

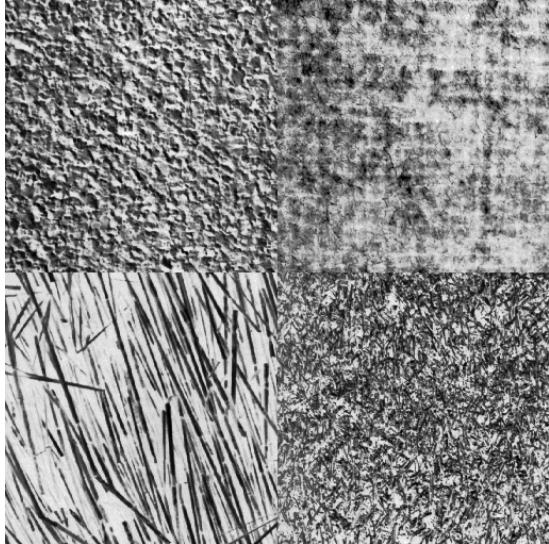
Digital Image Analysis - Mandatory 1

Cameron Lowell Palmer
NTNU
cameron.palmer@ntnu.no

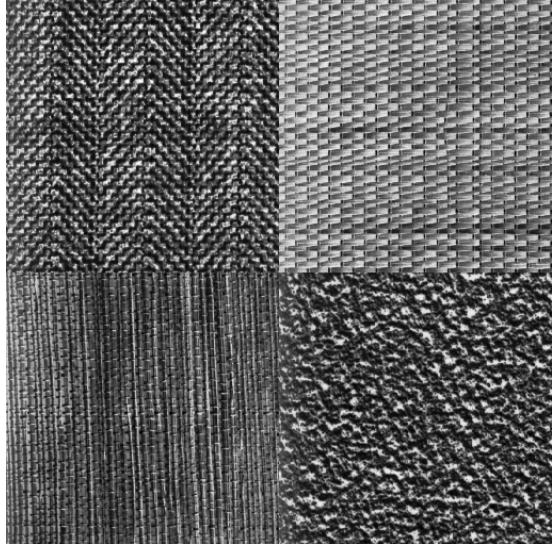
Fall 2016

1 Analyzing the textures

Describe the 8 different textures by words. What characterizes each texture? How do the textures differ? Keywords: texture direction, frequency, variance, homogeneity, texture element size.



(a) Mosaic 1



(b) Mosaic 2

Figure 1: The textures

Mosaic 1, Top-left

The texture of figure 2 seems to be directionally invariant and can be described as rough looking, resembling texturized concrete. The texture element size is small and relatively difficult to identify.

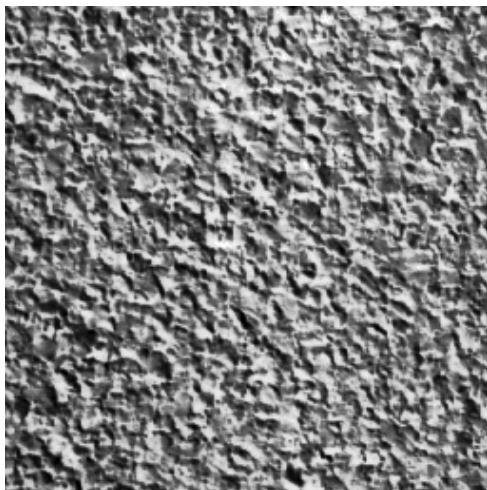


Figure 2: Mosaic 1, Top-left

Mosaic 1, Top-right

The texture in figure 3 looks like blotchy paper. With regular, rectangular cells running across the image with white separating lines. Possibly 20x20 cells in total. The cells are filled with medium to dark pixels.

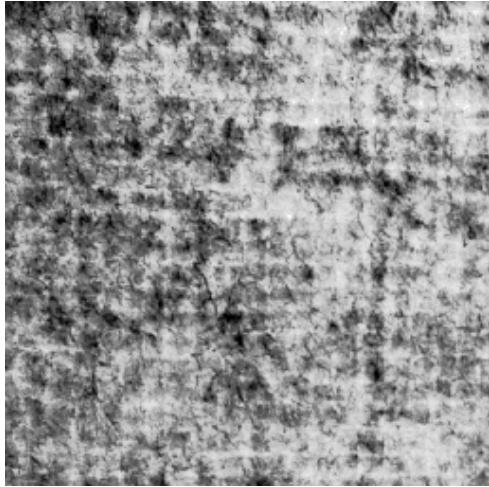


Figure 3: Mosaic 1, Top-right

Mosaic 1, Bottom-left

The texture in figure 4 looks like grass running diagonally across a light gray background. The angle of the texture is quite steep, being closer to 90° than 45° . The frequency of the main texel increases as you move from the left to right-side.

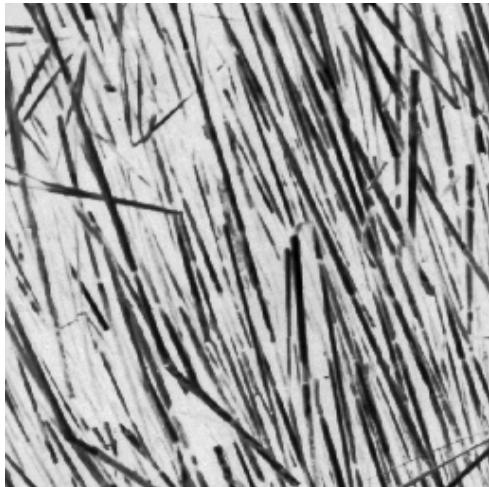


Figure 4: Mosaic 1, Bottom-left

Mosaic 1, Bottom-right

The texture in figure 5 is similar to figure 2 although the texels are smaller and rather than resembling rough concrete are more like looking at very dense black-and-white tree foliage from a high altitude. Again, I would describe this texture as direction invariant.

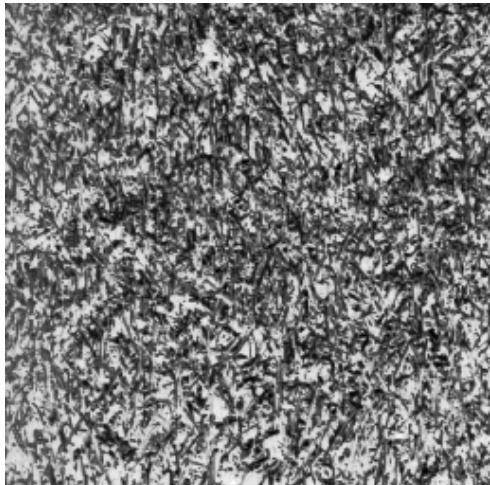


Figure 5: Mosaic 1, Bottom-right

Mosaic 2, Top-left

The texture in figure 6 is definitely a fabric with a weave running at alternating 45° angles. Around three cycles of direction change are visible. Mostly dark, but with specks of white spread fairly evenly across the subimage.

