CIT 515 Project 2B Report

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Part I:

After applying the function *Harr_inv2D* to the matrix *T* we get the following result:

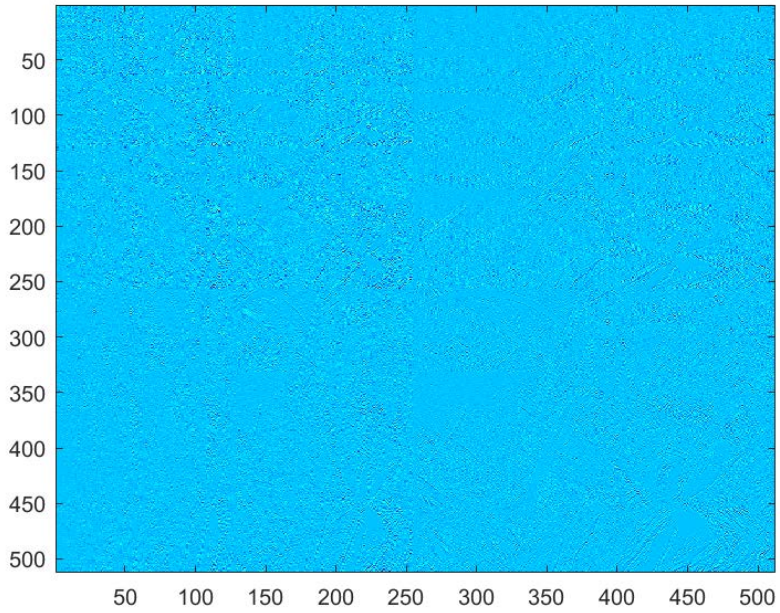
```
res_T = [576  704   1152   1280   1344   1472   1536   1536
         704  640   1152   1088   1344   1408   1536   1600
         768  832   1216   1472   1472   1536   1600   1600
         832  832   960    1344   1536   1536   1600   1536
         832  832   960    1216   1536   1600   1536   1536
         960  896   896    1088   1600   1600   1600   1536
         768  768   832     832   1280   1472   1600   1600
         448  768   704     640   1280   1408   1600   1600]
```

This is the same matrix as *Pbad* displayed below except for a typo that has been highlighted:

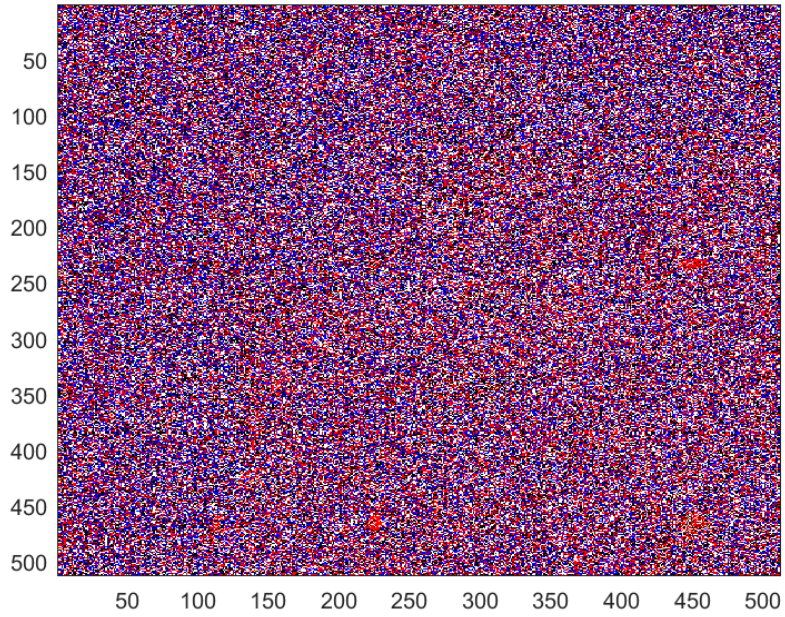
```
Pbad =  [576  704   1152   1280   1344   1472   1536   1536
         704  640   1156   1088   1344   1408   1536   1600
         768  832   1216   1472   1472   1536   1600   1600
         832  832   960    1344   1536   1536   1600   1536
         832  832   960    1216   1536   1600   1536   1536
         960  896   896    1088   1600   1600   1600   1536
         768  768   832     832   1280   1472   1600   1600
         448  768   704     640   1280   1408   1600   1600]
```

Part II: Image Transformation
Xduerer:

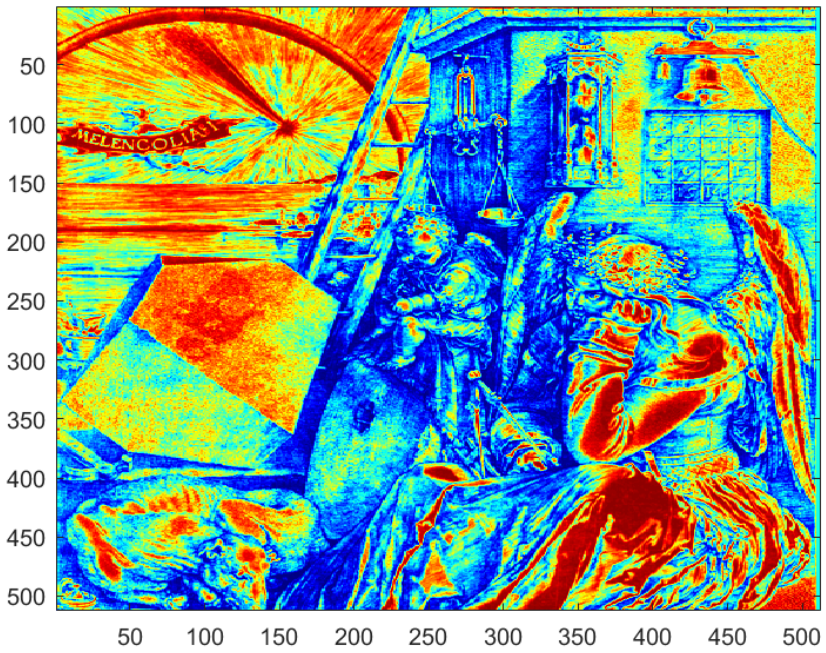
Haar2D on *Xdurer* with colormap jet: Outline points/ texture clearly visible.

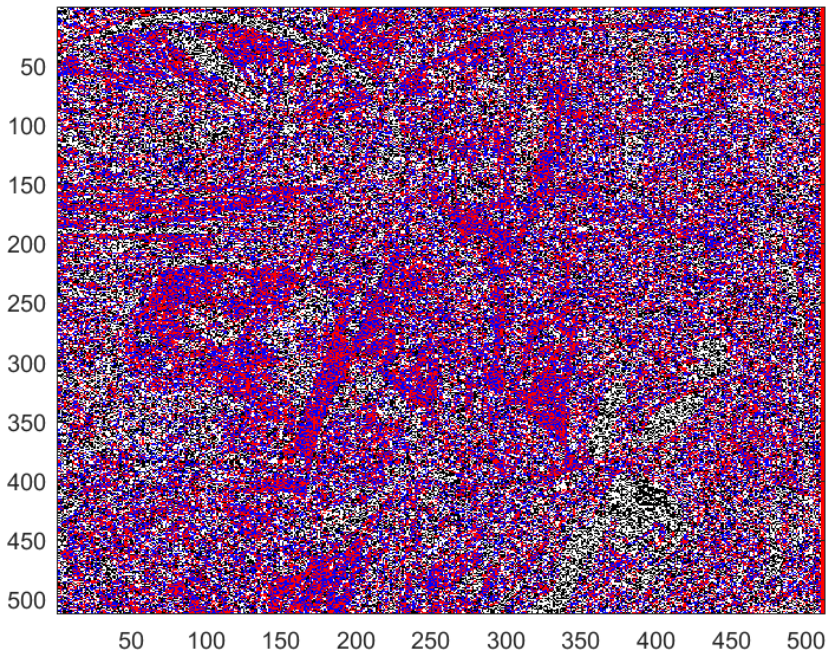


Haar2D on *Xdurer* with colormap flag: All textural details clearly visible.

