Finding Objects by Background Removal

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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: $\text{thres}(|I - B|)$ instead of $\text{thres}(I)$
Colour Differencing Example 1

Do in each of 3 colour channels:

$$\text{thr}(\| I_r - B_r \|) \parallel \text{thr}(\| I_g - B_g \|) \parallel \text{thr}(\| I_b - B_b \|)$$
Colour Differencing Example 2

Before

After

Subtract prestored background and threshold
Algo: change=open(2,coloror(thr(35,abs(Before-After)))))
(Use HS of HSI instead of RGB if illumination changes?)
Colour Differencing Results 2

Red change

Green change

‘OR’ed change

‘Open’ed
Coping with Varying Lighting

Use normalised 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:

\[
\left( \frac{r}{r + g + b}, \frac{g}{r + g + b}, \frac{b}{r + g + b} \right) = \left( \frac{2r}{2r + 2g + 2b}, \frac{2g}{2r + 2g + 2b}, \frac{2b}{2r + 2g + 2b} \right)
\]
Normalised RGB Example

Original

Normalised

Reduces shadow effects, too.
Background Ratio Isolation

If known but spatially varying illumination

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

Recall:

\[ \text{background}(r,c) = \text{illumination}(r,c) \times \text{bg\_reflectance}(r,c) \]
\[ \text{object}(r,c) = \text{illumination}(r,c) \times \text{obj\_reflectance}(r,c) \]
Background Ratio Isolation 2

Divide to remove illumination:
unknown(r,c)/background(r,c) =

1 if unknown = background
<<1 if unknown = dark object

Pick threshold in [0,1] e.g. 0.6
Background ratio results 1

Part

Background
Background ratio results 2

Raw histogram

Ratio histogram

Note ragged raw and smoother ratio histograms
Background removal results 3

Has also included shadow below and right.
Lecture Overview

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