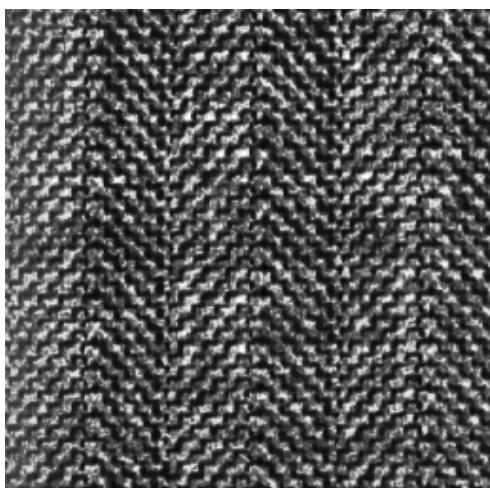


Figure 6: Mosaic 2, Top-left

Mosaic 2, Top-right

The texture in figure 7 is quite likely a woven natural grass fiber mat. The overall direction is a left-right, top-bottom grid pattern of fairly consistently sized rectangles, possibly 60x40 in size. The color seems to alternate across the cells from light to dark gray.

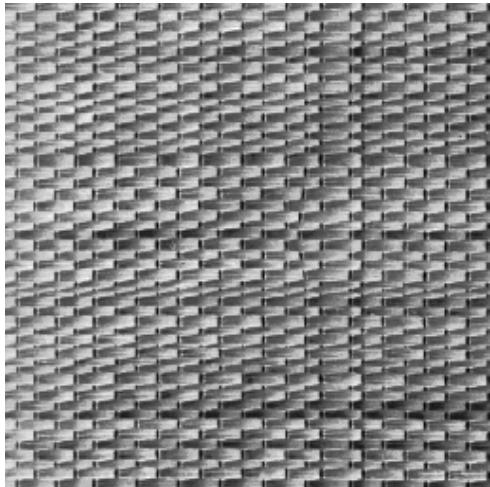


Figure 7: Mosaic 2, Top-right

Mosaic 2, Bottom-left

The texture in figure 8 is less directly identifiable, but like figure 3 seems to be some sort of natural fiber. It is clearly comprised of smaller texels than 3 and a tight wavy pattern that runs left-to-right. Each wave is cut or notched from top to bottom at a regular interval. Overall color is pretty dark.

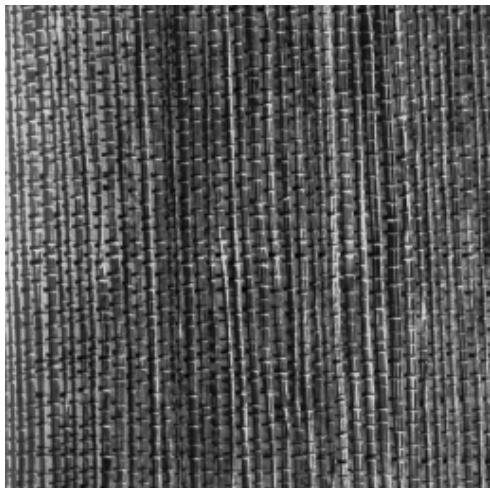


Figure 8: Mosaic 2, Bottom-left

Mosaic 2, Bottom-right

The texture in figure 9 is a darker version of figure 2 and looking a little smoother.

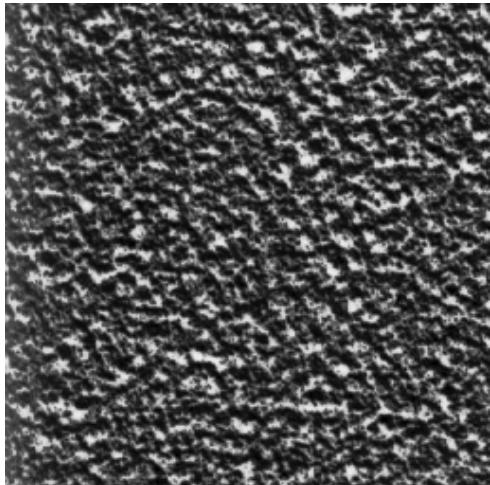


Figure 9: Mosaic 2, Bottom-right

2 Visualizing GLCM matrices

For the project I have chosen to use 16 gray-levels and a window size of 31 with a directional offset of 2. I chose the window size largely related to the general feature size contained within the texture. I think this is a good size that will adequately extract the textures although a smaller window size might do a better job of identifying the boundary.

The textures diagonal from each other in 1a, top-left, bottom-right, and top-right, bottom-left seem the most similar and in 1b, the top-left and bottom-right. This similarity will make it difficult to separate the textures in a clean way.

2.1 Mosaic 1, Top-left

All three angles I tried yielded nearly identical results backing up my direction invariance claim. Mostly concentrated along the diagonal and towards 0-0 and 255-255.

