

Finding Objects by Background Removal

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Slide 1/13

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Isolation in Complex Scenes

Threshold problems with image I :

- Many objects
- Space varying illumination

If have constant background image B (ie. before actions)

Try: $thres(| I - B |)$ instead of $thres(I)$

Slide 2/13

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Colour Differencing Example 1

Do in each of 3 colour channels:

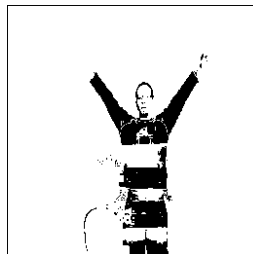
$$thr(| I_r - B_r |) \parallel thr(| I_g - B_g |) \parallel thr(| I_b - B_b |)$$



BACKGROUND



FOREGROUND



DIFFERENCE

Slide 3/13

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Colour Differencing Example 2



Before



After

Subtract prestored background and threshold

Algo: $change = open(2, color(thr(35, abs(Before - After))))$

(Use HS of HSI instead of RGB if illumination changes?)

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Colour Differencing Results 2



Red change



Green change



'OR'ed change



'Open'ed

Slide 5/13

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Coping with Varying Lighting

Use RGB:

$$(r, g, b) \rightarrow \left(\frac{r}{r+g+b}, \frac{g}{r+g+b}, \frac{b}{r+g+b} \right)$$

Double illumination still gives same normalised RGB:

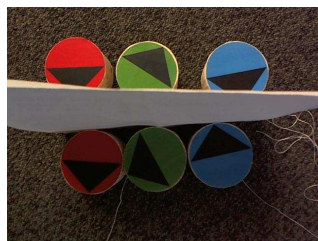
$$\begin{aligned} & \left(\frac{r}{r+g+b}, \frac{g}{r+g+b}, \frac{b}{r+g+b} \right) \\ &= \left(\frac{2r}{2r+2g+2b}, \frac{2g}{2r+2g+2b}, \frac{2b}{2r+2g+2b} \right) \end{aligned}$$

Slide 6/13

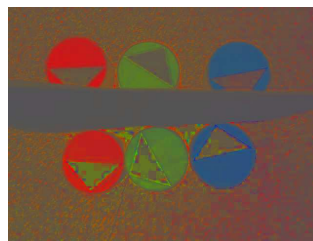
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Normalised RGB Example

Original



Normalised



Reduces effects, too.

Slide 7/13

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Background Ratio Isolation

If but spatially varying illumination

Reflectance: percentage of input illumination reflected. A function of the light source, viewer and surface colors and positions.

Recall:

$$\begin{aligned} \text{background}(r,c) &= \text{illumination}(r,c) * \text{bg_reflectance}(r,c) \\ \text{object}(r,c) &= \text{illumination}(r,c) * \text{obj_reflectance}(r,c) \end{aligned}$$

Slide 8/13

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Background Ratio Isolation 2

Divide to remove illumination:

$$\text{unknown}(r,c)/\text{background}(r,c) =$$

$$1 \quad \text{if unknown} = \text{background}$$

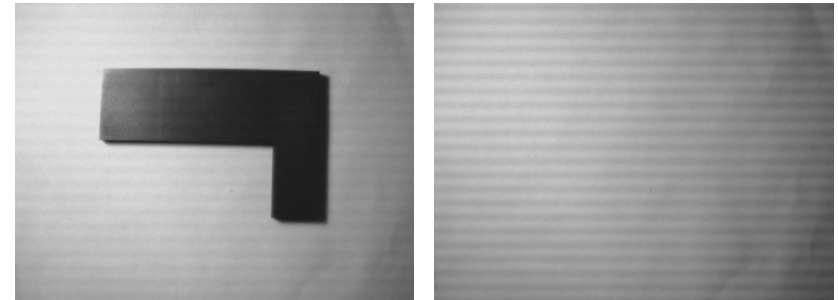
$$\ll 1 \quad \text{if unknown} = \text{dark object}$$

Pick threshold in $[0,1]$ e.g. 0.6

Slide 9/13

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Background ratio results 1



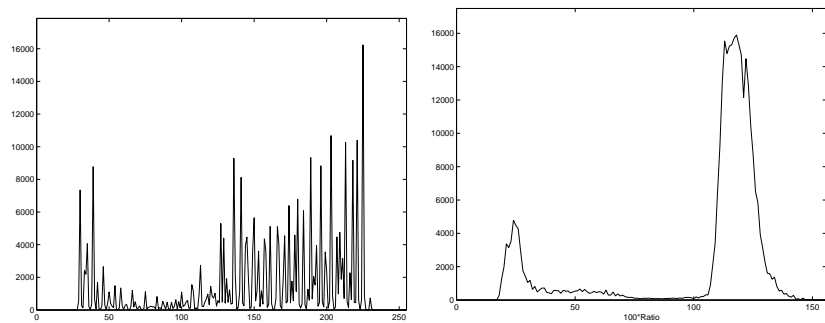
Part

Background

Slide 10/13

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Background ratio results 2



Raw histogram

Ratio histogram

Note ragged raw and smoother ratio histograms

Slide 11/13

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Background removal results 3



Has also included below and right.

Slide 12/13

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Lecture Overview

1. Background subtraction, including colour
2. RGB
3. Ratio with background for varying illumination