**CSE585/EE555:  Digital Image Processing II**

**Computer Project # 4:**

**Nonlinear Filtering and Anisotropic Diffusion**

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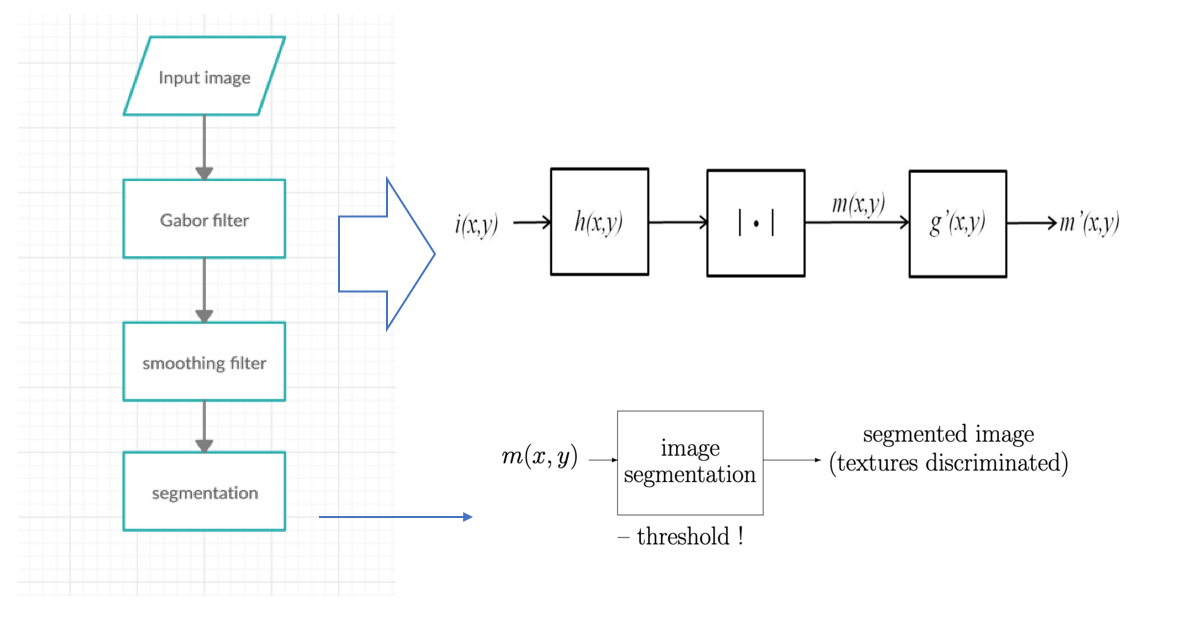
**Date: 04/06/2020**

1. **Objectives**

* To classify and segment bipartite texture regions in an image.
* To understand the principles of Gabor filter and how to design a single Gabor filter on textured image to accomplish optimal segmentation.
* To learn the algorithm of Gaussian part (low pass filter) and complex sinusoid part of Gabor elementary function (GEF).
* To investigate the parameters specify the Gabor filter and smoothing filter.
* To get familiar with image 3-D plot from texture analysis from Gabor filter and smoothing filter.
* To extract boundaries between major textures regions and to explore the criteria of defining a good segmentation of texture.

1. **Methods**

**Flow chart**



**Figure1. flow chart of Gabor filter texture segmentation**

**Code structure:**

**main.m:** the main code runs the 4 different tasks based on 4 images with various parameters settings, and output the grayscale images and 3D plot with m(x,y), m’(x,y) and final segmented results.

**support functions:**

**g.m: the Gaussian part of GEF**

**hx.m: GEF of h(x)**

**hy.m: GEF of h(y)**

**segment.m:** segmentation with discriminative threshold of each texture for classification.

1. **Algorithms**

To implement a optimal Gabor filter for texture segmentation, by looking at the output of m(x,y) that if it is a noisy step function for better discrimination and classification. Then we shall determine whether the GEF’s parameters are properly set or not.

**Algorithms are as following:**

By applying the Gabor filter:

m (x,y) = [I(x,y) \*\* h(x,y)]

where I denotes the input image, h is a GEF :

h(x,y) = g(x, y) exp [j2πF(xcosθ + ysinθ)] = g(x, y) exp [j2π (Ux + Vy)]

where, θ is the orientation of sinusoid.

and g is a circularly-symmetric Gaussian:

g(x,y) = exp {}

The assumption of this project is that Φ=0, so we can implement the GEF separably for x and y:

h(x,y) = h1(x) h2(y)

Thus, the GEF can be processed through three steps:

* i1(x,y) = i(x,y) \* h1(x)

=

* i2 (x,y) = i1(x,y) \* h2(y)

=

* m(x,y) = | i2 (x,y)|

Thus, Gabor filter has width of (4).