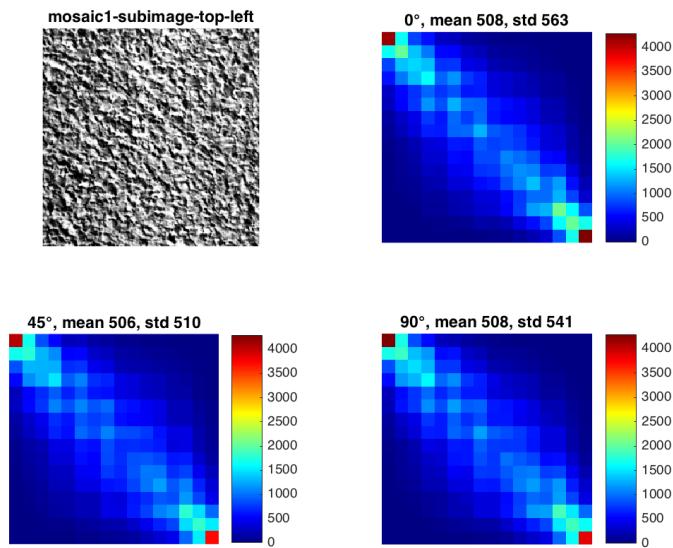


Figure 10: Mosaic 1, Top-left

2.2 Mosaic 1, Top-right

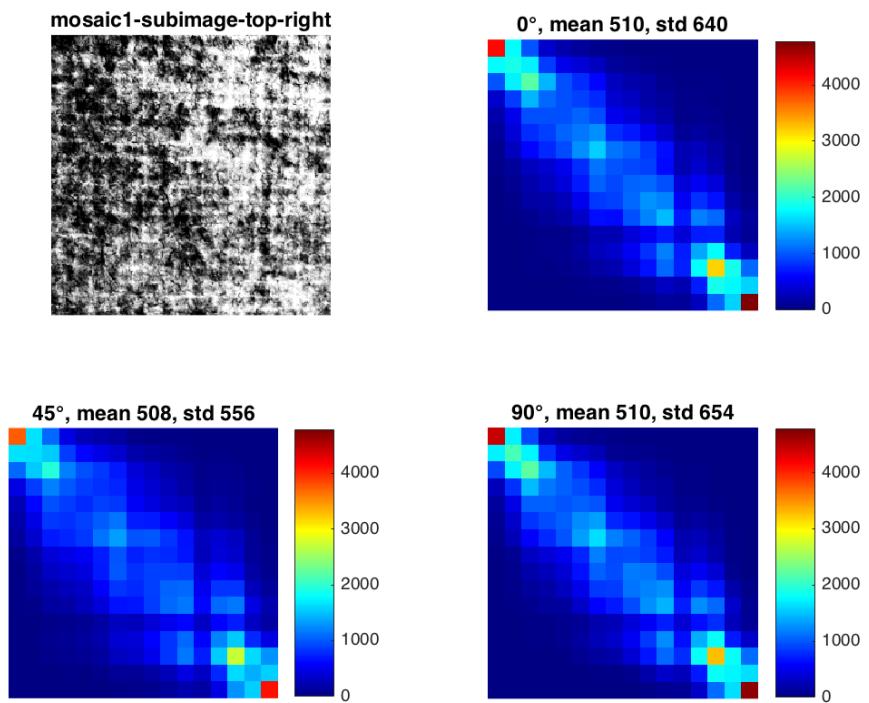


Figure 11: Mosaic 1, Top-right

2.3 Mosaic 1, Bottom-left

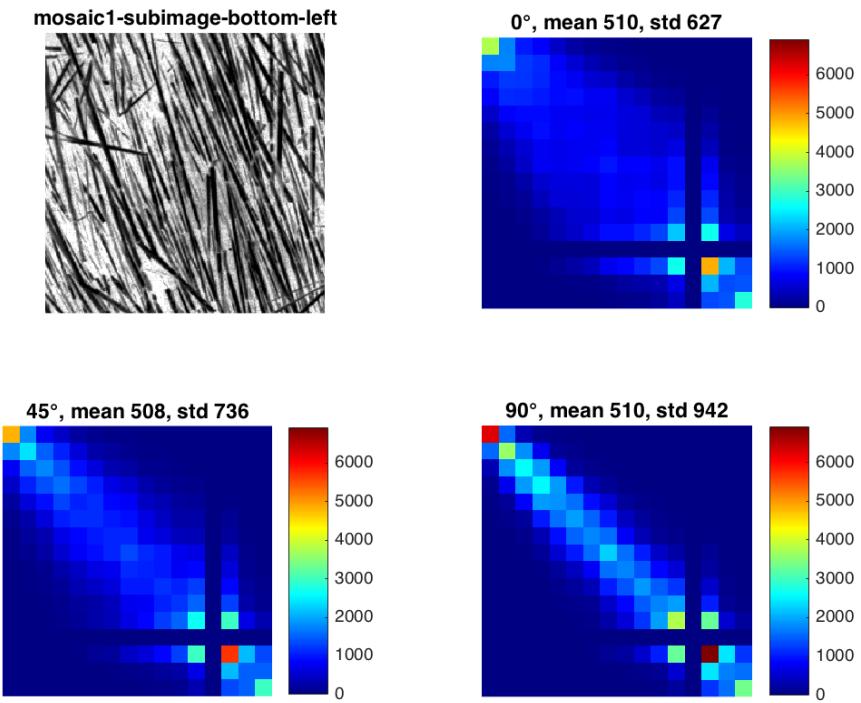


Figure 12: Mosaic 1, Bottom-left

2.4 Mosaic 1, Bottom-right

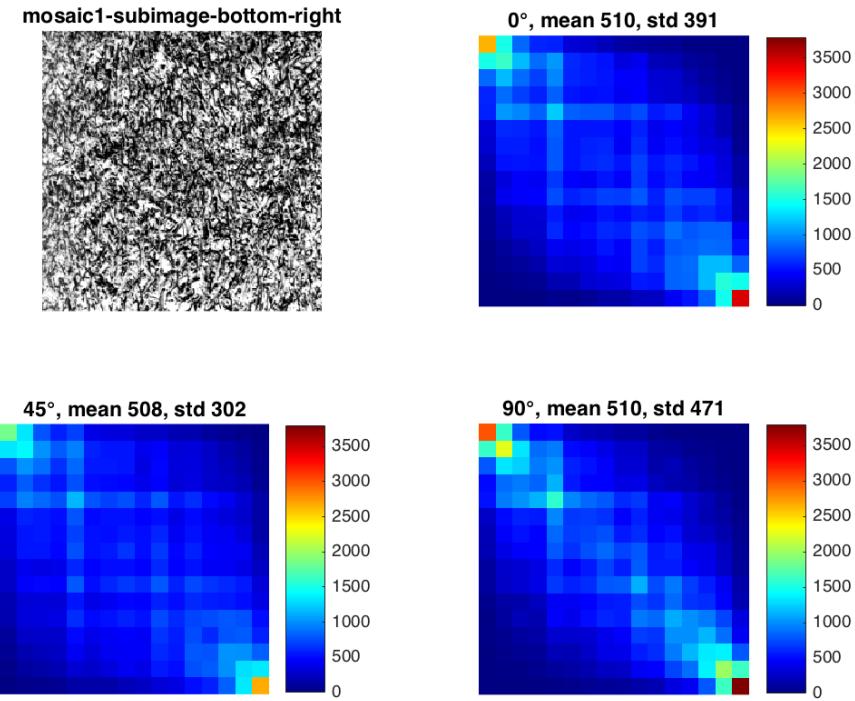


Figure 13: Mosaic 1, Bottom-right

2.5 Mosaic 2, Top-left

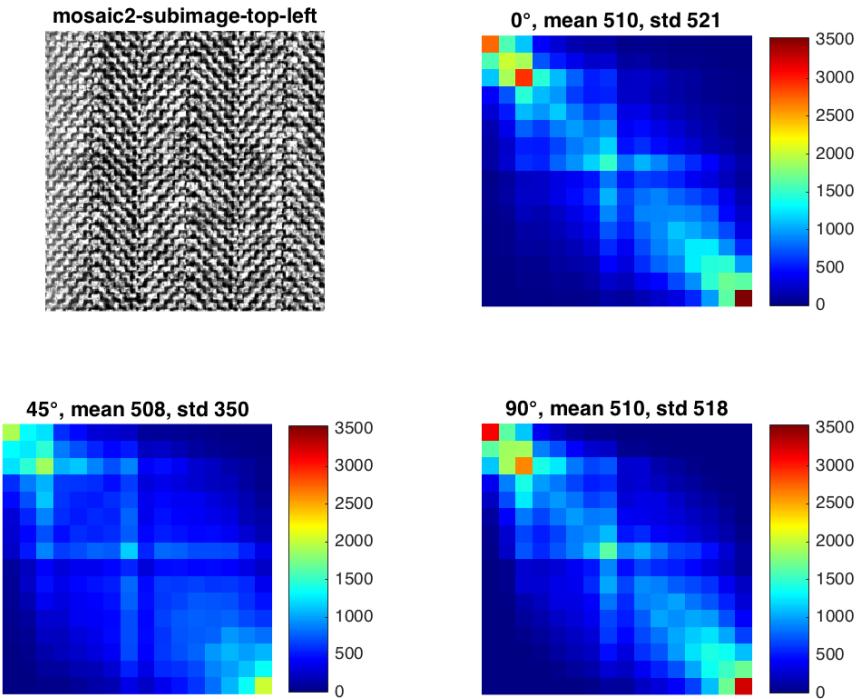


Figure 14: Mosaic 2, Top-left

2.6 Mosaic 2, Top-right

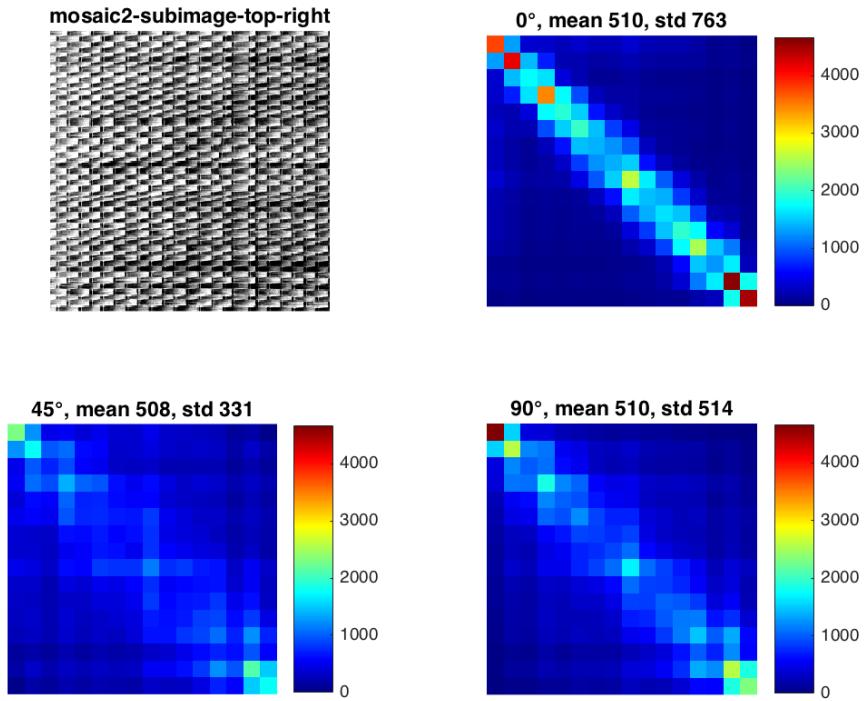


Figure 15: Mosaic 2, Top-right

