

CSC566: Image Processing

Lab: Colour Image Processing Using MATLAB

Lab Information

Duration: 2 hours

Software: MATLAB with Image Processing Toolbox

Input: Colour images (students may use their own images or MATLAB sample images)

Learning Outcomes

At the end of this lab, students should be able to:

1. Analyse RGB colour channels and histograms.
2. Convert images between RGB, HSV, and Lab colour spaces.
3. Perform colour-based image segmentation using HSV thresholding.
4. Improve segmentation results using morphological operations.
5. Enhance colour images using luminance-based contrast enhancement.

Part 0: Starter Code and Image Setup

Load a colour image and display it. Students may replace the image with their own.

```
clc; clear; close all;

I = imread('peppers.png'); % Replace with your own image
I = im2uint8(I);

figure; imshow(I);
title('Original RGB Image');
```

Part 1: RGB Channel Analysis

Separate the RGB image into its Red, Green, and Blue channels. Display each channel and plot its histogram.

```
R = I(:,:,1);
G = I(:,:,2);
B = I(:,:,3);

figure;
subplot(2,2,1); imshow(I); title('RGB Image');
subplot(2,2,2); imshow(R); title('Red Channel');
subplot(2,2,3); imshow(G); title('Green Channel');
```

```

    subplot(2,2,4); imshow(B); title('Blue Channel');

    figure;
    subplot(3,1,1); imhist(R); title('Histogram of Red');
    subplot(3,1,2); imhist(G); title('Histogram of Green');
    subplot(3,1,3); imhist(B); title('Histogram of Blue');

```

Question:

1. Which RGB channel best highlights the object of interest?
2. What does a wide histogram indicate about image contrast?

Part 2: Colour Space Conversion

Convert the RGB image into HSV and Lab colour spaces and observe each channel.

```

Ihsv = rgb2hsv(I);
H = Ihsv(:,:,1);
S = Ihsv(:,:,2);
V = Ihsv(:,:,3);

figure;
subplot(2,2,1); imshow(I); title('RGB');
subplot(2,2,2); imshow(H); title('Hue');
subplot(2,2,3); imshow(S); title('Saturation');
subplot(2,2,4); imshow(V); title('Value');

Ilab = rgb2lab(I);
L = Ilab(:,:,1);
A = Ilab(:,:,2);
B2 = Ilab(:,:,3);

figure;
subplot(1,3,1); imshow(mat2gray(L)); title('L*');
subplot(1,3,2); imshow(mat2gray(A)); title('a*');
subplot(1,3,3); imshow(mat2gray(B2)); title('b*');

```

Question:

1. Why is HSV more suitable for colour segmentation than RGB?
2. Which Lab channel best represents colour differences?

Part 3: Colour-Based Segmentation Using HSV

Segment a coloured object using HSV thresholding. Example below demonstrates segmentation of a red object.

```

mask1 = (H >= 0.00 & H <= 0.06) & (S >= 0.35) & (V >=
0.20);
mask2 = (H >= 0.90 & H <= 1.00) & (S >= 0.35) & (V >=
0.20);
mask = mask1 | mask2;

figure; imshow(mask);
title('Initial Segmentation Mask');

Iseg = I;
Iseg(repmat(~mask,[1 1 3])) = 0;

figure; imshow(Iseg);
title('Segmented Object');

```

Part 4: Mask Refinement Using Morphology

Improve the segmentation mask using morphological operations.

```

mask_clean = bwareaopen(mask, 200);
mask_clean = imclose(mask_clean, strel('disk', 6));
mask_clean = imopen(mask_clean, strel('disk', 4));
mask_clean = imfill(mask_clean, 'holes');

figure;
subplot(1,2,1); imshow(mask); title('Before Cleaning');
subplot(1,2,2); imshow(mask_clean); title('After
Cleaning');

Iseg2 = I;
Iseg2(repmat(~mask_clean,[1 1 3])) = 0;

figure; imshow(Iseg2);
title('Final Segmented Image');

```

Part 5: Colour Image Enhancement

Enhance image contrast by modifying only the luminance component to avoid colour distortion.

```

V2 = adapthisteq(V);
Ihsv2 = cat(3, H, S, V2);
I_enh = hsv2rgb(Ihsv2);

```

```
figure;
subplot(1,2,1); imshow(I); title('Original');
subplot(1,2,2); imshow(I_enh); title('Enhanced Image');
```

Submission Requirements

Students must submit:

1. A 2–3 page report including screenshots of results and answers to questions.
2. A MATLAB (.m) file with commented code.

Assessment Rubric (10 Marks)

RGB analysis and histograms (2 marks)

Colour space conversion (2 marks)

Colour-based segmentation (2 marks)

Morphological refinement (2 marks)

Colour enhancement and discussion (2 marks)