To get easier for the segmentation, apply the smoothing filter:

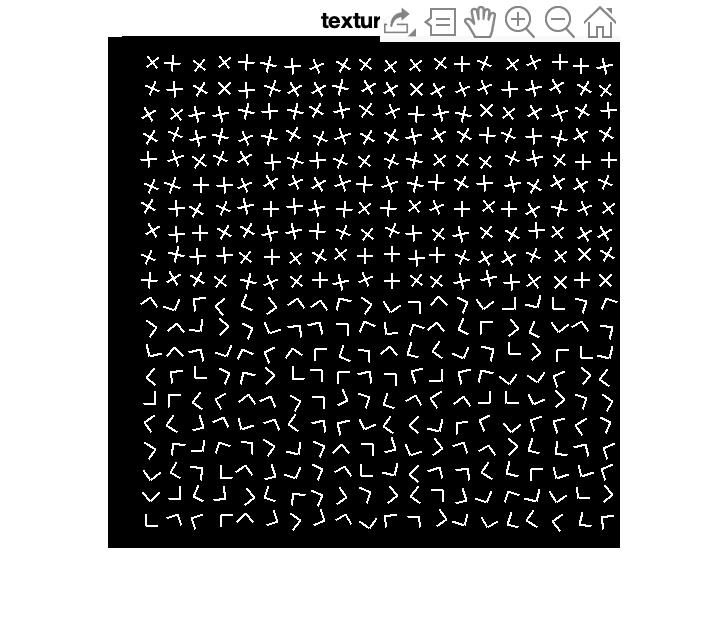
m’(x,y) = m(x,y) \* g’(x,y)

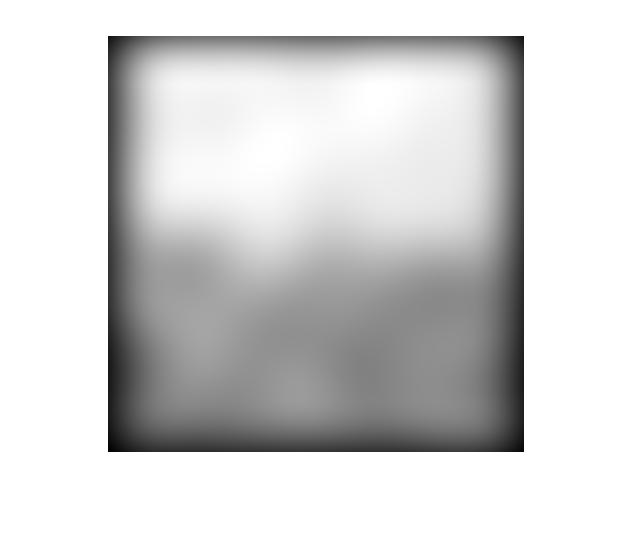
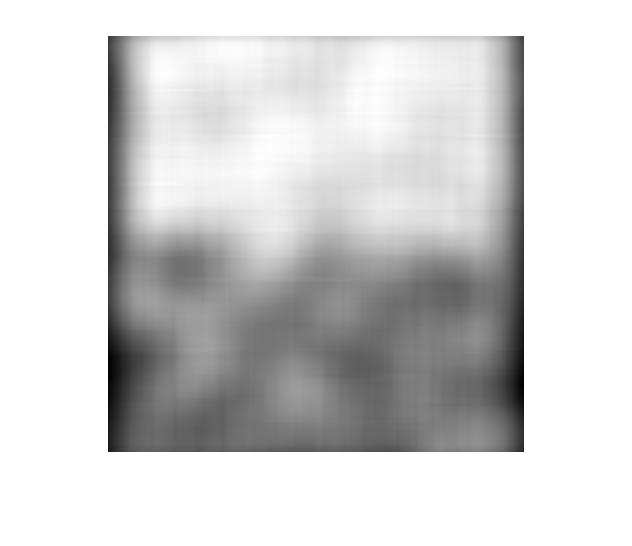
where g′ is another circular-symmetric Gaussian using a different .

