CSE 5524 - Homework #3
09/23/2013
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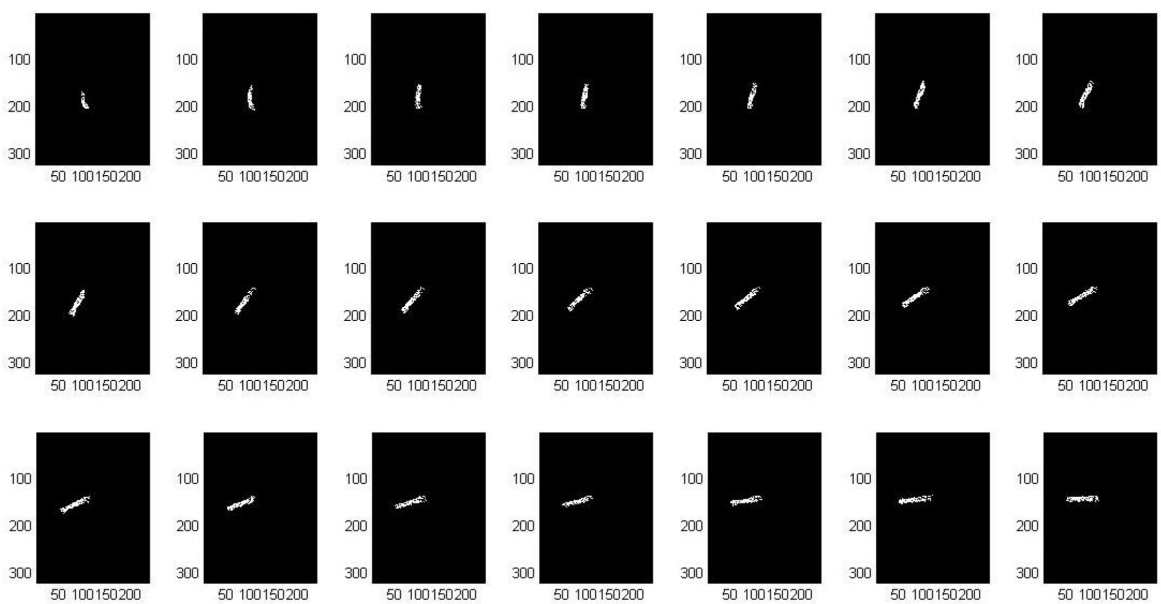
1). Using the images (aerobic2.[001-022].bmp) provided on the class WWW site, compute simple motion detection between consecutive frames using (abs) image differencing. Remove any tiny regions (use bwareaopen, median filtering, etc.). Experiment with different thresholds.

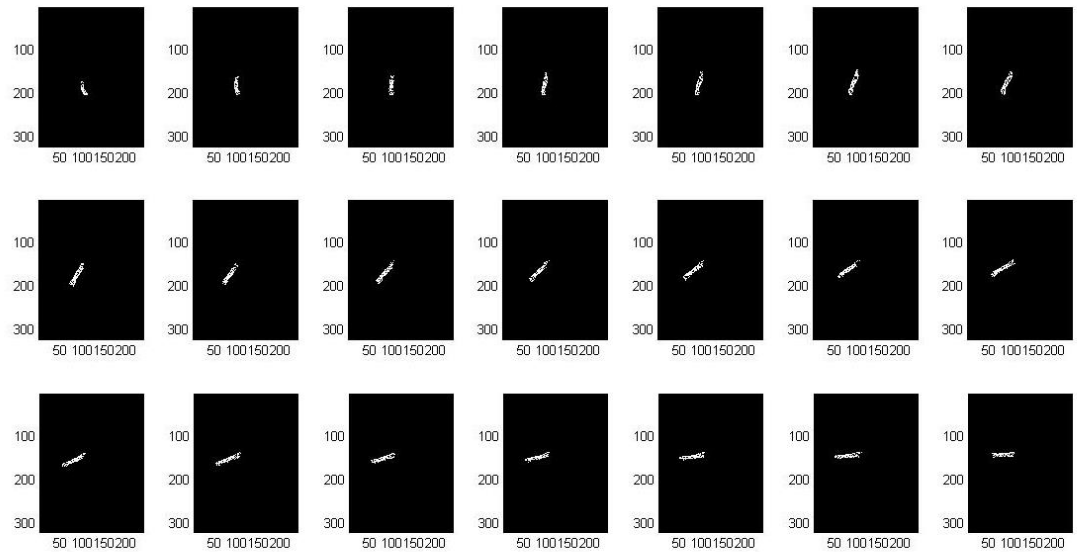
- Computed image difference using a combination of threshold and bwareaopen function values
- Removed the slight motion in the head and other body while thresholding and got just the major motion - that of the hand
- Checked at threshold = 10(bwareaopen function value =140)
- Checked at threshold = 15(bwareaopen function value =140)
- Checked at threshold = 20(bwareaopen function value =80)
- Best output in my opinion was achieved when I used a combination of threshold of 15 and bwareaaopen function value of 140

