Digital Image Processing-Assignment 05

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I. 實驗說明

Implement Kapur's Entropy Thresholding on Lena. Compare the segmentation result to Otsu's one.

II. 程式碼

Otsu's 來源：https://www.mathworks.com/matlabcentral/fileexchange/51297-image-segmentation-using-otsu-method

```
%% ISP Lab 9 Otsu Thresholding
% AliArshad Kothawala
% 7/04/15
close all;clear all;clc

I=imread('lena.tif'); % Read the Image
figure(1),imshow(I); % display the Original Image
figure(2),imhist(I); % display the Histogram

n=imhist(I); % Compute the histogram
N=sum(n); % sum the values of all the histogram values
max=0; %initialize maximum to zero

for i=1:256
    P(i)=n(i)/N; %Computing the probability of each intensity level
end

for T=2:255      % step through all thresholds from 2 to 255
    w0=sum(P(1:T)); % Probability of class 1 (separated by threshold)
    w1=sum(P(T+1:256)); %probability of class2 (separated by threshold)
    u0=dot([0:T-1],P(1:T))/w0; % class mean u0
    u1=dot([T:255],P(T+1:256))/w1; % class mean u1
    sigma=w0*w1*((u1-u0)^2); % compute sigma i.e variance(between class)
    if sigma>max % compare sigma with maximum
        max=sigma; % update the value of max i.e max=sigma
        threshold=T-1; % desired threshold corresponds to maximum variance of between class
    end
end

threshold
bw=im2bw(I,threshold/255); % Convert to Binary Image
figure(3),imshow(bw); % Display the Binary Image
imwrite(bw, 'otsu.jpg');
```

Kapur's 來源：https://www.mathworks.com/matlabcentral/fileexchange/74468-image-thresholding-otsu-method-and-kapur-method

```
function imagBW = kapur(imag)

imag = imag(:, :, 1); % gray image
counts = imhist(imag);  % counts are the histogram
GradeI = 256;    % the resolusion of the intensity. i.e. 256 for uint8.
% MIN = 1e-7;

prob = counts ./ sum(counts);  % Probability distribution

psai = zeros(GradeI, 1);
prob_t = 0;
entropy_t = 0;

ind = find(prob);
entropy_L = sum( prob(ind) .* log(prob(ind)) ) * (-1);

for i = 0 : GradeI-1
    prob_t = prob_t + prob(i+1);

    if prob(i+1) > 0 && prob_t < 1
        entropy_t = entropy_t - prob(i+1) * log(prob(i+1));
```

```
        psai(i+1) = log(prob_t * (1-
            prob_t)) + entropy_t / prob_t
            + ...
             (entropy_L-entropy_t) / (1-
                prob_t);
    elseif (prob(i+1) == 0 && i > 0)
        psai(i+1) = psai(i);
    end
end

[maxPsai, ind] = max(psai);
th = (ind - 1) / (GradeI -1);
imagBW = im2bw(imag, th);
```

III. 成果

Fig. 1. lena

Fig. 2. lena after Otsu's Entropy Thresholding

Fig. 3. lena after Kapur's Entropy Thresholding

IV. 比較

Otsu's Entropy Thresholding 得出的 threshold 比 Kapur's 低，因此 Otsu's 圖片呈現較明亮。