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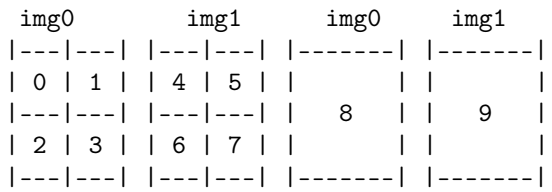
1 Texture description

In this part of the report I will try to analyze the different textures. I will go through every sub-texture and give a description based on: Characteristics, Texture direction, frequency of the texture, variance of the texture, homogenity, and the size of the texture elements.

Before i describe the different textures, i will index the different images in the following way: (the same is true for the program)



Figur 1: Order of analyze

This means i will start in the top left corner of mosaic1 and and in the bottom right corner of mosaic2.
In the program 8 and 9 is reserved for the whole mosaic1 and mosaic2 respectively.

1.0 Texture 0

Characteristics:
Texture is mainly random noise. Somewhere in the texture you get some patters that looks like holes.

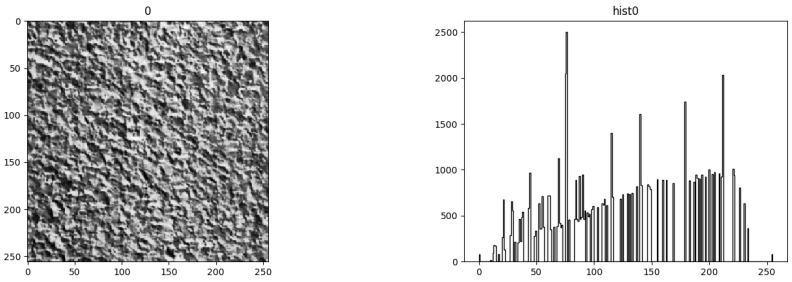
Texture Direction
There are a slight movement in the $\frac{3\pi}{4}$ rad direction, and as mentioned, some circular patterns can be observed.

Frequency
The crevasses is on a rough average 10px in diameter, and the edges between them is closer to 4px.

Variance
If we look at the histogram, we can see that it is one of the textures with the least variance. We do have some peaks int the histogram that drives down the variance a bit

Homogeneity
The texture is has very few homogeneous areas.

Texture element size
As mentioned, the texture is very like random noise, so the size is hard to determine. If we think of the elements as the crevasses, the texture element size is a few pixels.



(a) Texture 0

(b) Histogram of Texture 0 0

Figur 2: Texture with histogram

1.1 Texture 1

Characteristics:
Texture has a clearer pattern of squares that is roughly 8 px wide and high. It is also some random noise in the top left corner of the texture.

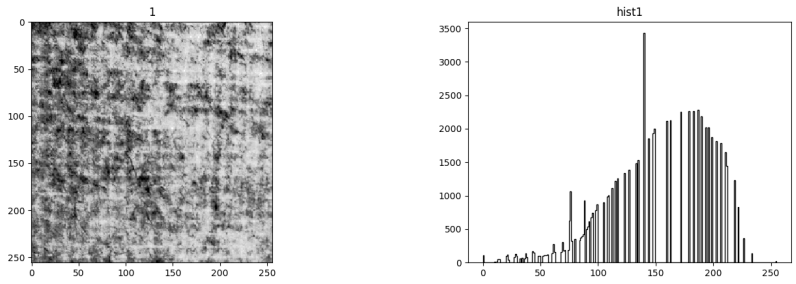
Texture Direction
The texture direction is almost horizontal (and vertical), with a slight angle clockwise.

Frequency
The frequency of the squares are approximately 1/40. Since there are that many repetitions in the image.

Variance
The histogram is fairly balanced, so the variance is in the middle if the spectrum. Especially compared to 4

Homogeneity
The texture is has no big homogeneous areas.

Texture element size
As mentioned, the squares has a diameter of approximatively 7 px.



(a) Texture 1 (b) Histogram of Texture 1

Figur 3: Texture with histogram

1.2 Texture 2

Characteristics:
The texture is a series of lines that face in roughly the same direction.

