Oblig2 INF4300

mathiaki

14. november 2017

Innhold

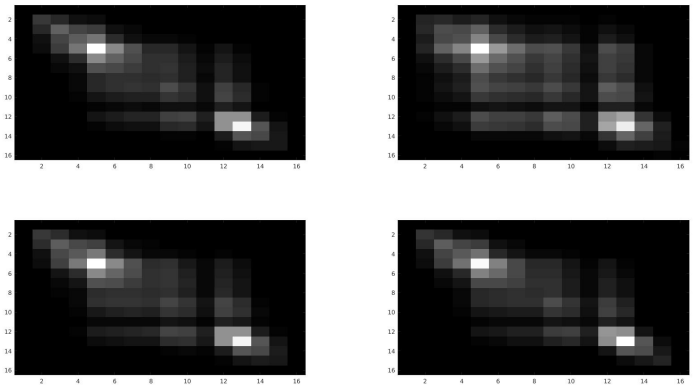
1 Texture description

The first thing to do in this mandatory assignment was to find the best GLCM for all 3 of the textures. In the last assignment our job was to find these matrices, but this time we already have the finished glcm matrices.

With the finished GLCM matices, we can now get the feature images for the different orientations.

1.1 Matrix data

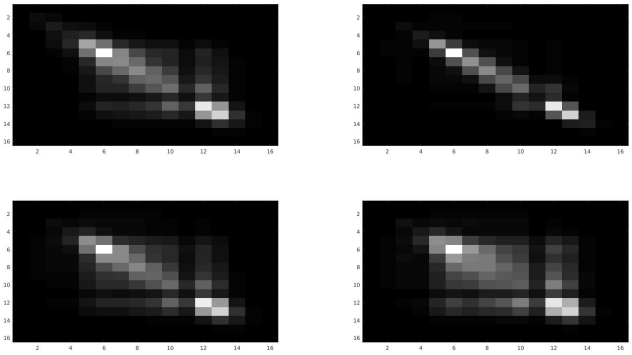
from the files included we get this result for the 4 different textures:



(a) Texture 1

Figur 1: Texture 1 GLCM

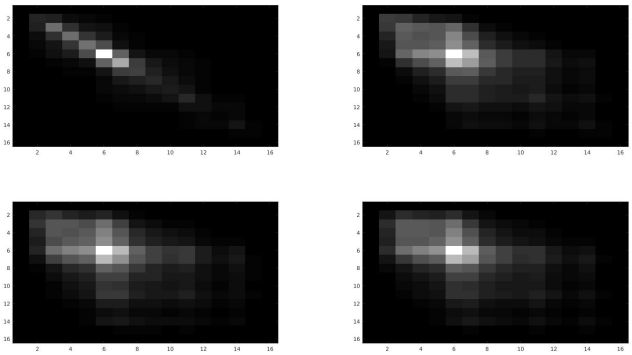
From this first texture we choose the first of the 4 images.
This corresponds to dx=0 dy=1



(a) Texture 2

Figur 2: Texture 2 GLCM

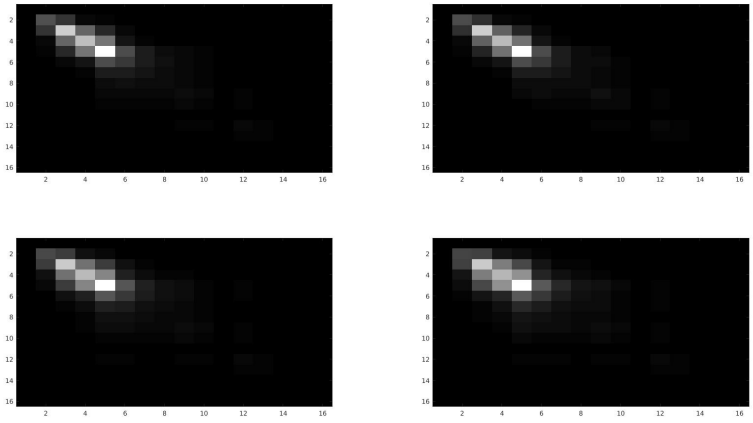
From this first texture we choose the first of the 4 images.
This corresponds to dx=1 dy=0



(a) Texture 3

Figur 3: Texture 3 GLCM

From this first texture we choose the first of the 4 images.
This corresponds to dx=0 dy=-1



(a) Texture 4

Figur 4: Texture 4 GLCM

From this first texture we choose the first of the 4 images.
This corresponds to dx=0 dy=-1
Now that we have all the necessary dxy values, we can now start with the sliding GLCM part of the program.