Output

Threshold =10, bwareaopen(140)



threshold =15,bwareaopen(140)



2). Compute an MEI and MHI on the image sequence (using the best motion differencing approach from step 1 above), simulating the timestamp with the frame number of each image. Choose a duration that includes all images of the sequence into the final template. Use imagesc to show your results. Compute the 7 similitude moments for the MEI and the MHI and compare (normalize the MEI and MHI to be between 0-1 before computing the moments).

- Computed the MHI using frame number as the timestamp
- Changed value of duration factor. Effect was just as expected. Shorter span of the motion was captured by the MHI when delta value was decreased
- To include all images of the sequence, duration was set to number of images which came from image differencing = 21 (First image is Frame 1)
- Computed MEI by thresholding MHI
- Output vector N for moments is of the form [n_{02} n_{03} n_{11} n_{12} n_{20} n_{21} n_{30}]. The similitude moments give a measure of the spread of the object under consideration while weighting the rows and columns in different combinations
- No moment was 0 in either of the images since none of them have any symmetry like the box in the previous assignment
- Comparing the moment values of MEI and MHI, for delta = 10, these values were almost identical (not considering the very slight deviation). In fact, the lower the value of delta the lesser this deviation becomes. This is because as we reduce delta, the images MEI and MHI get more similar to each other
- As we increase the delta value, the deviation in moment values for MEI and MHI increases
- For delta=21, the absolute values of all similitude moments except n_{11},n_{30} were *slightly* greater for the MHI image. For n_{11},n_{30}, sign was reversed

