18/19 3204/6223

Q/1

i). find book. — Template match?
HT lines.

but need speed — thresholding?
— colour

colour difficult. needs calibration.
relative colour is good.

edge detection & colour inside.
largest element in image

ii). find text.
use character recognition (templates
slow).

find material stored in index.
author title

moments fourier descriptors.

iii). don't use text
use interest points SIFT/SURF

& then match

limitations?

standard computer vision

illumination

movement

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2 <u>core principles</u>

first | threshold

adv. simple

disadv. get partial disconnected edges

need to use advanced operators e.g. Canny.

second order | zero X'ing detection

performance/connected edges, filtering.

complexity/speed.

6/. circular edges.

1 HT + edge detection.

2 templates.

3 design an operator

-1	+1	-1
+1	0	+1
-1	+1	-1

-1	-1	+1	-1	
-1	+1	0	+1	
+1	+1	0	+1	+1
	+1	0	+1	+1
-1	-1	+1	-1	-1

needs many templates

4/. look for curved lines.
adjacent points where direction changes slowly.

9/. adv. — speed vs complexity
limitations. vs generality

3

a/. Fourier?

decomposition into frequencies allows understanding / coding.

has properties such as rotation / shift invariance.

allows convolution at speed via FFT

b/. $|F(P(x-\tau, y))| = |e^{-j\omega_x \tau} P(\omega_x, \omega_y)|$

$= |e^{-j\omega\tau}| \, |P(\omega_x, \omega_y)|$

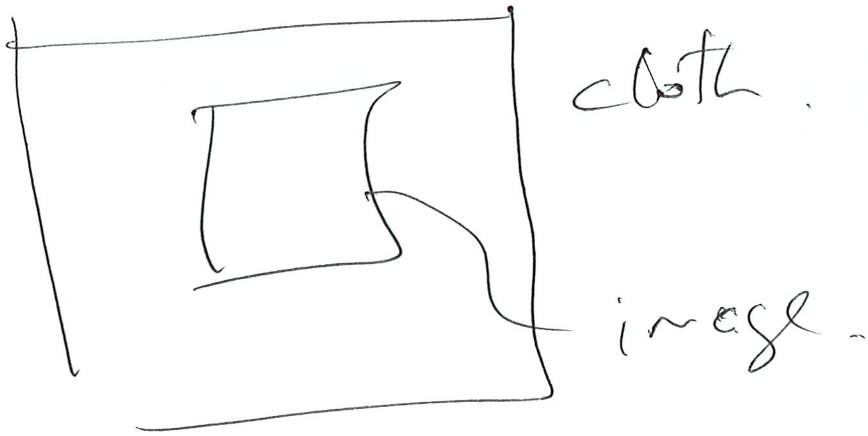
$= 1 \times |P(\omega_x, \omega_y)|$

So shift invariant.

$$F(p) = \sum_i \sum_j e^{-j\frac{2\pi}{N}(ux+vy)} \times P_{i,j}$$

try. $p^T = P_{j,i}$ then $F = F(p^T) = F^T$

c).



cloth can move &

so can camera

& the magnitude stays

the same.

17 - 18

1. Everything — display
— edge detection
— smoothing
— textures

2. notes — focussed response.

1 1

1 2 1 3x1

1 3 3 1

1 4 6 4 1 5x1

$$3\times 3 \quad \begin{pmatrix}1\\2\\1\end{pmatrix}\times\begin{bmatrix}1 & 2 & 1\end{bmatrix} = \begin{pmatrix}1 & 2 & 1\\2 & 4 & 2\\1 & 2 & 1\end{pmatrix}$$

$$e^{-(x^2+y^2)/2\sigma^2} = \begin{bmatrix} e^{-1/2\sigma^2} & 1 & e^{-1/2\sigma^2} \\ \_\_ & & \_\_ \end{bmatrix}$$

use equations

No scaling possible.

One is integer — the other is floating point.

c). changes v little

two template are quite similar.

possibly some high frequency effects from discretisation in the approximation.

Question 3.

(a) **Describe** the difference in principle between first-order and second-order edge detection. **Describe** one approach for either operator.

focussed notes

[12 marks]

(b) **Describe** how zero-crossing detection can be achieved in second-order edge detection.

focussed notes

[15 marks]

(c) **Describe** whether thresholding could be applied to the output of second-order edge detection to avoid the complexity of (b).

[6 marks]