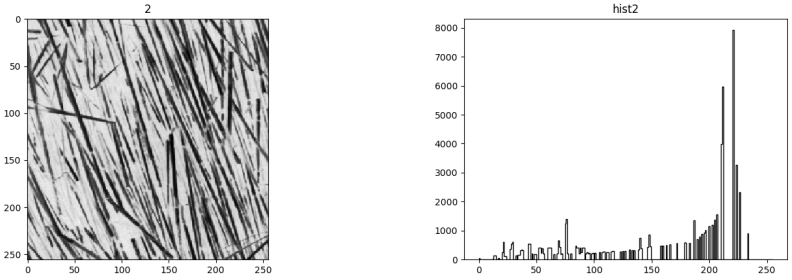
Texture Direction
The majority of the stripes has an angle of 100°. (or 1.745 rad)

Frequency
The frequency of the pattern, diagonally to the lines is 3-4 pixels in width, and they are repeating 30-40 times in the picture.

Variance
This pattern has a small variance, probably the smallest.

Homogeneity
The texture has large homogeneous areas, both in and around the stripes.

Texture element size
The element size is only a few pixels wide, and around 50 pixels high.



(a) Texture 2

(b) Histogram of Texture 2

Figur 4: Texture with histogram

1.3 Texture 3

Characteristics:
This seems like another white noise texture. Difference between this and 2 is that the first image had crevasses, and this does not.

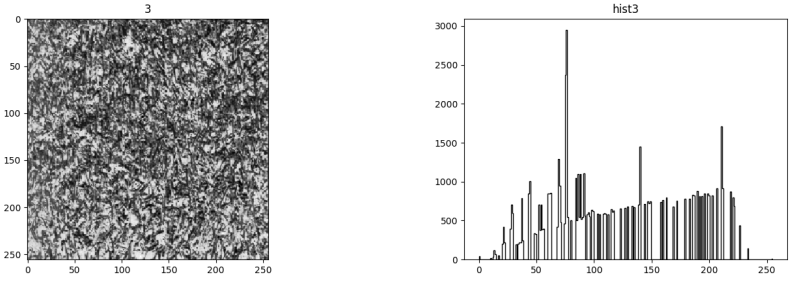
Texture Direction
There are no clear direction in the texture. This (and partly 2) is isotropic textures.

Frequency
It is hard to say anything about the frequency, but a rough guess might be 2-3px of the same grey-scale. This means a high frequency

Variance
This pattern has a low variance, but the pixel value aprox. 75 upping the variance.

Homogeneity
The texture is not homogeneous, nor does it have any homogeneous areas.

Texture element size
The texture element size is minimal.



(a) Texture 3 (b) Histogram of Texture 3

Figur 5: Texture with histogram

1.4 Texture 4

Characteristics:
This texture has a clear pattern of diagonal lines. The lines are a couple of pixels wide, but almost to thin to make a continuous line.(Almost a zigzag pattern instead)

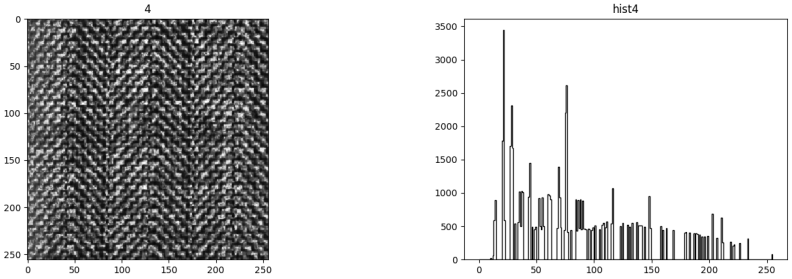
Texture Direction
We have two clear directions in this texture: $\frac{3\pi}{4}$ and $\frac{\pi}{4}$ rads.

Frequency
Frequency of the pattern is $1/3$ since the repeating pattern appears three times.

Variance
Compared to the high variance textures, the texture has a lower variance.

Homogeneity
There are not any areas with the same px value over a large area, so there are not much of homogeneous areas.

Texture element size
If you think of the texture as the diagonal lines, the size is 3-4 px in width and $1/6$ of the img in length.



(a) Texture 4 (b) Histogram of Texture 4

Figur 6: Texture with histogram

1.5 Texture 5

Characteristics:
Another Texture with a clear texture elements consisting of *blocks* that has a regular pattern thought-out the texture.