<u>**Output**</u>

<u>At delta = 10</u>

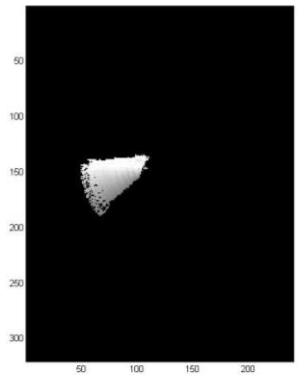


Figure 1: Motion History Image

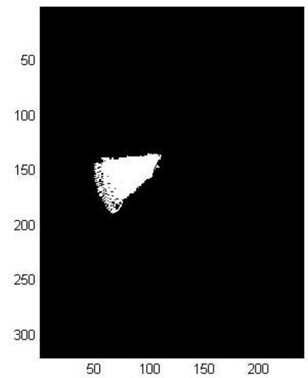


Figure 2: Motion Energy Image

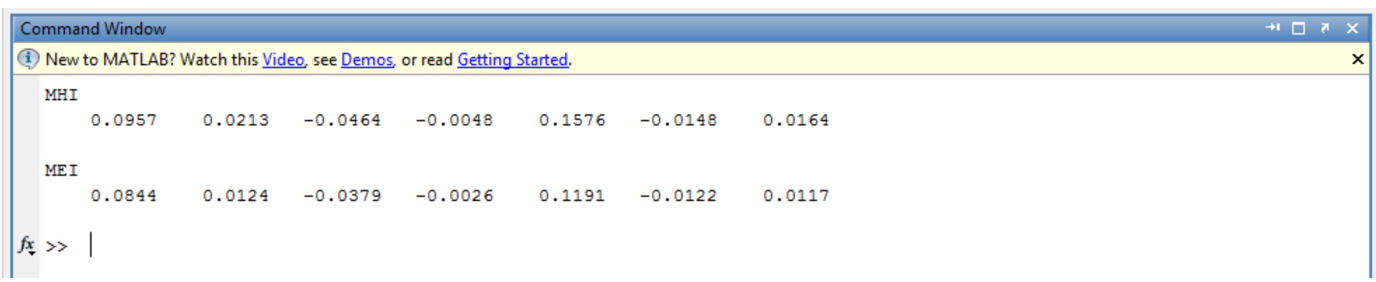


Figure 3: Moments

<u>At delta=21</u>

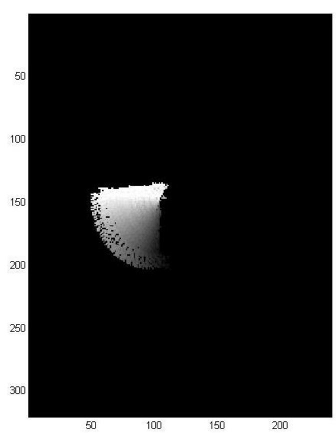


Figure 4: Motion History Image

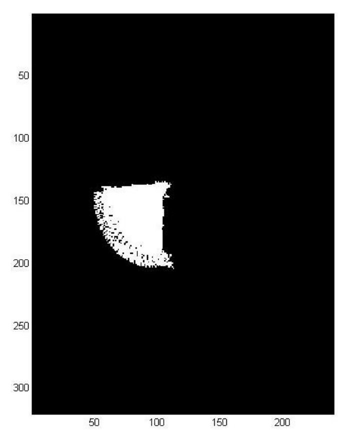
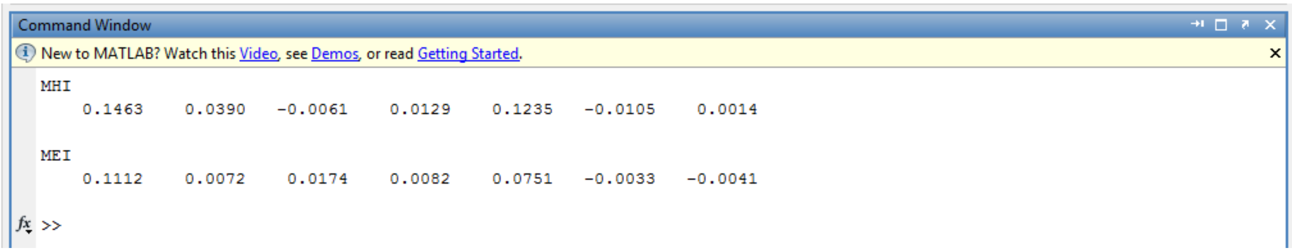


Figure 5: Motion Energy Image



```
Command Window
New to MATLAB? Watch this Video, see Demos, or read Getting Started.
MHI
    0.1463    0.0390   -0.0061    0.0129    0.1235   -0.0105    0.0014

MEI
    0.1112    0.0072    0.0174    0.0082    0.0751   -0.0033   -0.0041

fx >>
```