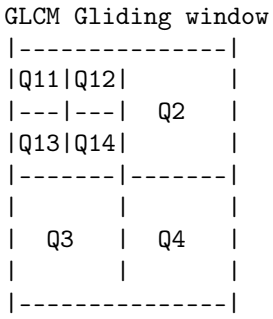
From this point onwards we stop using the GLCM matrices from the assignment, and start making and using our own:

```
function glcm = GLCM(img, G, dx, dy)
% at this pont in the process this function was not self-made.
% Heavy inspiration for Kristoffer Hoisaeter, since he did the first
% obligatory assignment in MATLAB, and I made my gliding window in python.


%size of image
[M,N] = size(img);


W = 1./((M-dx)*(N-dy));
glcm = zeros(G);

%going through and counting
for i=1:M
    for j=1:N
        %making sure the indexes does not exceed matrix dimensions
        if j + dy < 1 || j + dy > N || i + dx < 1 || i + dx > M
            continue
        else
            a = img(i,j);
            b = img(i+dx,j+dy);
            glcm(a+1,b+1) = glcm(a+1,b+1) + 1;
        end
    end
end

%symmetric and normalized
glcm = glcm + glcm';
glcm = glcm./sum(sum(glcm));
%glcm = W*glcm;
```

An important note here is that the GLCM is going to be symmetric, so Q2 and Q3 will be (close to) identical every time.

2 Quadrant and sliding

With the GLCM matrices from assignment 1 we can now divide the each of the GLCM matrices in to 4 parts:



Figur 5: GLCM Gliding matrix

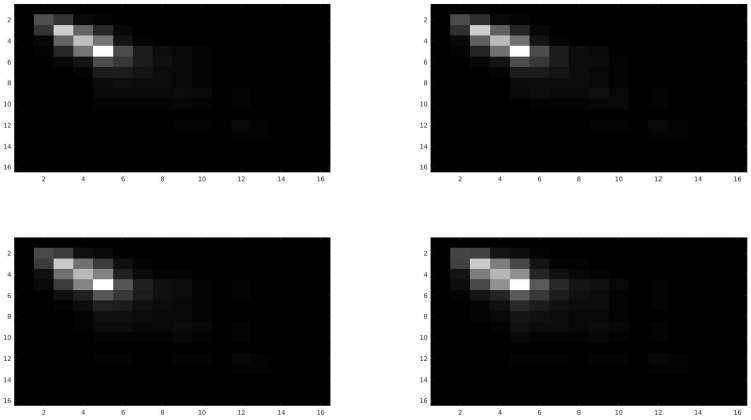
When we now run the gliding GLCM the result of the different quadrants are stored in the respective variables. As shown in 5.

As the Q1 quadrant has the most difference between the different textures, it is natural to spit the quadrant up in to 4 subquadrants.

```
function [Q1,Q2,Q3,Q4,Q11,Q12,Q13,Q14] = gGLCM(img, G, dx, dy,
    window)
% at this pont in the process this function was not self-made.
% Heavy inspiration for Kristoffer Hoiseter, since he did the first
% obligatory assignment in MATLAB, and I made my gliding window in
    python.


[M,N] = size(img);
halfW = floor(window/2);

%expanding the image with a border
imgBorder = zeros(M+window-1, N+window-1);
imgBorder(halfW+1:end-halfW,halfW+1:end-halfW) = img;

%size of the new image
[Mborder, Nborder] = size(imgBorder);

i = repmat((0:(G-1))', 1, G);
j = repmat((0:(G-1)), G, 1);


Q1 = zeros(M,N);
Q2 = zeros(M,N);
Q3 = zeros(M,N);
Q4 = zeros(M,N);

%spitting the top left quadrant in 4, because the action is
    happening here
```

```
Q11 = zeros(M,N);
Q12 = zeros(M,N);
Q13 = zeros(M,N);
Q14 = zeros(M,N);


%going through the image
for m = 1+halfW:Mborder-halfW-1
    for n = 1+halfW:Nborder-halfW-1

        win = imgBorder(m-halfW:m+halfW, n-halfW:n+halfW);

        p = GLCM(win,G,dx,dy);

        Q1(m-halfW,n-halfW)=sum(sum(p(1:G/2,1:G/2)))/sum(sum(p));
        Q2(m-halfW,n-halfW)=sum(sum(p(1:G/2,G/2:G)))/sum(sum(p));
        Q3(m-halfW,n-halfW)=sum(sum(p(G/2:G,1:G/2)))/sum(sum(p));
        Q4(m-halfW,n-halfW)=sum(sum(p(G/2:G,G/2:G)))/sum(sum(p));

        Q11(m-halfW,n-halfW)=sum(sum(p(1:G/4,1:G/4)))/sum(sum(p));
        Q12(m-halfW,n-halfW)=sum(sum(p(1:G/4,1+G/4:G/2)))/sum(sum(p
    ));
        Q13(m-halfW,n-halfW)=sum(sum(p(1+G/4:G/2,1:G/4)))/sum(sum(p
    ));
        Q14(m-halfW,n-halfW)=sum(sum(p(1+G/4:G/2,1+G/4:G/2)))/sum(
    sum(p));


    end


end
end
```

The Q matrices can now be analyzed:



(a) Texture 4

Figur 6: Texture 4 GLCM

3 Multivariate Gaussian Classifier

After we got the GLCM matrix for the 3 different values, our next next task is to use a Multivariate Gaussian Classifier to try to classify the 4 patterns.

The formula for Multivariate Gaussian Classifier (in multiple dimensions) is:

$$p(x|\mu, \sum) = \frac{1}{(2\pi)^{\frac{d}{2}}} exp\left(-\frac{1}{2}(x-\mu)^T \sum^{-1}(x-\mu)\right)$$