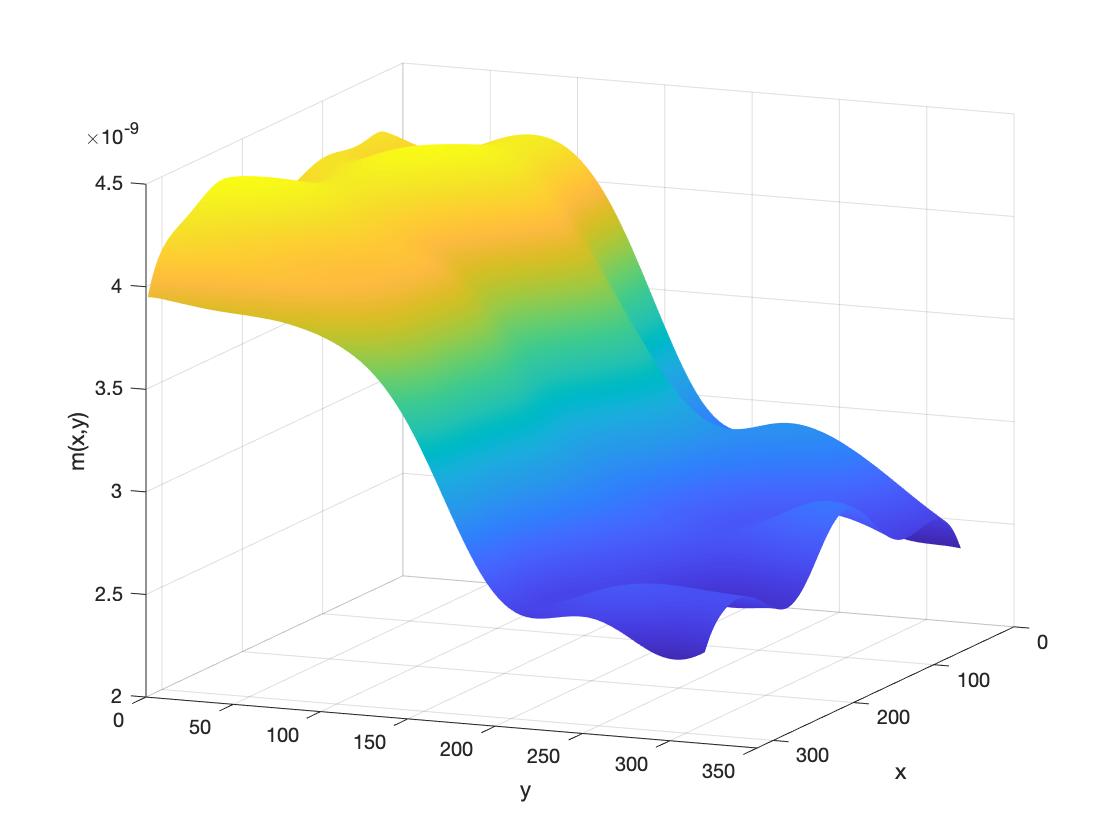
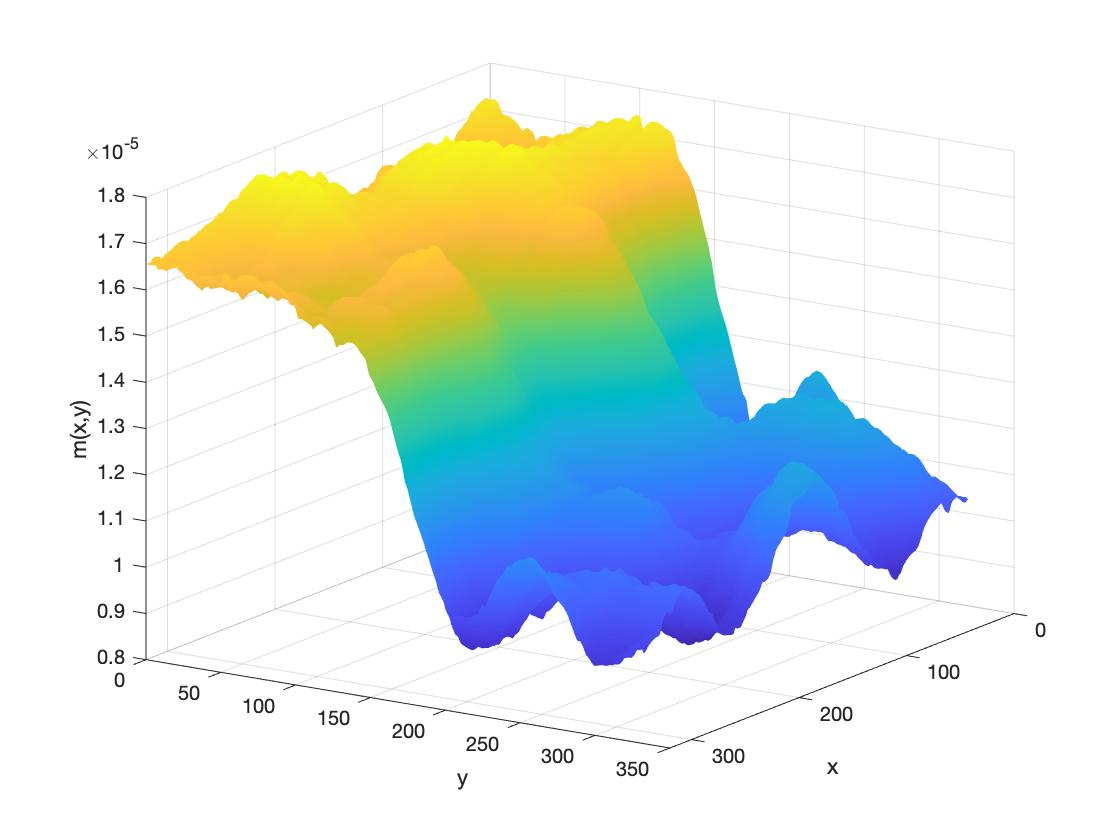
1. **Results**

Since that values near the outer perimeter of the image cannot be completely processed, thus, when displaying results, we have zeroed out unprocessed perimeter areas.

Image1:







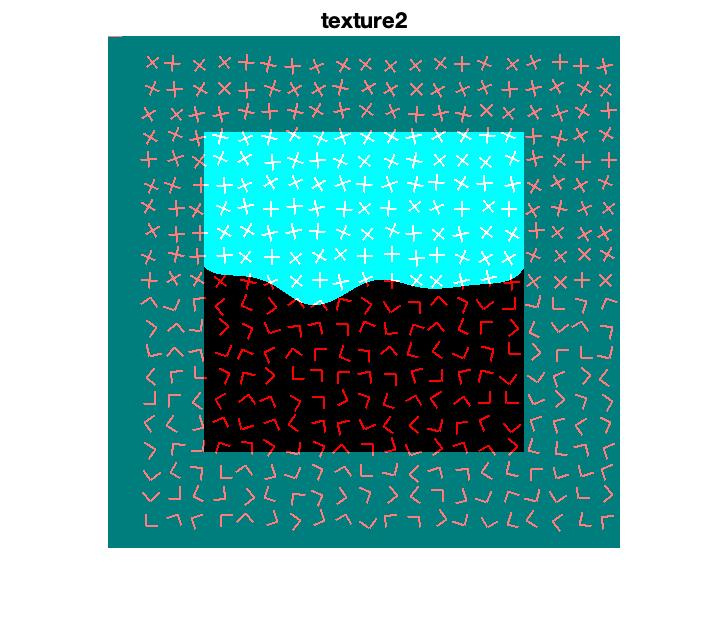
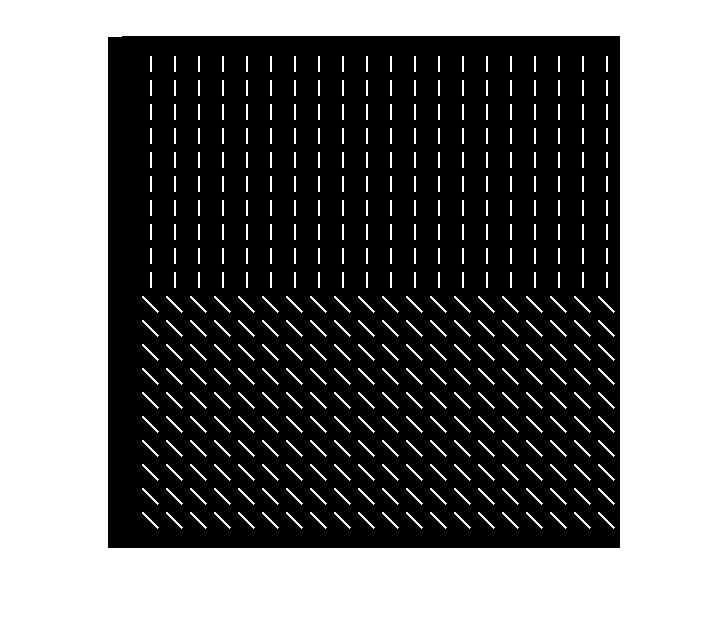
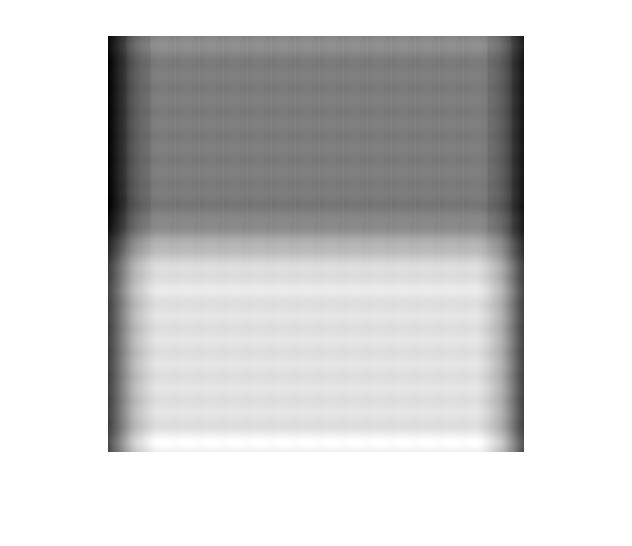