2.7 Mosaic 2, Bottom-left

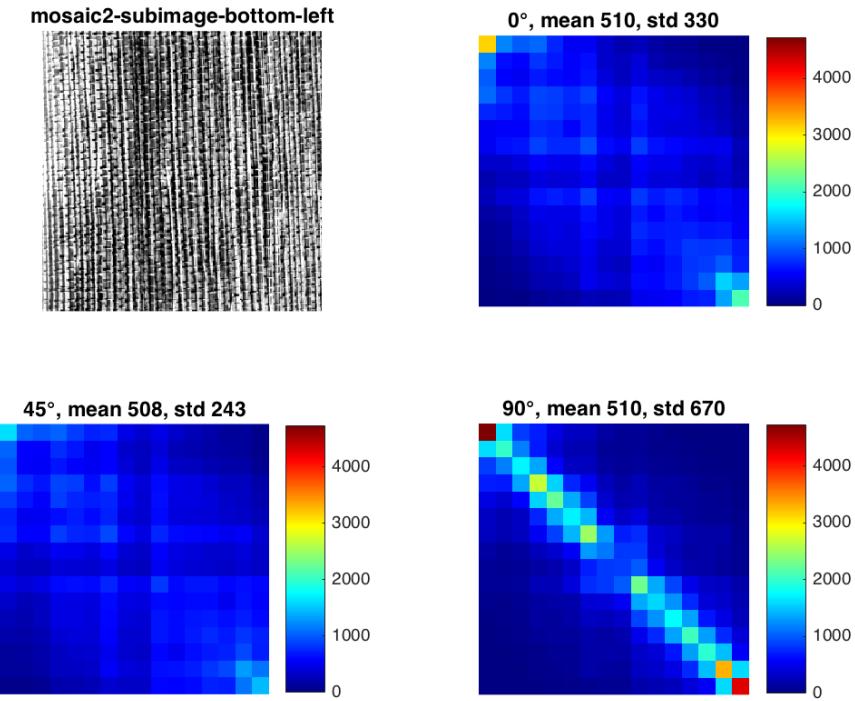


Figure 16: Mosaic 2, Bottom-left

2.8 Mosaic 2, Bottom-right

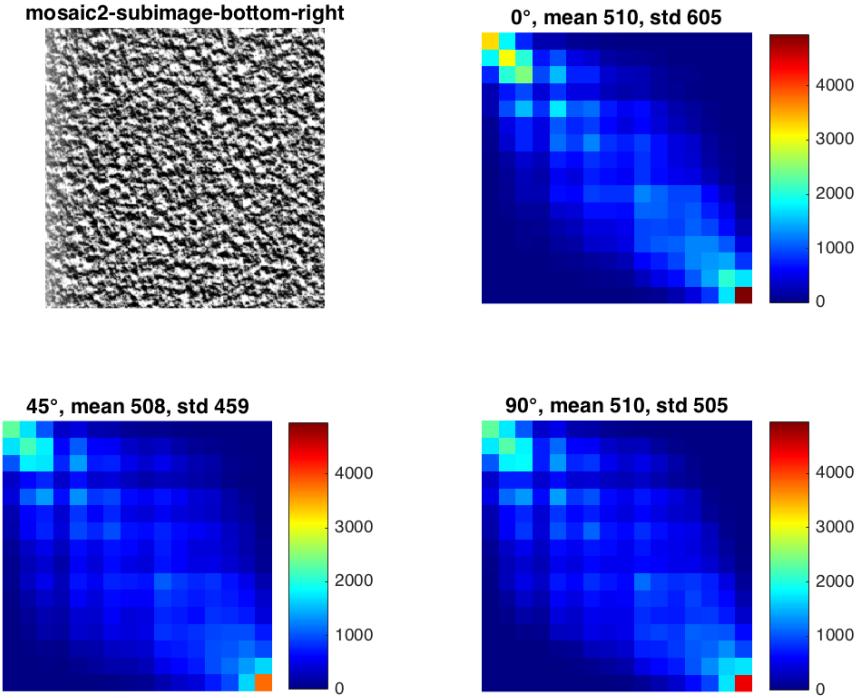


Figure 17: Mosaic 2, Bottom-right

3 Computing GLCM feature images in local windows

Window size was chosen mostly based on the overall size of the image and the subimage texture size. Given that the images are 512x512 pixels and the subimages take up a quarter of each image a window size of 31 seemed reasonable. I computed each of the GLCM features at 0°, 45°, and 90° angles.

