NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

School of Science

Information Technologies in Medicine and Biology

Direction: *Bioinformatics*

Image Processing and Analysis

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Deadline Date: *12/04/2013*

Assignment 3

Task 1

In the first task of our assignment we were asked to get the transformation of Hough Tr with its 5 points given from the classnotes (P1, P2, P3, P4, P5) and compute the coordinates ρ and θ for the lines P1P2, P1P3 and P1P4.

So we did, we know that for every point (x, y) in the Cartesian plane we relate the consonant curve xcos(θ)+ysin(θ) = ρ in one plane (ρ,θ). All the points of a line with polar parameters (ρ',θ') correspond to consonant curves that all intersect in the same point (ρ', θ').

In Figure 1, for the lines P1P2, P1P3 and P1P4 there are quoted consonant curves and as a result the point of intersection (ρ, θ) of the consonant curves is the point requested in this task.

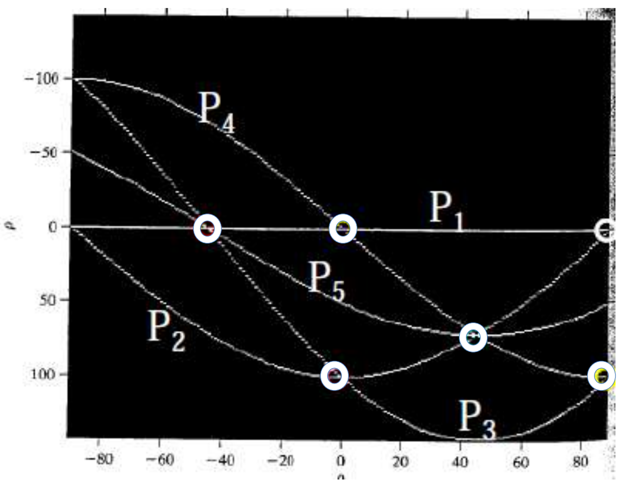

Figure 1: consonant curves and points of intersection

Responsively to the above, for the computation of the above coordinates ρ, θ of the above line we have:

- P1P2 :
  - (ρ, θ) = (0,0)
- P1P3 :
  - (ρ, θ) = (0,-45)
- PIP4 :
  - (ρ, θ) = (0,90)

Task 2

As a second task of our assignment we were asked to define a transformation which will reveal circles with a constant radius of $R_0=2$.

So, the requested transformation should be based on the formula:

$$(x-x_0)^2+ (y-x_0)^2=R_0^2$$

And as a result the requested transformation corresponds to the formula:

$$(x-x_0)^2+ (y-x_0)^2 = 4$$

So, we conclude that 3 or more regions in space (x,y) with one common point, the (x_0,y_0) indicate the possible existence of a circumference with the above folmula

Task 3

As a third task of our assignment we were asked to study and execute the example code given and write down our conclusions.

To start with, the H_T_3.m source file describes the creation and the projection of the Hough transformation. More specifically, it loads and read an image and at the follow it detects edges using the Canny formula. After that the transformation is applied on the image, and at the end it depicts the transformed image as shown in Figure 2.

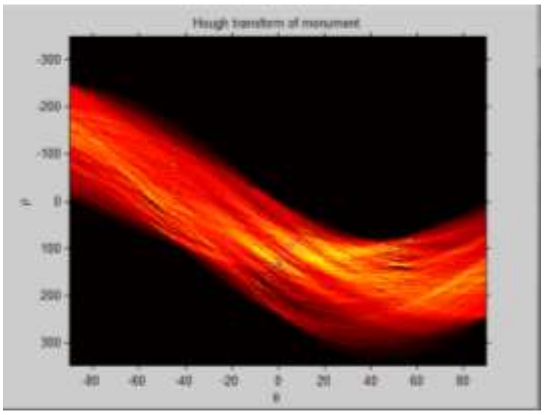

Figure 2: Transformated image with Canny formula applied

In the next source file H_T_3a.m we apply the command for finding Hough peaks which detects the cell with the biggest content, and sets all the surrounding cell of the neighborhood in zero. This formula is repeated until it finds the max set number of peaks which pass the threshold that has been set. If a threshold has not been applied in the routine called, then by default a threshold of ceil(0.5*max(H(:))) is set and the number of peaks is set to 2. Figure 3 shows the final result.