Figure 6: Moments

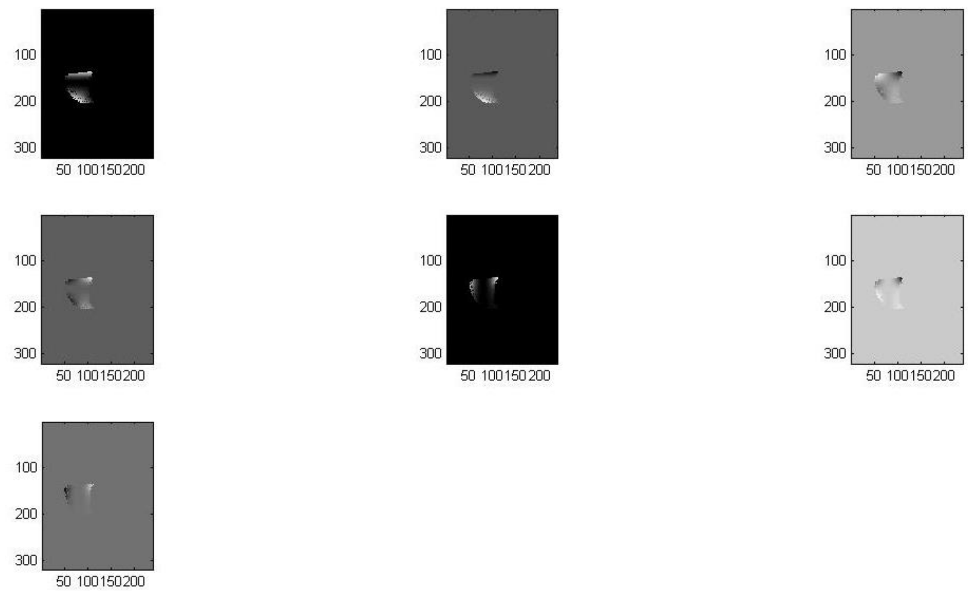


Figure 7: MHI moments

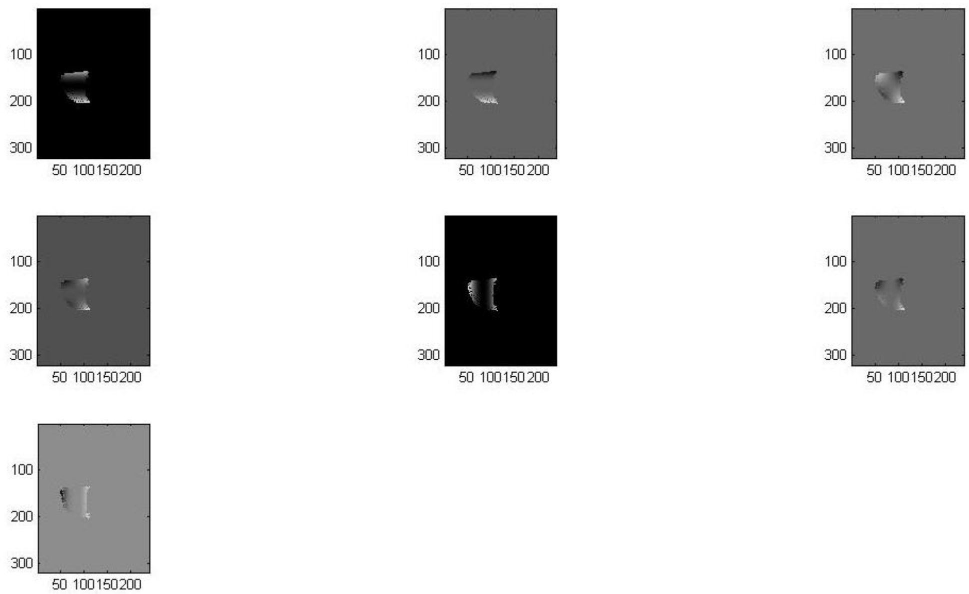


Figure 8: MEI moments

3). Create a 100x100 binary image with a black (0) background and a white (255) 21x21 box centered in the image. Create a new "box" image, but shift the box 1-pixel to the right and 1-pixel down. Compute the normal flow between the images. Use MATLAB's quiver function to draw the vector motions. (Make sure your axes are consistent for the plots – examine 'axis(ij)'.) Make sure all masks are "correct" with proper scaling/normalization. Is the result what you expected?

- The actual output wasn't as expected
- In theory, since we are trying to get the motion of each pixel, the vectors should be pointing in direction of motion (which in this case would be something like in the south-east direction)
- However, the vectors point towards the east along the rows and to the south along the columns
- Also at the corner pixels of the square, the vectors aren't exactly pointing horizontal or vertical. They had an angle associated with them

Output

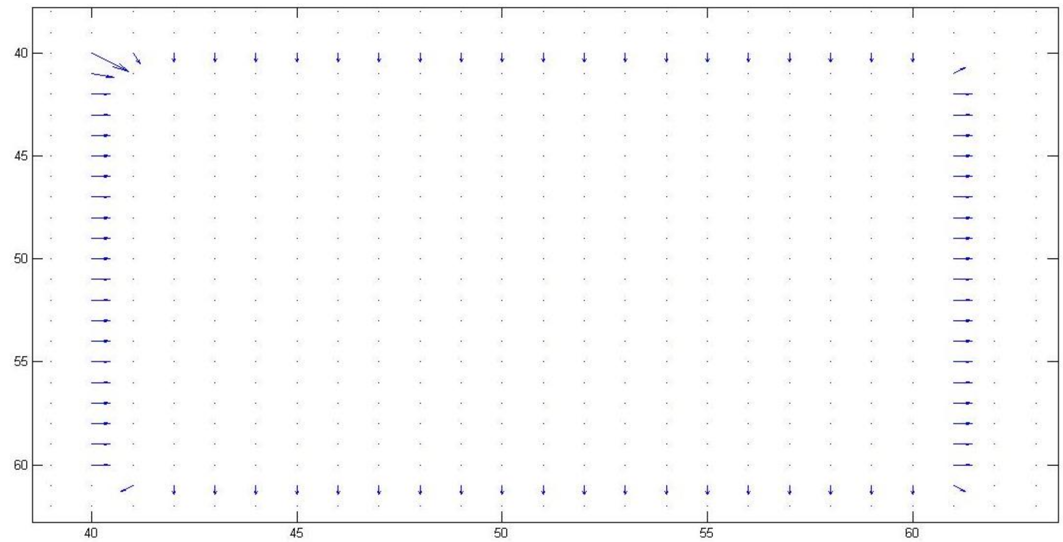


Figure 9: Motion Vector Plot

CODE

1). normalize.m function

```
function [ I ] = normalize( Im )
%Normalize Im to [0-1] and return normalized image
for i=1:size(Im,1)
    for j=1:size(Im,2)
        I(i,j)  = (Im(i,j) - min(min(Im)))/(max(max(Im))-min(min(Im)));
    end
end
```