3.1 Mosaic 1, Angle 0

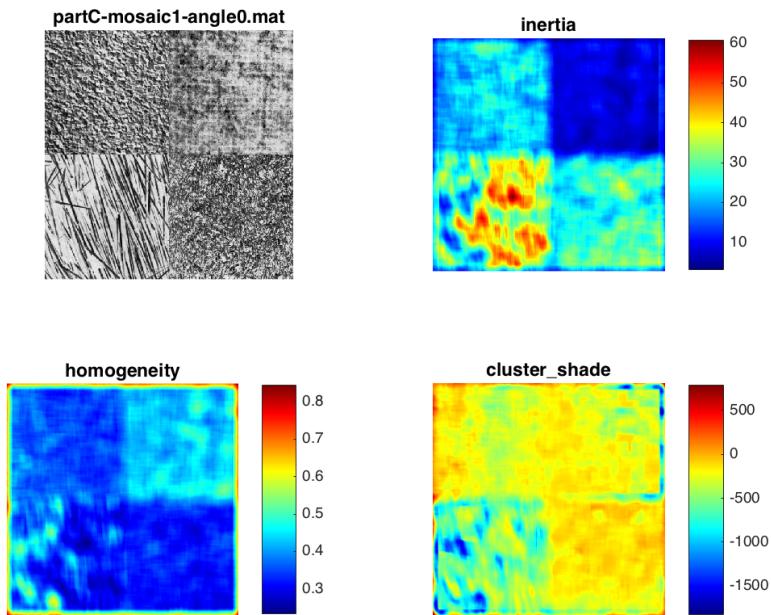


Figure 18: Mosaic 1, Angle 0

3.2 Mosaic 1, Angle 45

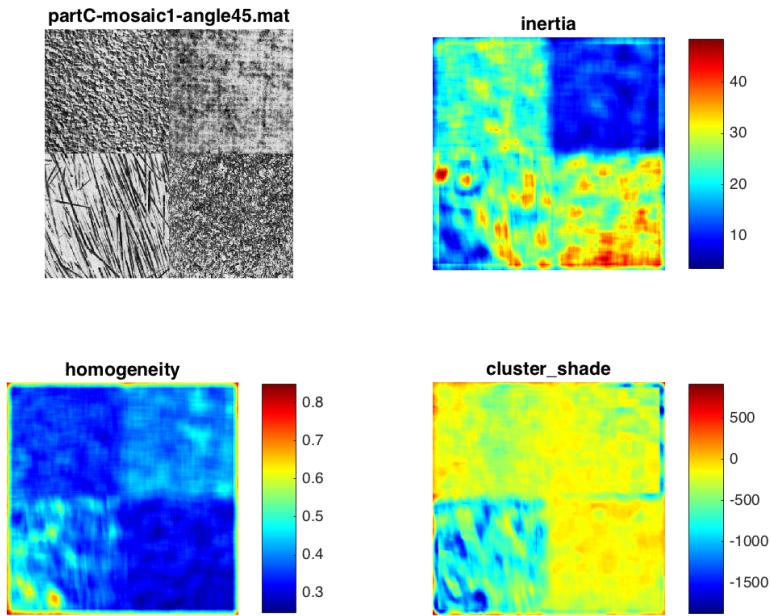


Figure 19: Mosaic 1, Angle 45

3.3 Mosaic 1, Angle 90

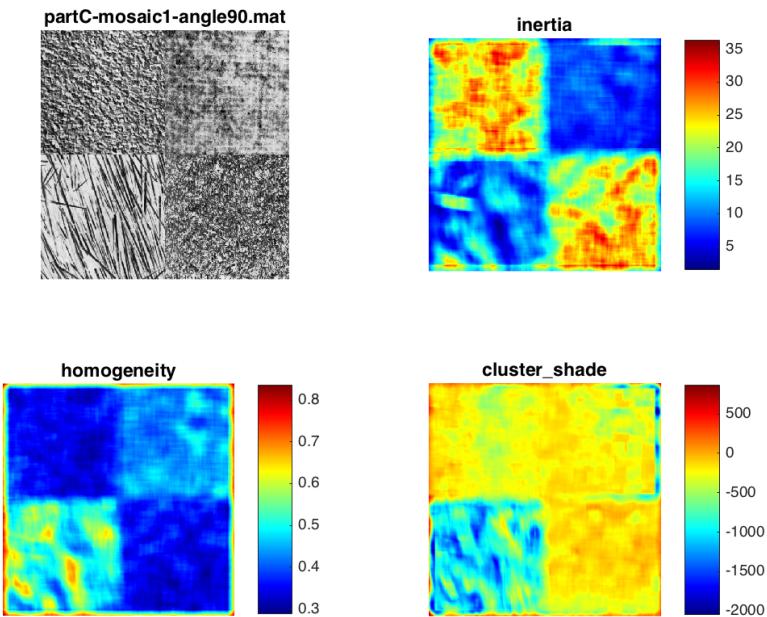


Figure 20: Mosaic 1, Angle 90

3.4 Mosaic 2, Angle 0

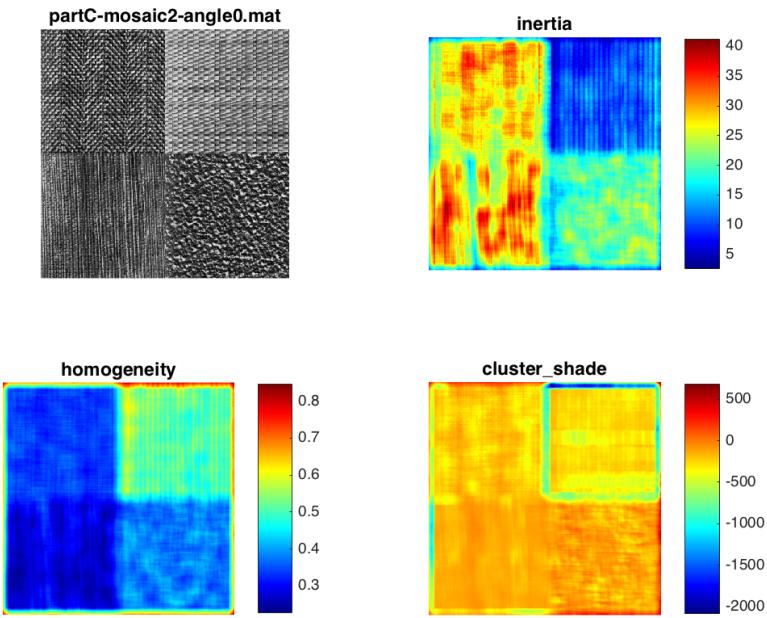


Figure 21: Mosaic 2, Angle 0

3.5 Mosaic 2, Angle 45

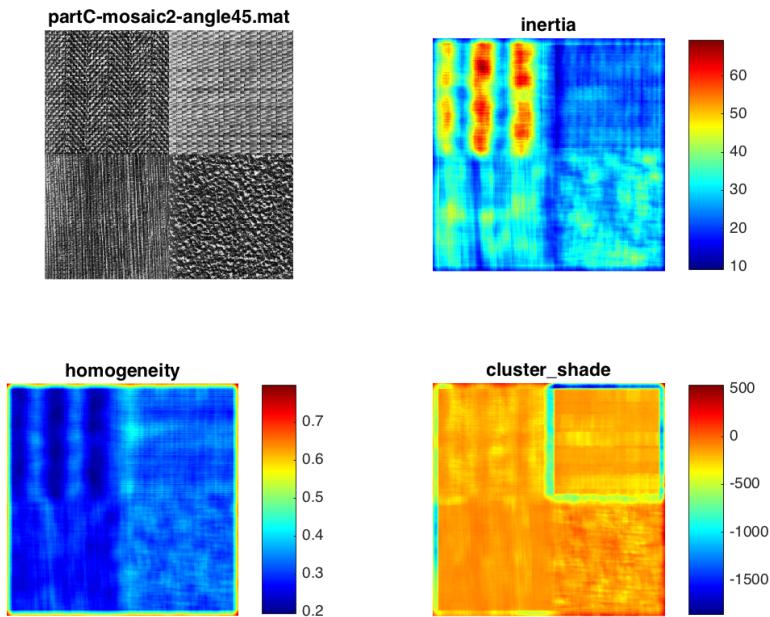


Figure 22: Mosaic 2, Angle 45

3.6 Mosaic 2, Angle 90

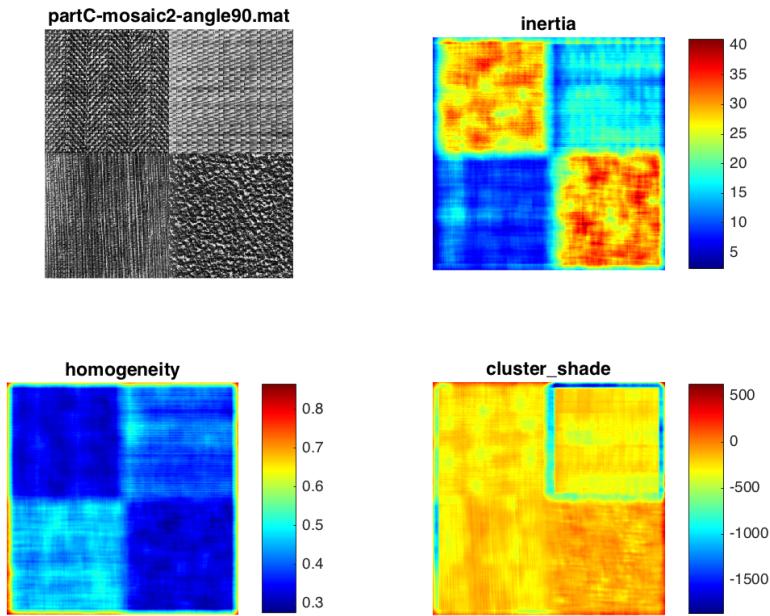


Figure 23: Mosaic 2, Angle 90

4 Segment the GLCM feature images and describe how they separate the textures

Generally I used only a couple of angles and a specific combination of GLCM features to extract the subimages. In both mosaics I first used homogeneity to isolate the two diagonal subimages and then simply flipped the thresholding to isolate the other pair. Then it became a matter of separating each pair using a different feature to break apart the pair.

Mosaic 1, Top-left

Segment 24. Segmented using homogeneity at .40 and a 90° angle, followed by inertia at 13 using a 45° angle.