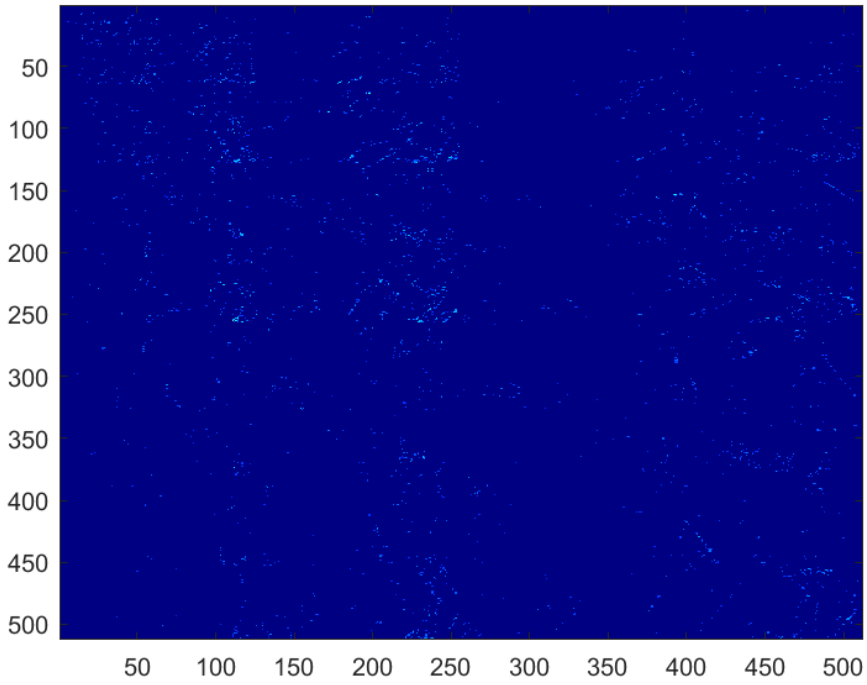


After immediate decoding\reconstructing it we get back the original image:

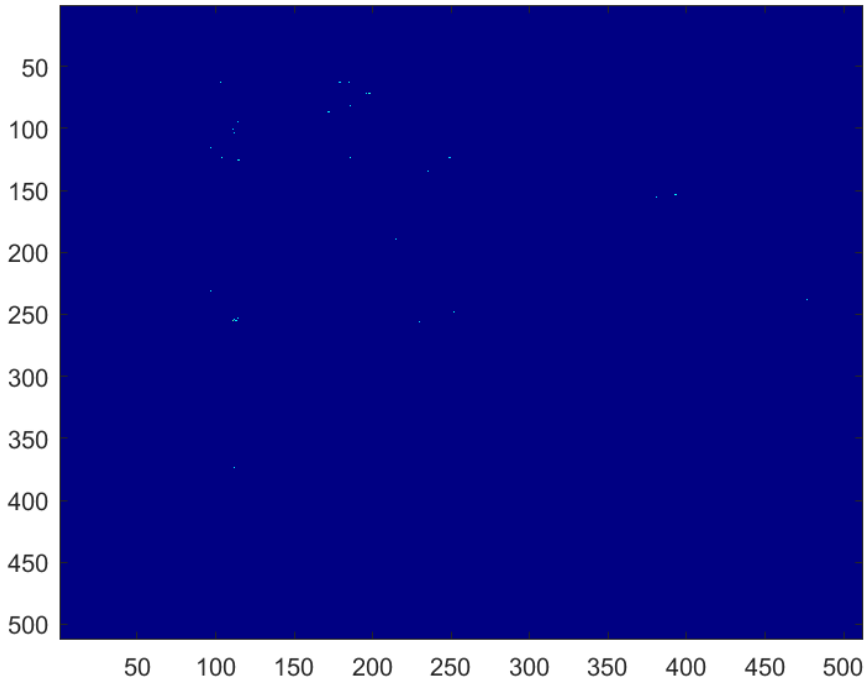




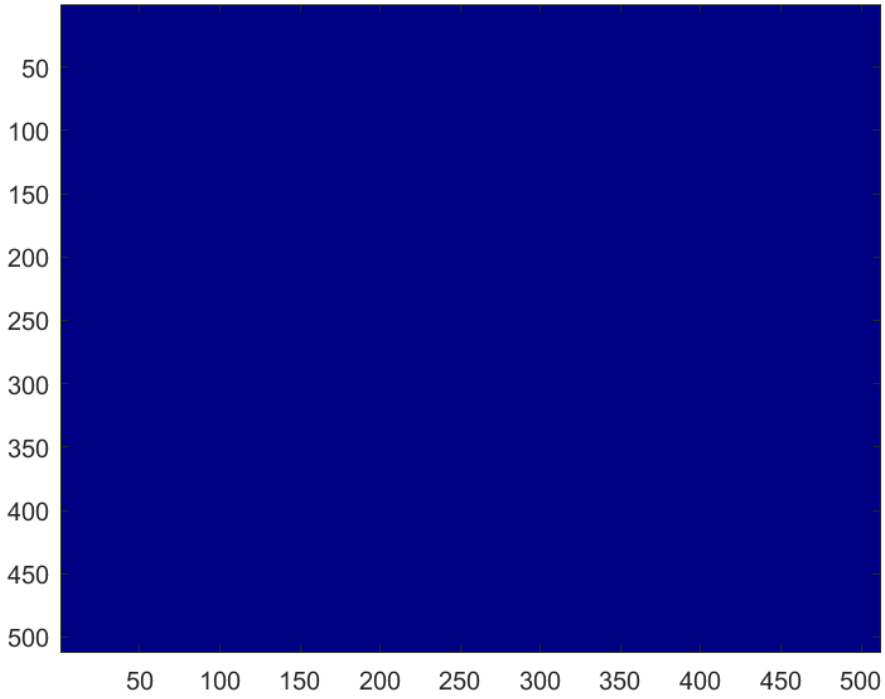
Using a threshold with colormap jet, we set the absolute value coefficients of the transformed image to zero.
Threshold of 10: Points are still clearly visible.