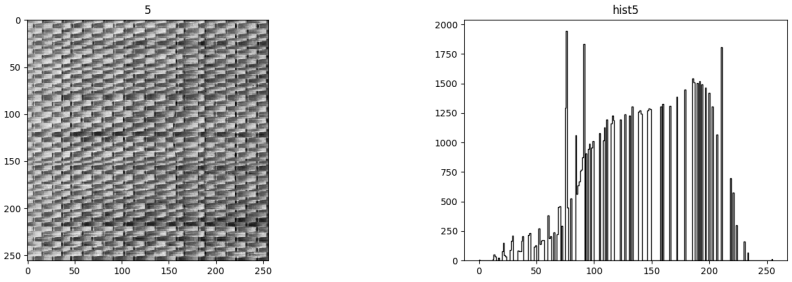
Texture Direction
We have two clear directions in this texture: horizontal and vertical. And like in 3 the texture is skewed of by a couple of degrees.

Frequency
The texture elements are repeating 12-14 times throughout the texture in the horizontal direction, so the horizontal frequency is 1/12. In the same way, the vertical frequency is 1/50.

Variance
This texture has a high variance.

Homogeneity
Inside the texture elements we find some homogeneous areas.

Texture element size
Texture element size here is the size of the rectangles. The texture element size is 5*20px**2



(a) Texture 5 (b) Histogram of Texture 5

Figur 7: Texture with histogram

1.6 Texture 6

Characteristics:
The texture has clear vertical lines that has a slight counter clockwise angle.

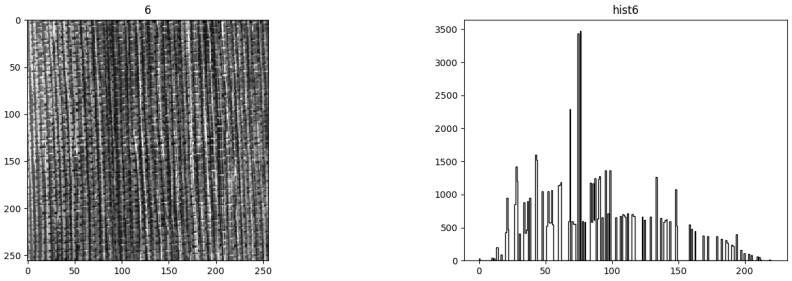
Texture Direction
The texture has an angle if $\frac{\pi}{2} + \epsilon$

Frequency
The vertical frequency is $1/50$ for the whole image.

Variance
This texture has a pretty similar variance to 6.

Homogeneity
We find some homogeneous areas if we follow the texture elements in the vertical direction.

Texture element size
Texture element size here is 3*250 px**2



(a) Texture 6

(b) Histogram of Texture 6

Figur 8: Texture with histogram

1.7 Texture 7

Characteristics:
The characteristics of this texture is pretty similar to 2. The texture does not have the same holes as the first one, but if we look at the edges of the image,10 ,here using canny edge detecting, we see a pretty similar result.

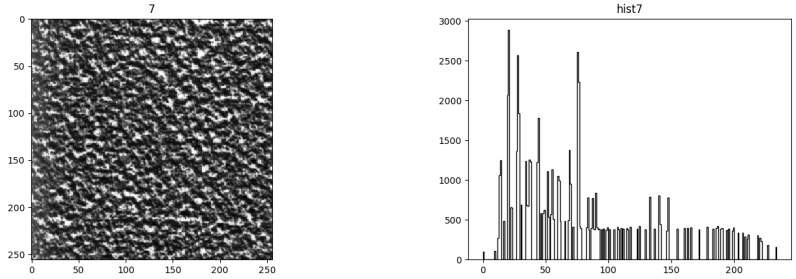
Texture Direction
You can imagine that the texture has an angle if $\frac{3\pi}{4}$ or $\frac{\pi}{4}$, but i would call it isotropic.

Frequency
Texture frequency is the same as in 3. approx 3/250.

Variance
This texture has a pretty similar variance to 3.

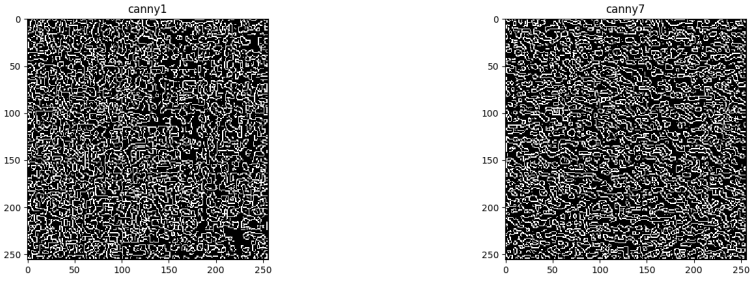
Homogeneity
We have very few large homogeneous areas. We do have a lot of small ones.