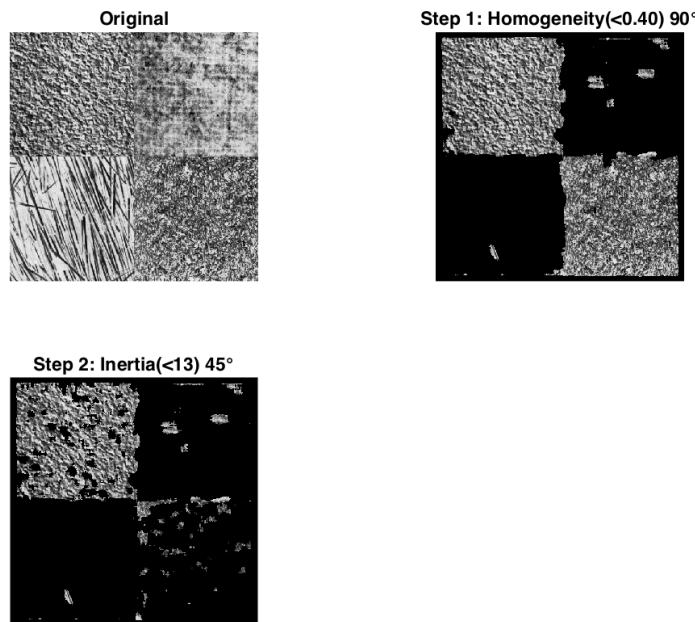


Figure 24: Mosaic 1, top-left

Mosaic 1, Top-right

Segment 25. Segmented using homogeneity at .40 and a 90° angle, followed by cluster shade at -400 using a 45° angle.

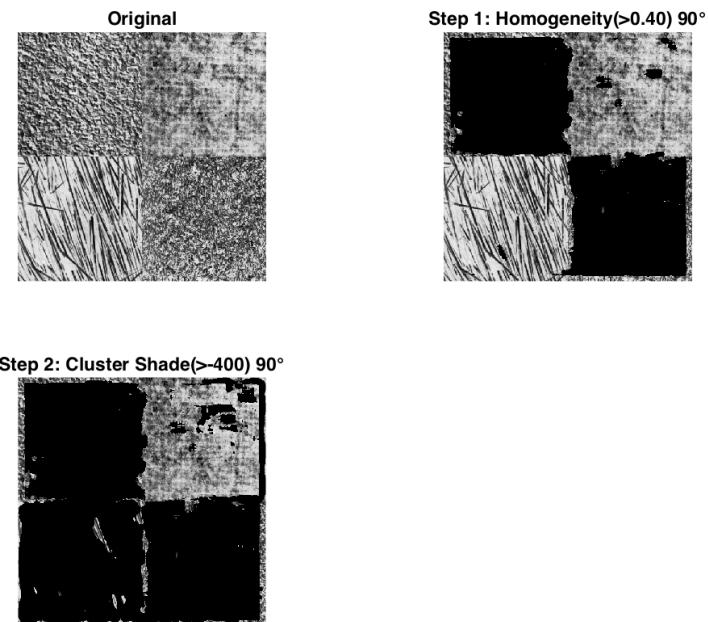


Figure 25: Mosaic 1, top-right

Mosaic 1, Bottom-left

Segment 26. Segmented using homogeneity at .40 and a 90° angle, followed by cluster shade at -400 using a 90° angle.

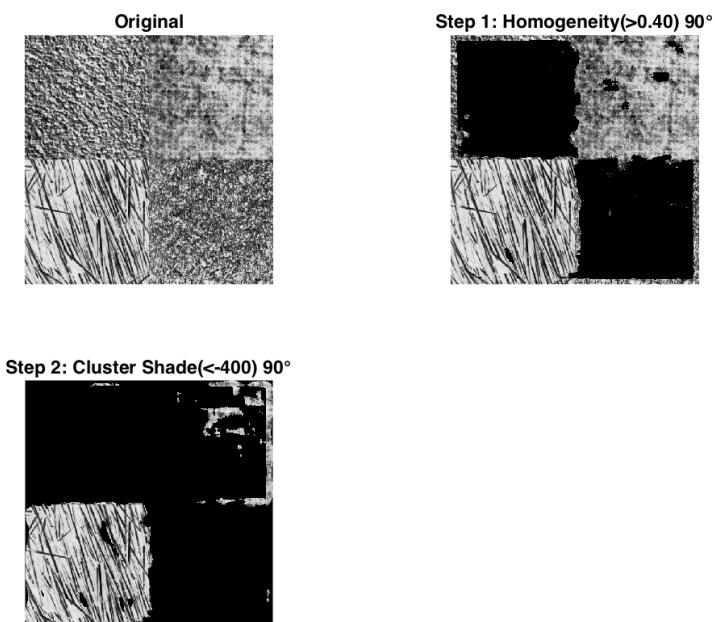


Figure 26: Mosaic 1, bottom-left

Bottom-Right

Segment 27. Segmented using homogeneity at .40 and a 90° angle, followed by inertia at 13 using a 45° angle.

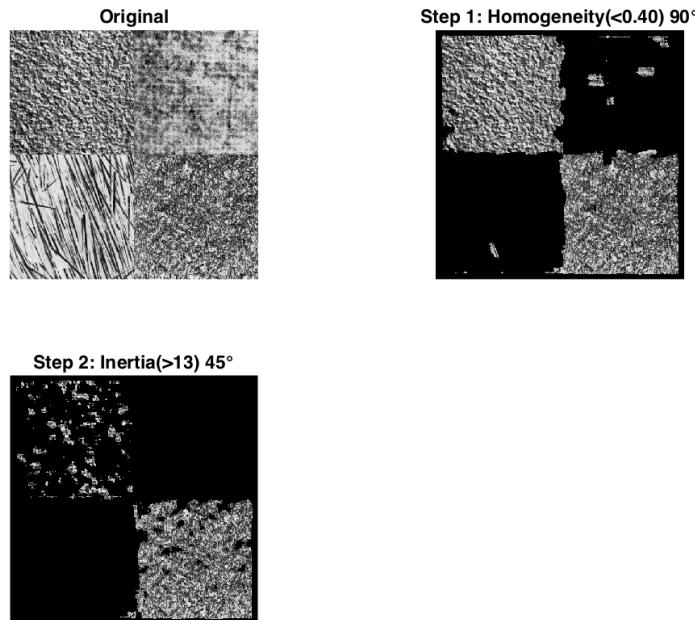


Figure 27: Mosaic 1, bottom-right

Mosaic 2, Top-left

Segment 28. Segmented using the combination of Variance and Homogeneity. Variance (threshold 0.4) isolated the top-left and bottom-right patterns and the regularity of the top-left pattern responded well to homogeneity (threshold 0.36) for isolation.