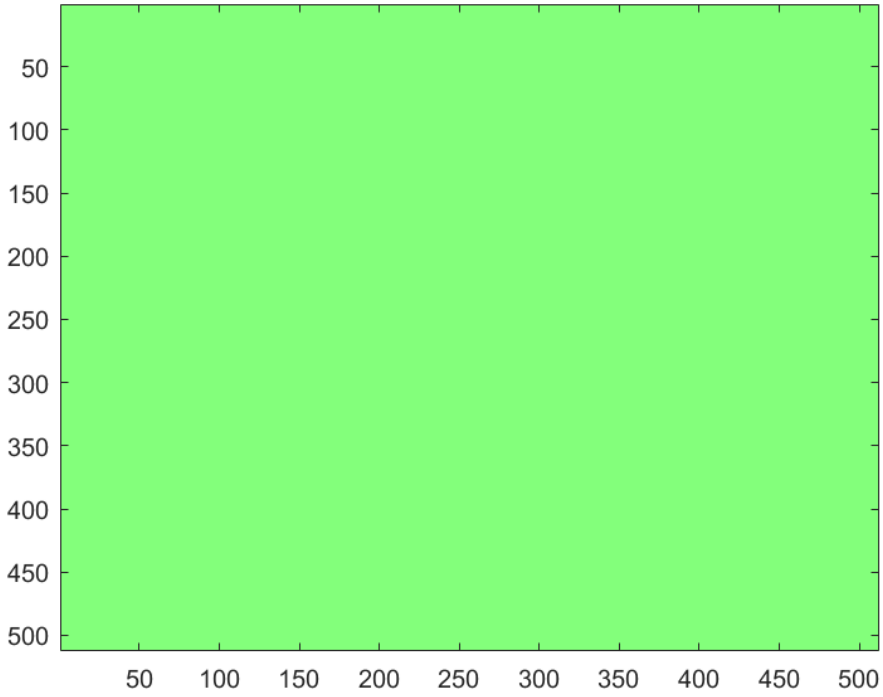
Threshold of 20: No points are visible. Fewer points are visible.



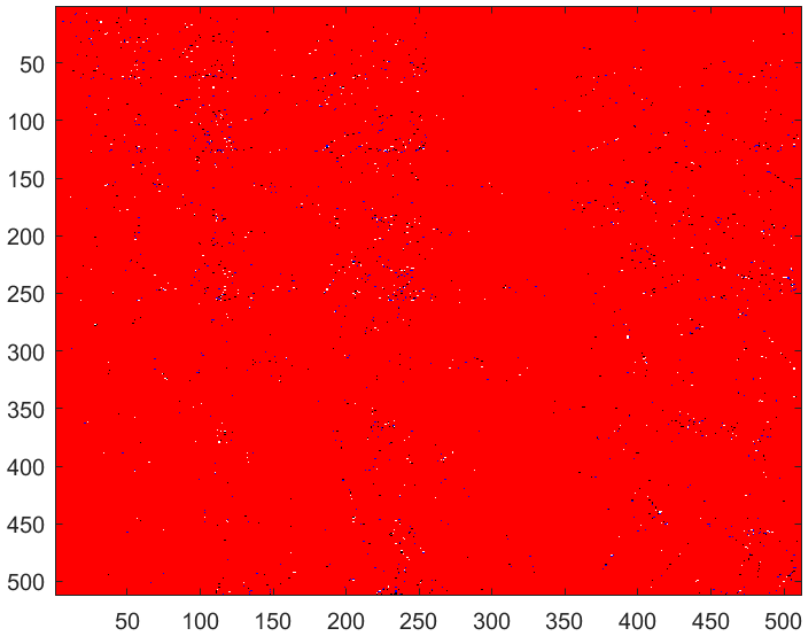
Threshold of 50: No points are visible.