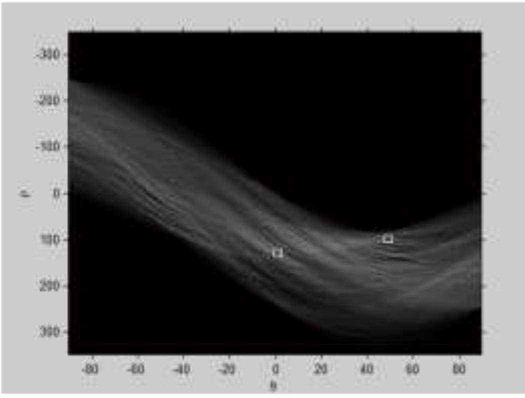

Figure 3: The 2 hough peaks after applying the above threshold

The final source file H_T_4.m shows how to emphasize the structure of Hough Transformation and to transact the detection of critical lines in an image. Specifically, the image is rotated so that the critical lines are not parallel with the axons. Then, image edge detection is applied using the Canny formula and the Hough transformation. Finally, as the last step, a threshold and a max number of peaks is applied using houghpeaks formula, in our case for finding 3 peaks. The resulted depicts are shown in Figure 4 and Figure 5.

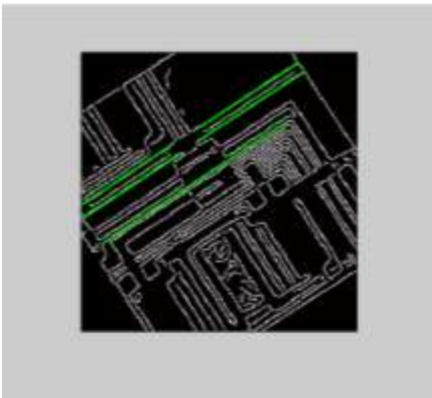
Figure 4: Resulted from Canny formula and Hough transformation

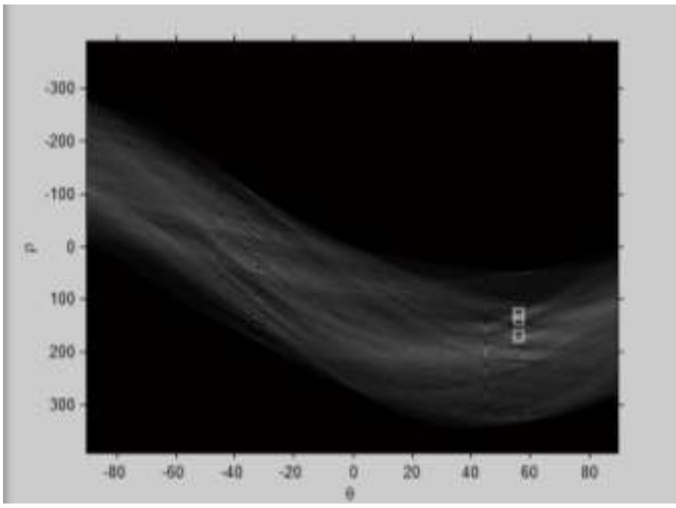

Figure 5: Resulted from Canny formula and Hough transformation

Task 4

In the final task of our assignment we were asked to implement a program that will detect the lines of the chess grid.

So, as it is asked in this exercise, the basic steps followed in order to find the lines of the grid in the chess image are:

1. Edge detection using Canny formula and specific arguments as shown in Appendix (BW = edge(I, ’canny’, [0.1,0.2], 2.7)). We chose as the last parameter the number 2.7, as it provided as with the best results. In this way, we ensure that the edge signal will not show edges from the image background. For example have a look in Figure 6 and Figure 7. Figure 6 is provided with the last parameter equal 2 and Figure 3 is provided with the last parameter equal 2.7.