2) HW4.m script

```
% Manjari Akella
% CSE5524 - HW4
% 09/23/2013

mkdir('Output');

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Question 1
clear all;
close all;
clc;
N=22;
for  i=1:N
filename = sprintf('given_pics/aerobic2.%03d.bmp', i);
Im(:,:,i) = double(imread(filename));
```

```matlab
end
figure('Name','Q1: Image Differencing','NumberTitle','off');
for i=2:N
    I(:,:,(i-1)) = abs(Im(:,:,i)-Im(:,:,i-1))>15;
    diff_I(:,:,(i-1)) = bwareaopen(I(:,:,(i-1)),140);
    imwrite(diff_I(:,:,(i-1)),strcat('Output/diff_I',num2str(i-1),'.bmp'));
    subplot(3,7,i-1),imagesc(diff_I(:,:,(i-1)));
    colormap('gray');
    axis('image');
end
pause;

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Question 2
% Compute Motion History Image
MHI = zeros(320,240);
for i=2:N
    MHI(diff_I(:,:,i-1)~=0)=(i-1);
    MHI(MHI<((i-1)-21))=0;
end
figure('Name','Q2: Motion History Image','NumberTitle','off'),imagesc(MHI);
colormap('gray');
axis('image');

% Compute Motion Energy Image
MEI = MHI>0;
figure('Name','Q2: Motion Energy Image','NumberTitle','off'),imagesc(MEI);
colormap('gray');
axis('image');

% Normalize Motion History Image
NMHI = normalize(MHI);

% Find out the seven moment descriptors for NMHI
n02 = similitudeMoments(NMHI,0,2);
n03 = similitudeMoments(NMHI,0,3);
n11 = similitudeMoments(NMHI,1,1);
n12 = similitudeMoments(NMHI,1,2);
n20 = similitudeMoments(NMHI,2,0);
n21 = similitudeMoments(NMHI,2,1);
n30 = similitudeMoments(NMHI,3,0);
fprintf('MHI\n');
N = [n02, n03, n11, n12, n20, n21, n30];
disp(N);

% Find out the seven moment descriptors for MEI
n02 = similitudeMoments(MEI,0,2);
n03 = similitudeMoments(MEI,0,3);
n11 = similitudeMoments(MEI,1,1);
n12 = similitudeMoments(MEI,1,2);
n20 = similitudeMoments(MEI,2,0);
n21 = similitudeMoments(MEI,2,1);
n30 = similitudeMoments(MEI,3,0);
fprintf('MEI\n');
N = [n02, n03, n11, n12, n20, n21, n30];
disp(N);
```

```
pause;

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Question 3
clear all;
close all;
clc;
Im1 = double(imread('my_pictures/box.bmp'));
Im2 = double(imread('my_pictures/box_shifted.bmp'));
%Set up filters
fx_s = (-fspecial('sobel')')/8;
fy_s = (fx_s)';
%Run filters on Image at time t
fx = imfilter(Im2,fx_s,'replicate');
fy = imfilter(Im2,fy_s,'replicate');
figure('Name','Q3: Filtered Image x-
gradient','NumberTitle','off'),imagesc(fx);
colormap('gray');
axis('image');
figure('Name','Q3: Filtered Image y-gradient
','NumberTitle','off'),imagesc(fy);
colormap('gray');
axis('image');
% Compute ft
ft = Im2-Im1;
t = fx.^2+fy.^2;
d = sqrt(t);
% Compute vectors
for i=1:100
    for j=1:100
        if(d(i,j)~=0)
            u(i,j) = (-ft(i,j)/d(i,j))*(fx(i,j)/d(i,j));
            v(i,j) = (-ft(i,j)/d(i,j))*(fy(i,j)/d(i,j));
        else
            u(i,j) = 0;
            v(i,j) = 0;
        end
    end
end
figure('Name','Q3: Motion vector plot','NumberTitle','off'),quiver(u,v);
axis('ij');

%%%%%%%%%%%%%%%%%%%%%% END %%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```