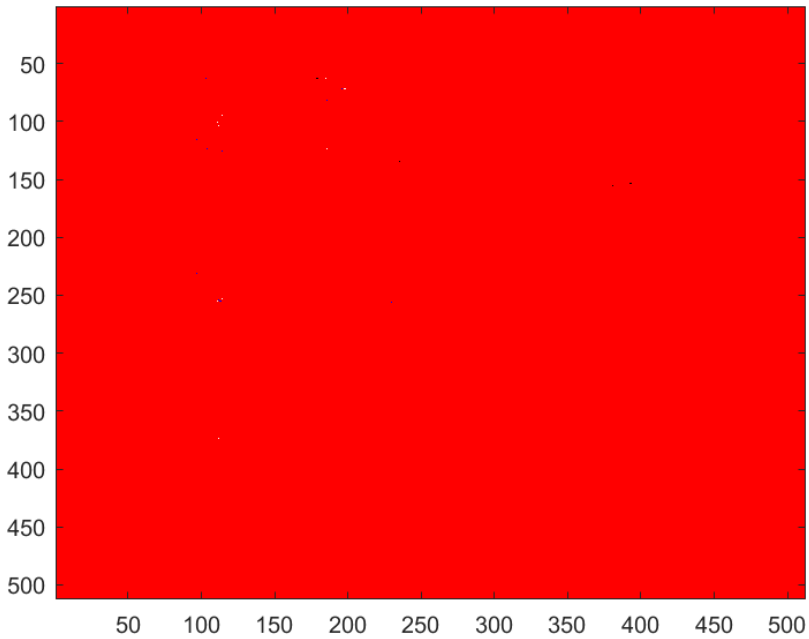
Threshold of 100: Color change.



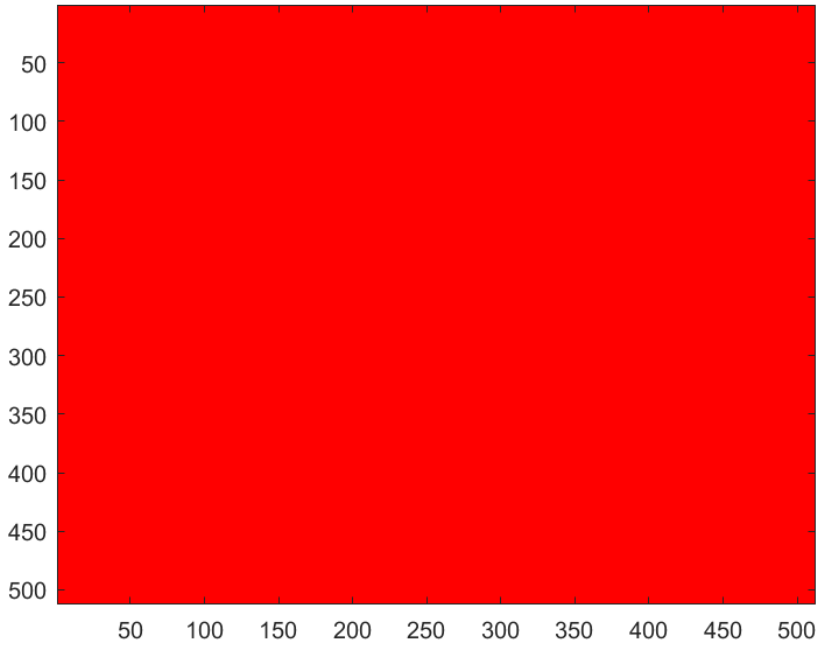
Using a threshold with colormap flag, we set the absolute value coefficients of the transformed image to zero.
Threshold of 10: Points are still clearly visible.



Threshold of 20: No points are visible. Fewer points are visible.