Texture element size
Texture element size here is 3*3 px** 2



(a) Texture 7 (b) Histogram of Texture 7

Figur 9: Texture with histogram



(a) Canny 0 (b) Canny 7

Figur 10: Comparison of the edges of 2 and 9

2 Visualizing the GLCM matrices

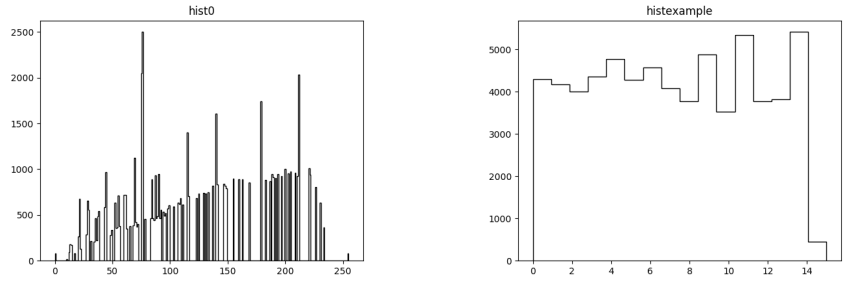
Now that we have a description of each image we want to work on each one of the images separately. And the first thing we want to do is to find a suitable GLCM. The problem with running a GLCM on the images is that we have 255 different grey-levels. So there are 2 operations we want to do before we continue.

- rescale the histogram[1]
- reduce the number of grey levels.

This can be don with the cv2 and skimage packages:

```
1
2 equalized_hist=cv2.equalizeHist(original_img)
3
4 equalized_rescaled_hist=(ski.exposure.rescale_intensity(
      equalized_hist, out_range=(0, 15)))
```

At the end we get the Original picture histeq-ed with 16 grey-levels.



(a) Old Histogram (b) New Histogram

Figur 11: Transformation of the histogram (just an example, not actual transformation)

[1]The reason that we rescale the histogram is to ensure that the histogram isn't skewed. With a rescaled histogram we can be more certain that the GLCM is better represented.

2.1 The GLCM vals

2.1.0 Texture 0

As we remember from 2 we should use the angle $\frac{3\pi}{4}$ and the dist 4px.

2.1.1 Texture 1

As we remember from 3 we should use the angle 0 and angle π rad the dist 4px.

2.1.2 Texture 2

As we remember from 4 we should use the angle 1.745 rad and the dist 8 px. (length can vary on this one)

2.1.3 Texture 3

As we remember from 5 it was isotropic , so we use dist 2px. (isotropic is here just the average of linspace(0,2π,8))

2.1.4 Texture 4

As we remember from 6 we should use the angle $\frac{3\pi}{4}$ and the angle $\frac{\pi}{4}$ the dist 7px.

2.1.5 Texture 5

As we remember from 7 we should use the angle 0 rad and angle π rad the dist 4 and 12 respectively

2.1.6 Texture 6

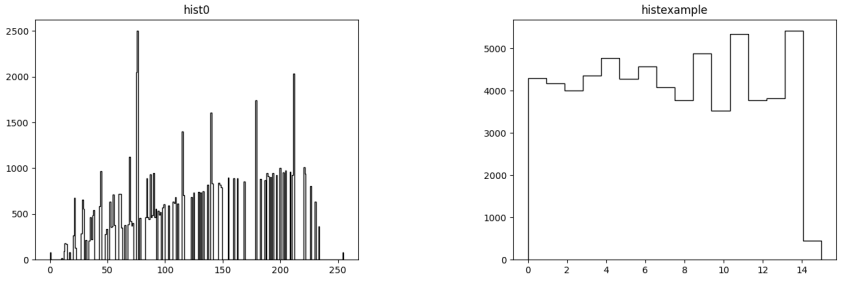
As we remember from 8 we should use the angle π and the dist 8px (here we can use any length, preferably something that is not in the frequency of the horizontal component)

2.1.7 Texture 7

As we remember from 9 it was isotropic , so we use dist 3px. (isotropic is here just the average of linspace(0,2π,8))

2.2 The GLCM Results

2.2.0 Texture 0



(a) Old Histogram

(b) New Histogram

Figur 12: Transformation of the histogram (just an example, not actual transformation)

2.2.1 Texture 1

2.2.2 Texture 2

2.2.3 Texture 3

2.2.4 Texture 4

2.2.5 Texture 5

2.2.6 Texture 6

2.2.7 Texture 7