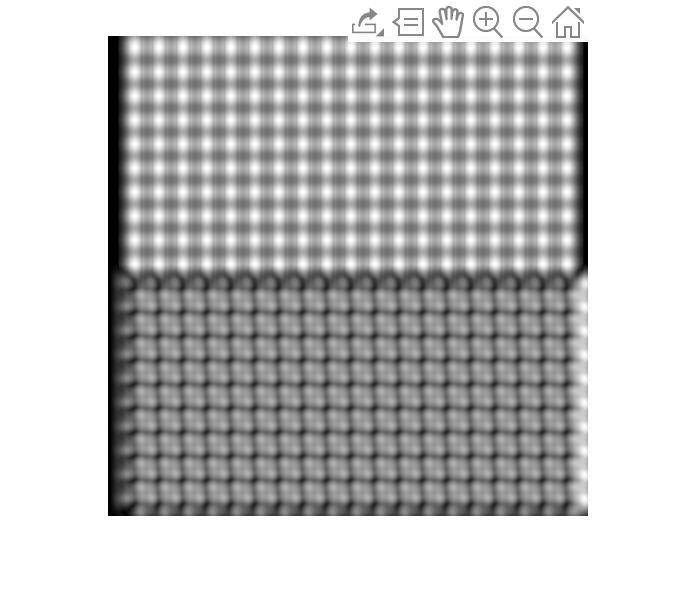
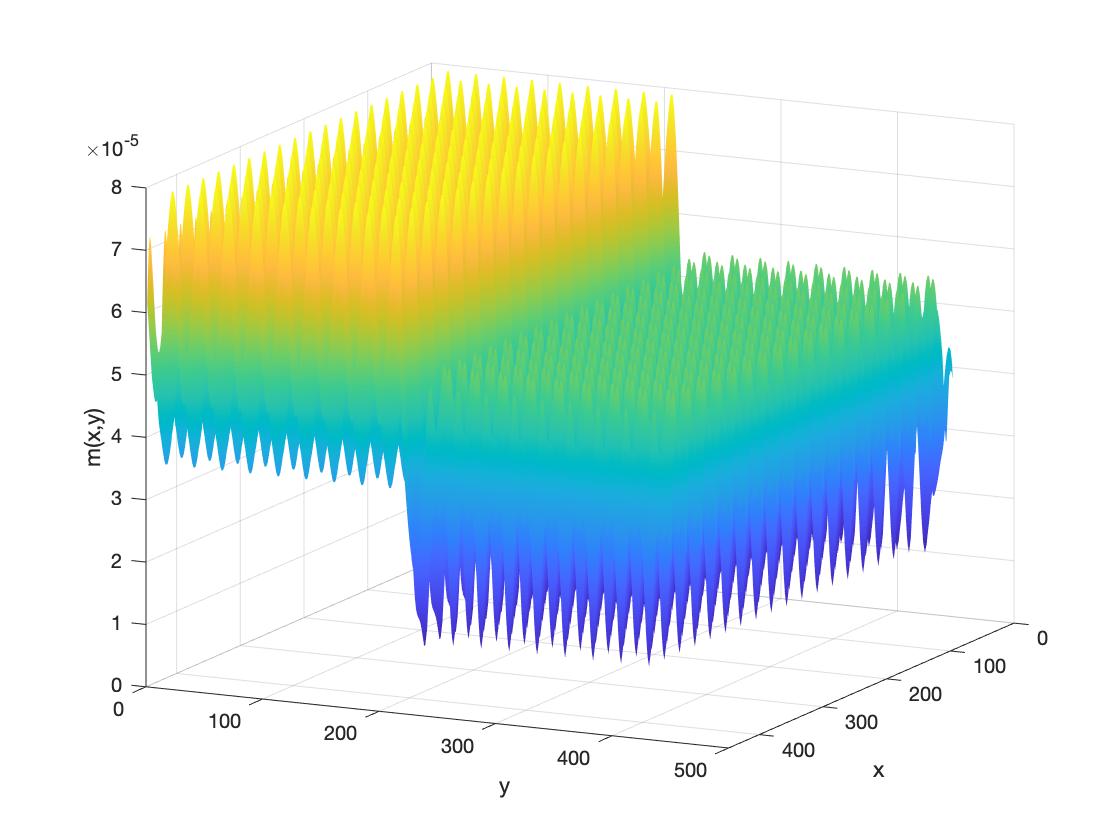
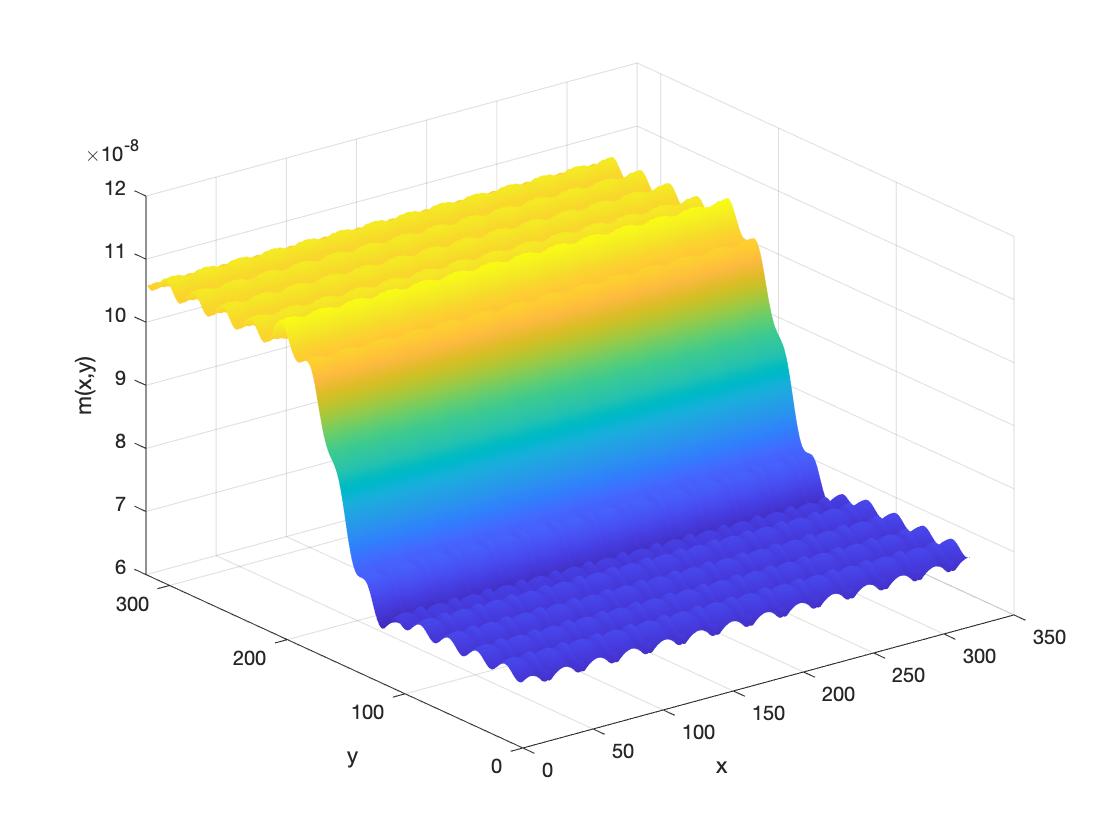