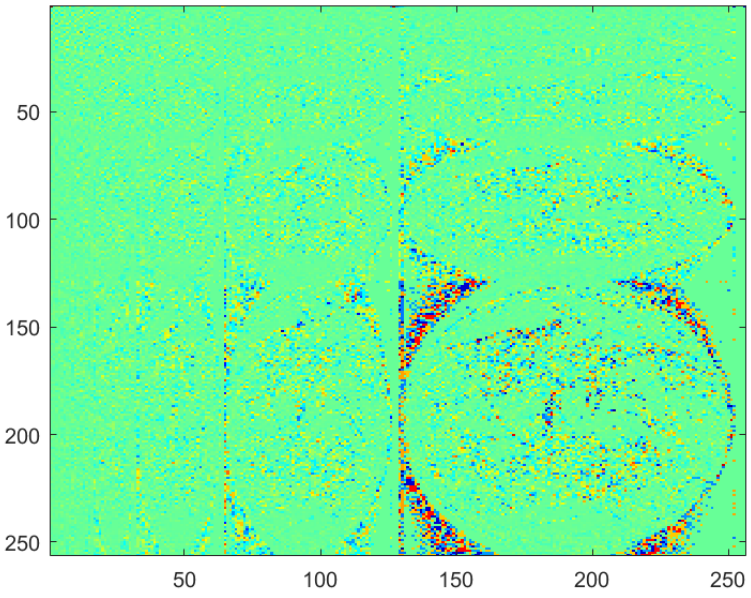


Threshold of 50: No points are visible.

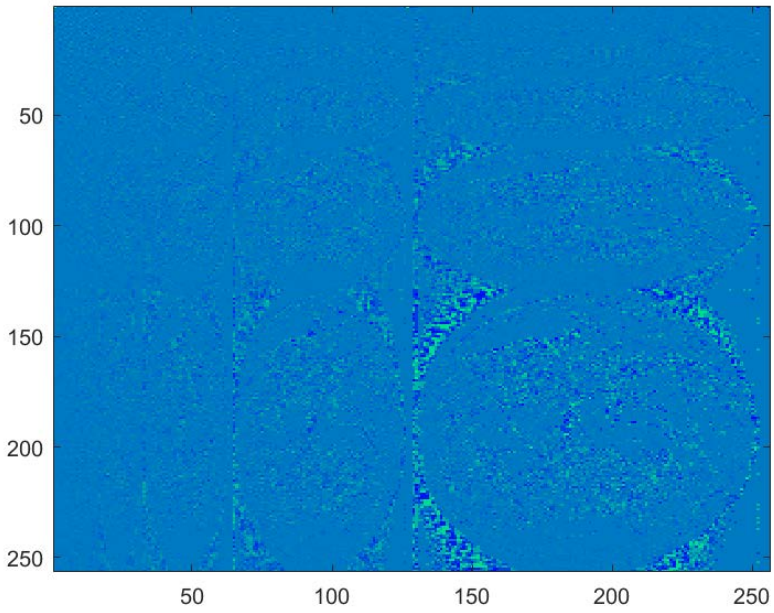


Earth:

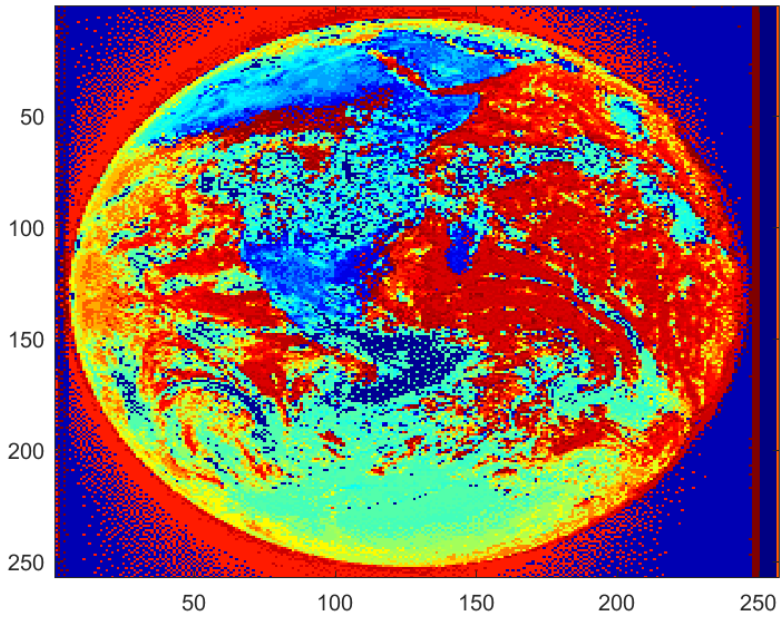
Haar2D on *Earth* with colormap jet: Outline points/ texture clearly visible.