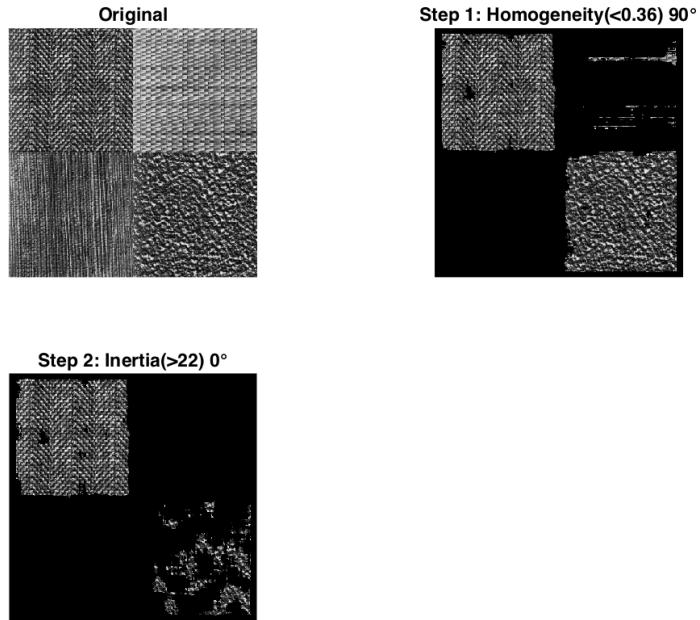


Figure 28: Mosaic 2, top-left

Top-Right

Segment 29. Segmented using Cluster Shade and thresholded with a value of 0.3, offset [4, 0].

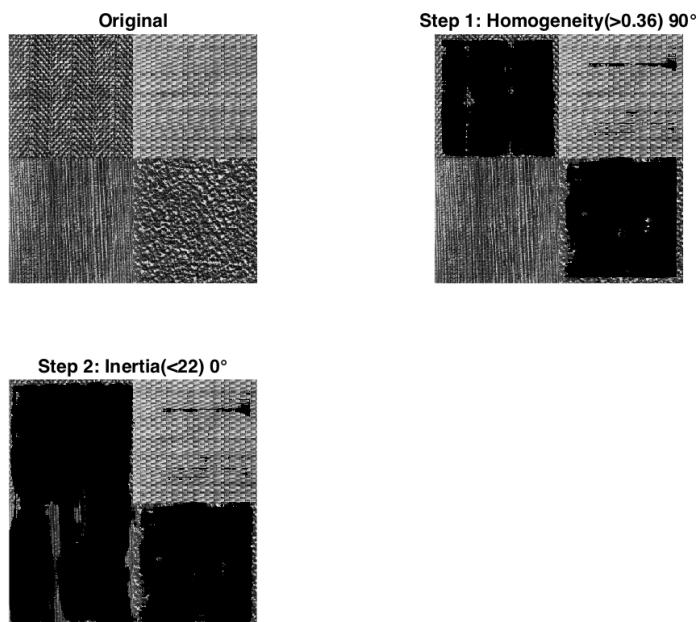


Figure 29: Mosaic 2, top-right

Bottom-Right

Segment 30. Similar to the top-left texture, but had the opposite response to homogeneity (threshold 0.35).

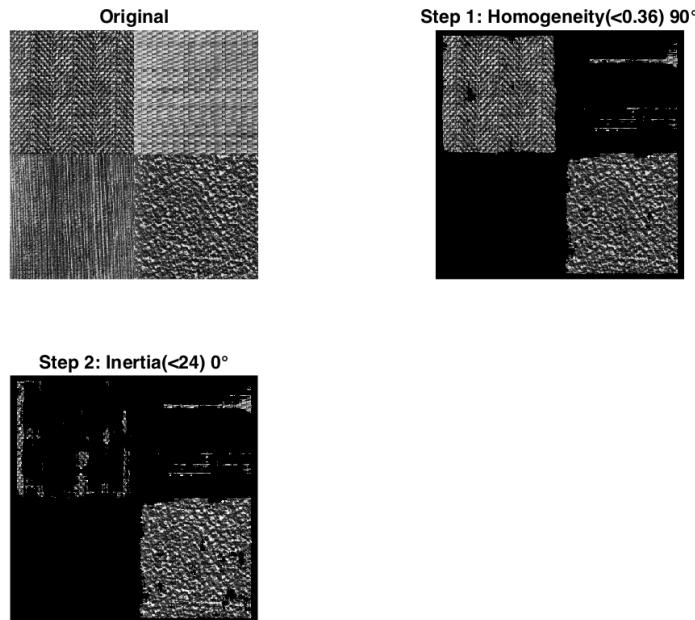


Figure 30: Mosaic 2, bottom-right

Bottom-Left

Segment 31. Segmented using Inertia and thresholded with a value of 0.3, offset [4, 0].

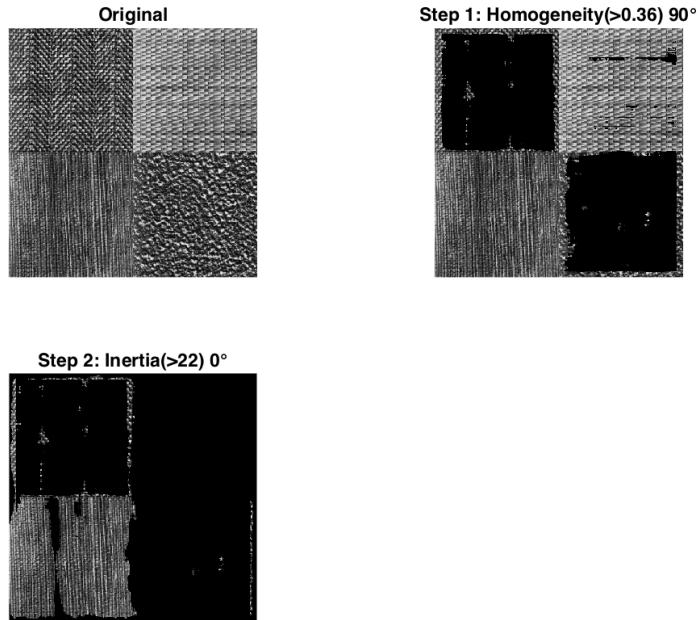


Figure 31: Mosaic 2, bottom-left