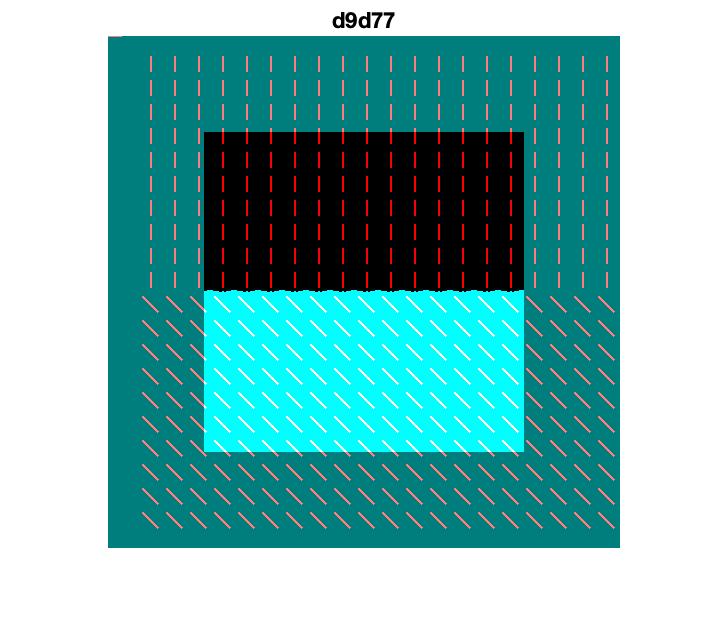
image2:





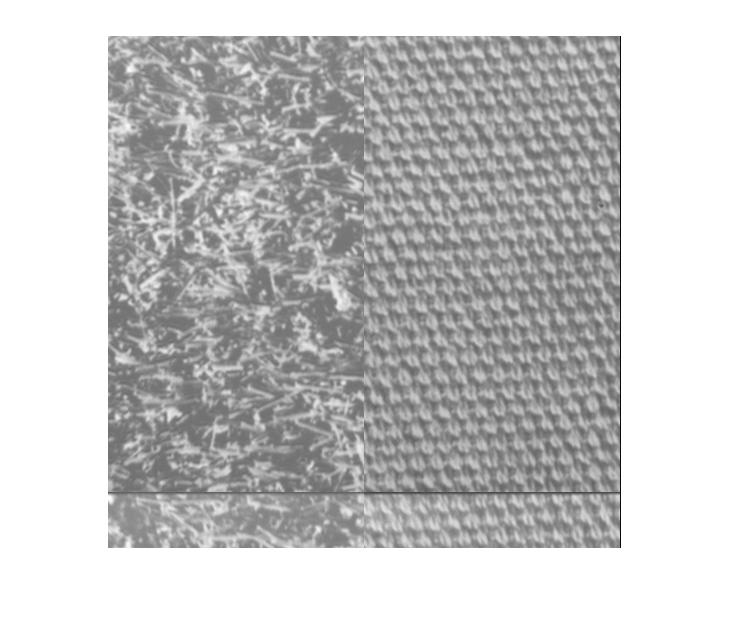


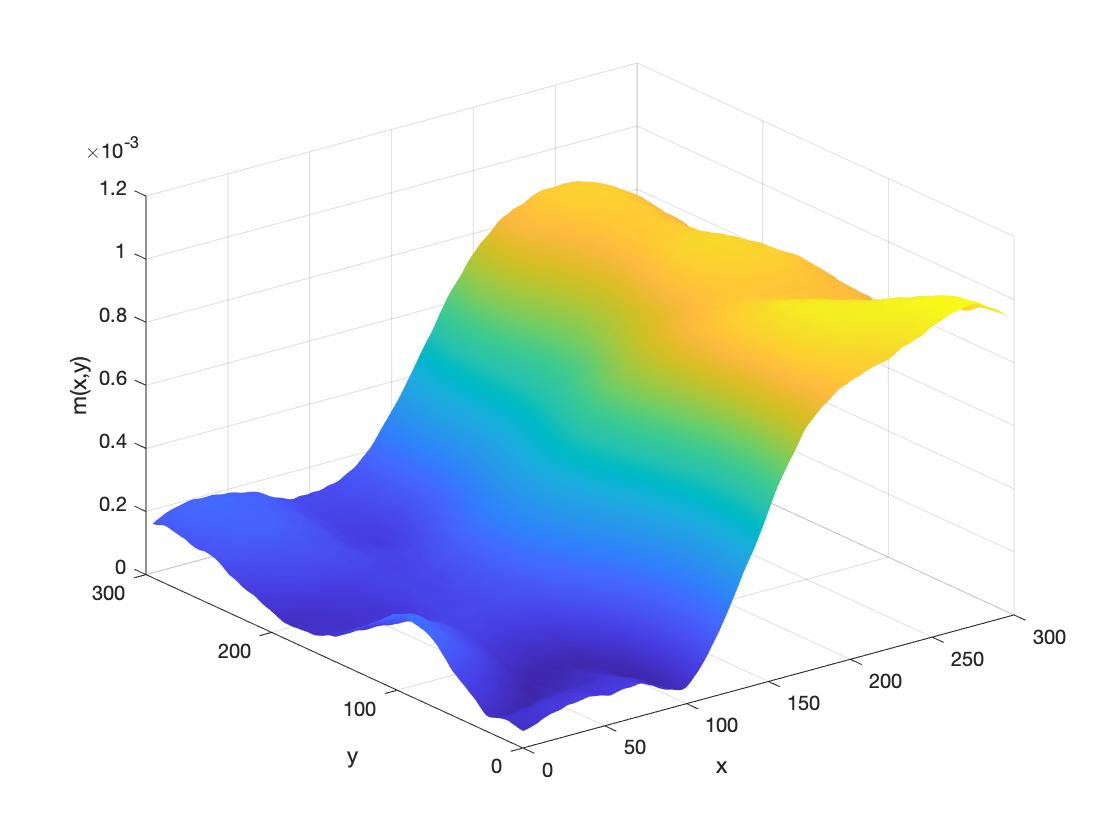


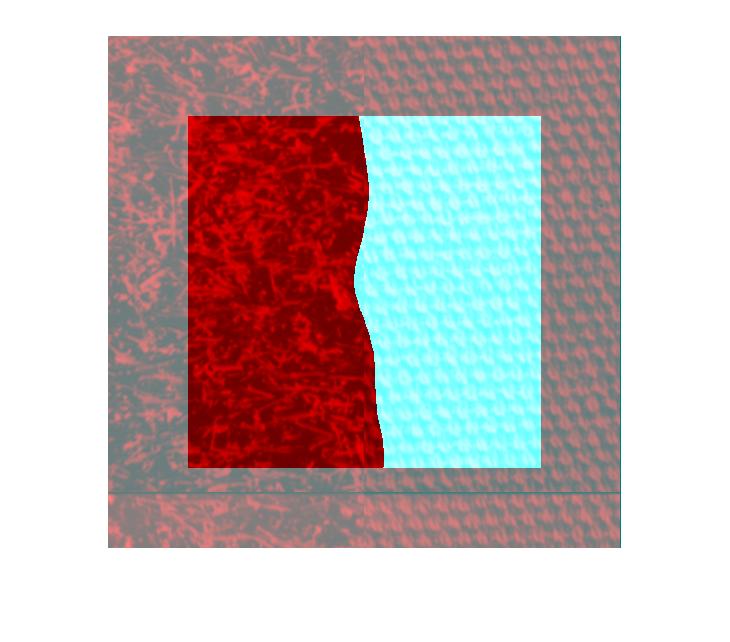


Observation:

image3 :