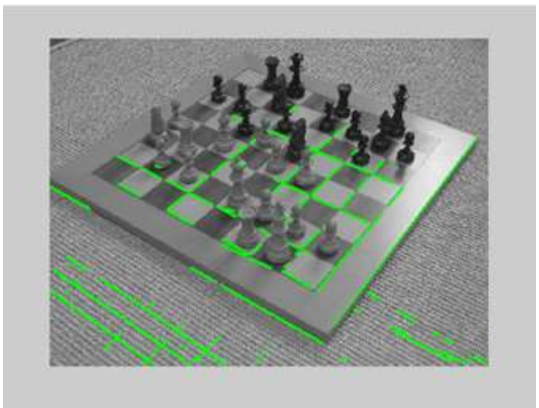
Figure 6: Line edges given a parameter of 2

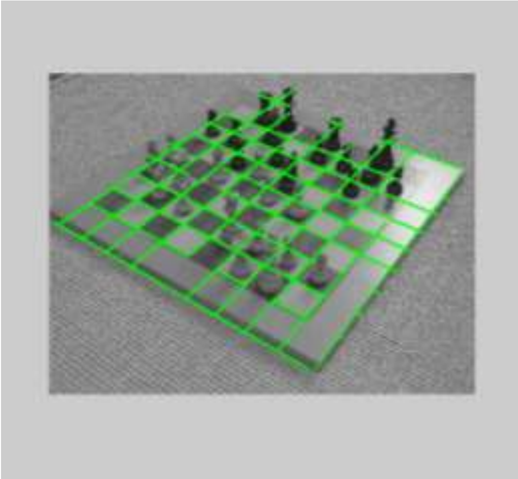
Figure 7: Line edges given a parameter of 2.7

2. Creation of Hough Trasformation for the edge image created previously ([H,T,R] = hough(BW)).
3. Use of the houghpeaks routine, so that to select 20 points from the Hough transformation. We concluded to use 20 peak points after several tryouts. We also altered the FillGap of the houghlines function from 5 to 50. So finnaly, with these peaks we carved the chess grid in the initial image.

APPENDIX

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Author: Begetis Nikolaos-Postgraduate Student- Bioinformatics,ITMB
%% Supervisor: Sangriotis Manolis - Professor - ITMB
%% Course: Image Processing and Analysis
%% Filename: chess_nbegetis.m
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% A program to demonstrate the formation & display of Hough Transform
function []=chess_nbegetis()

clear *;clc;
close all;

I  = imread('chesimage.png');

% Evaluate the edge image (black-white)
BW = edge(I,'canny' ,[0.1,0.2],2);
% no carpet edges from the background are detected.
% These argument values were given in problem definition.

figure;imshow(BW,[]);
[H,T,R] = hough(BW);

Hneg=max(H(:))-H;% Use of Hneg for display and printing so that
% printer's ink is not wasted.

figure
imshow(Hneg,[0,max(H(:))],'XData',T,'YData',R,'InitialMagnification',
'fit');
% The value 0.3*max(H(:)) has been decided by trial end error, so
% that an image to be formed on the monitor with clear the Hough
% buterflies (points).

xlabel('\theta'), ylabel('\rho');
axis on, axis normal, hold on;
% In the displayed image please notice the butterflies  on the two
% lines. These ones correspond to the parallel lines of the
% chessboard.

P  = houghpeaks(H,30,'threshold',0.12*max(H(:)));% The values of
'threshold'
% have been decided by trial and error so that as many as possible
% butterflies in H-image are marked.  Be Careful! if possible
% only butterflies in the two lines to be marked if possible.


x = T(P(:,2)); y = R(P(:,1));
plot(x,y,'s','color','k');
% Find lines and plot them
lines = houghlines(BW,T,R,P,'FillGap',100,'MinLength',8);
% The values of parameters

figure, imshow(I), hold on
max_len = 0;
for k = 1:length(lines)
```

```
    xy = [lines(k).point1; lines(k).point2];
    plot(xy(:,1),xy(:,2),'LineWidth',2,'Color','green');

end

end
```