx$

m_1 is mean $\equiv \int_{-\infty}^{\infty} x\,p(x)\,dx$

central moments

$$M_n = \int_{-\infty}^{\infty} (x-\mu)^n p(x)\,dx$$

$M_2 = \int_{-\infty}^{\infty} (x-\mu)^2 p(x)\,dx$ is variance

10\5

2D $(p-q)^{th}$ central moment

$$M_{pq} = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} (x-\mu_x)^p (y-\mu_y)^q \, I(x,y)\, dx\, dy$$

to get transform invariance:

$(p-q)^{th}$ normalized central moments

$$\eta_{pq} = \frac{M_{pq}}{M_{00}^{\beta}} \quad \text{where } \beta = \frac{p+q}{2} + 1$$

and $p+q \geq 2$

Seven shape parameters

$\Lambda_1 = \eta_{20} + \eta_{02}$;

$\Lambda_2 = (\eta_{20} - \eta_{02})^2 + 4\eta_{11}^2$;

book errors (see p. 244)

$$\Lambda_4 = (\eta_{30} + \eta_{12})^2 + (\eta_{21} - \eta_{03})^2$$

$$\Lambda_5 = (\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2]$$

+ [illegible]