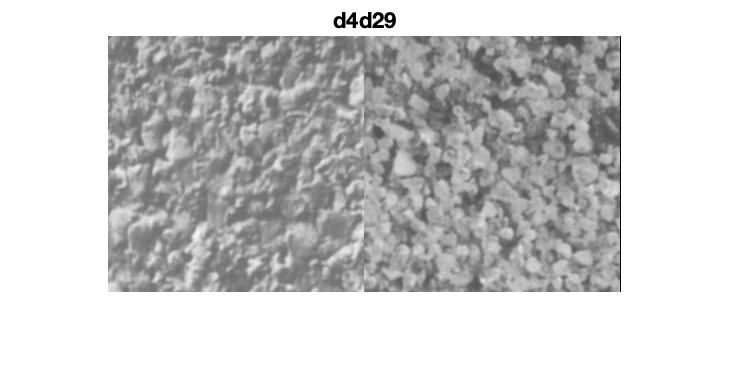
 

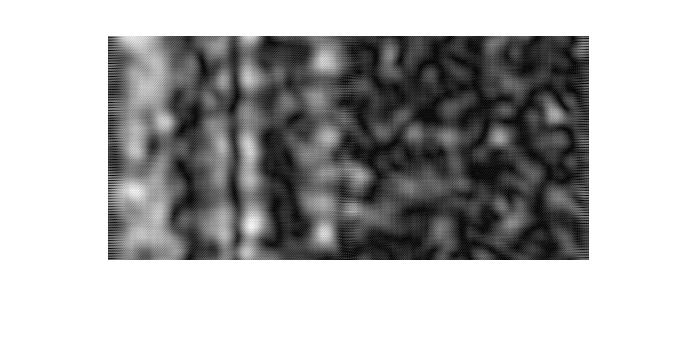


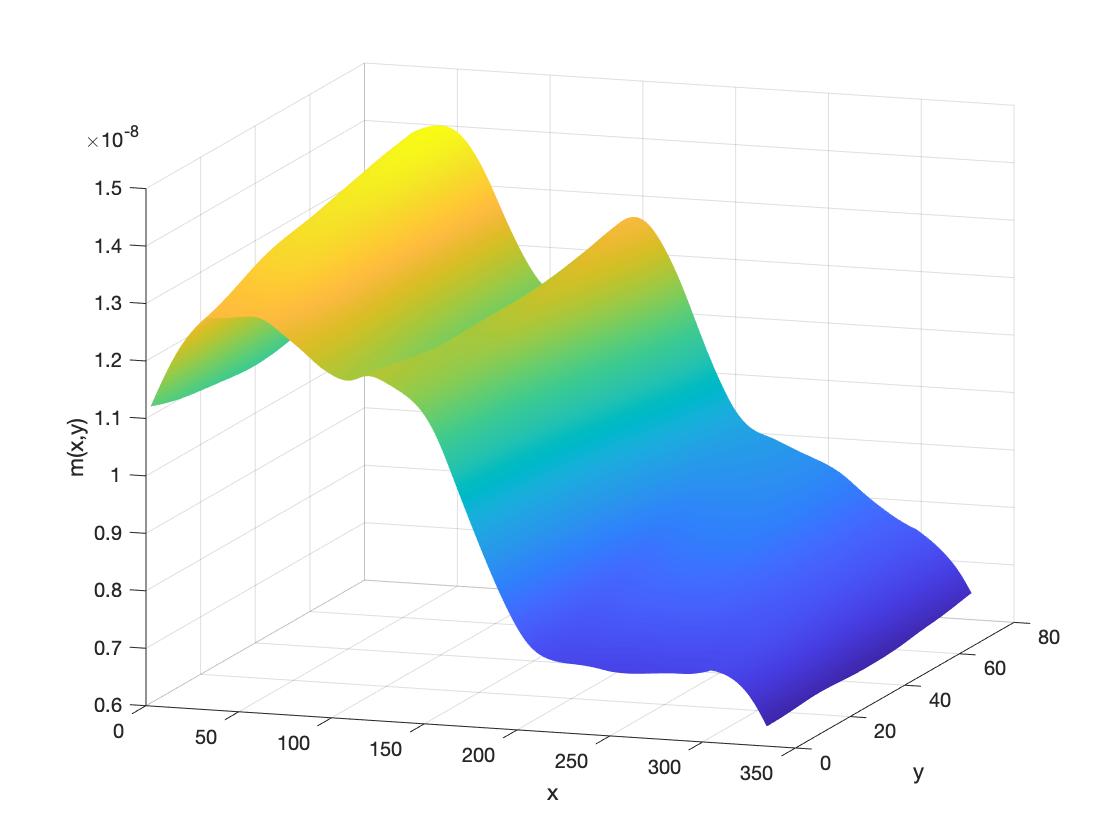
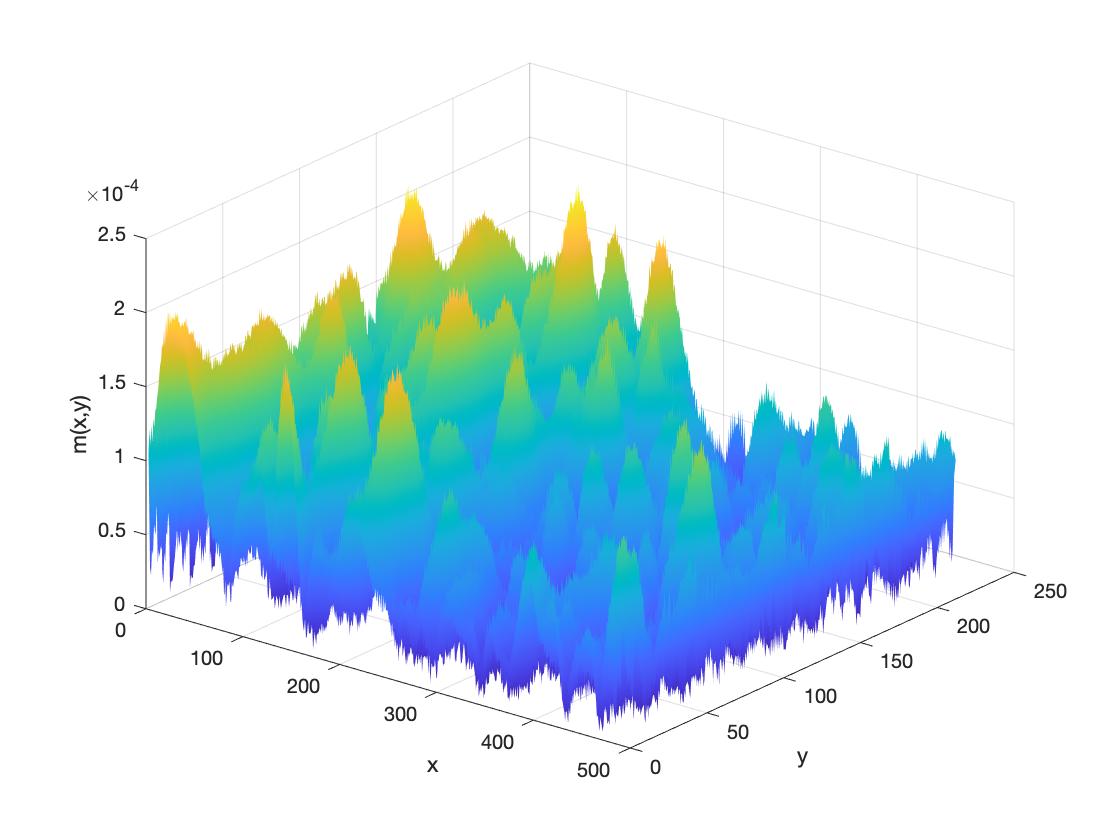


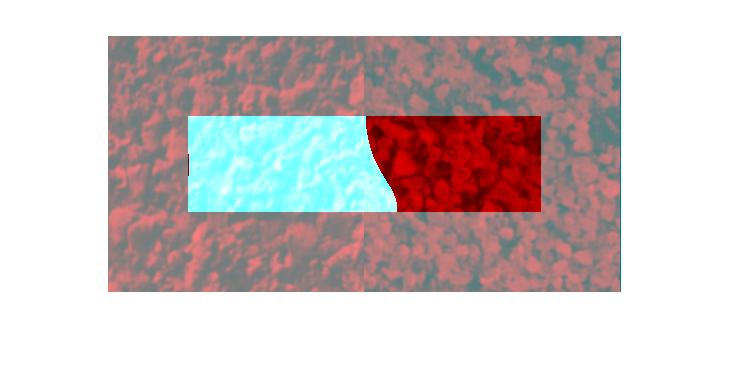
Observation:

image4:









Observation:

1. **Conclusion**

In conclusion, the project