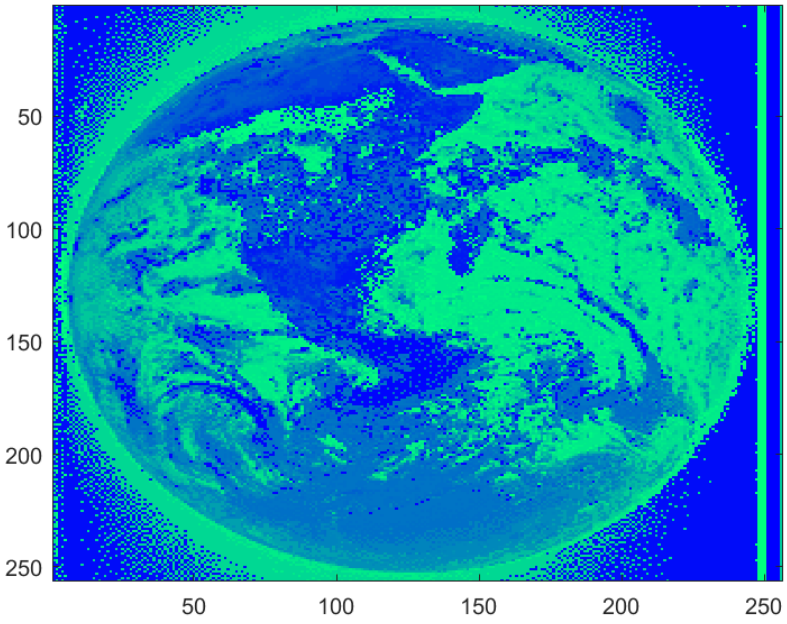


Haar2D on *Earth* with colormap winter: All textural details clearly visible.

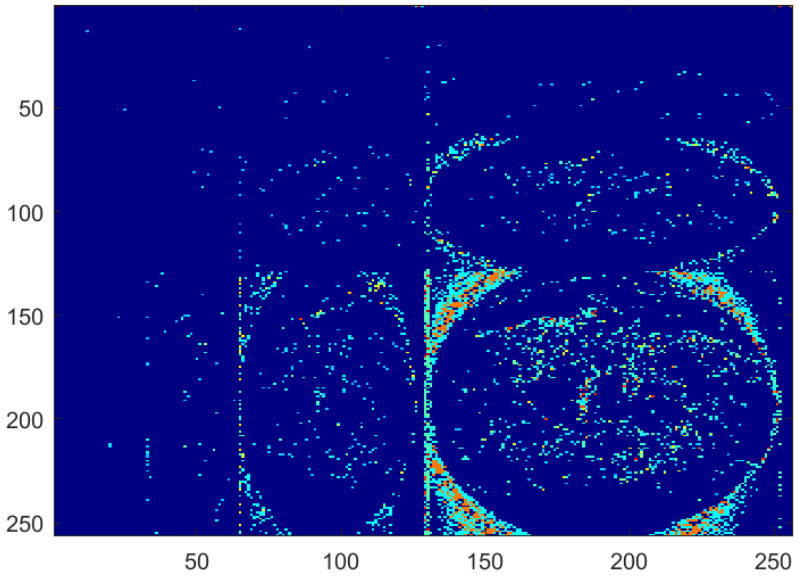


After immediate decoding\reconstructing it we get back the original image:

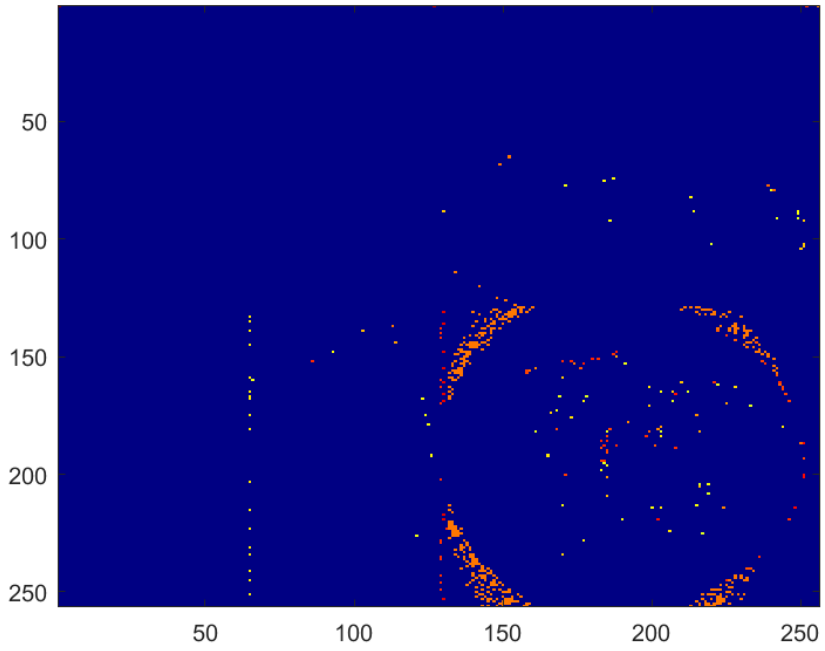




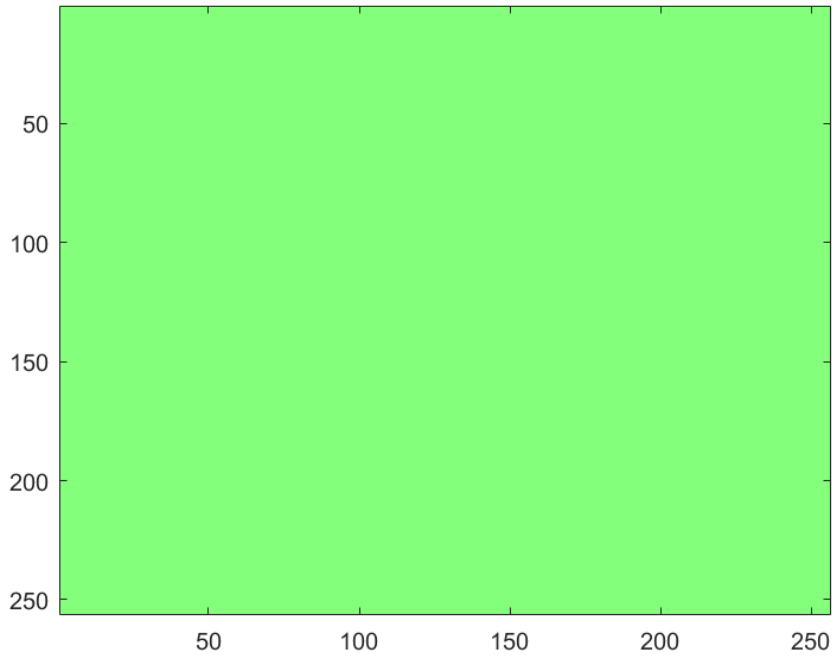
Using a threshold with colormap jet, we set the absolute value coefficients of the transformed image to zero.
Threshold of 10: Points are still clearly visible and segregated.



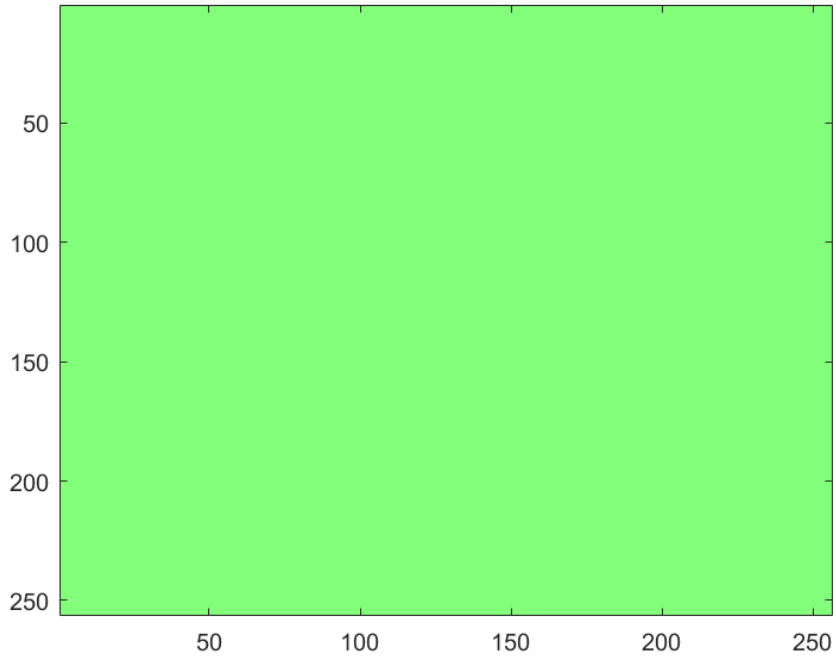
Threshold of 20: No points are visible. Fewer points are visible.



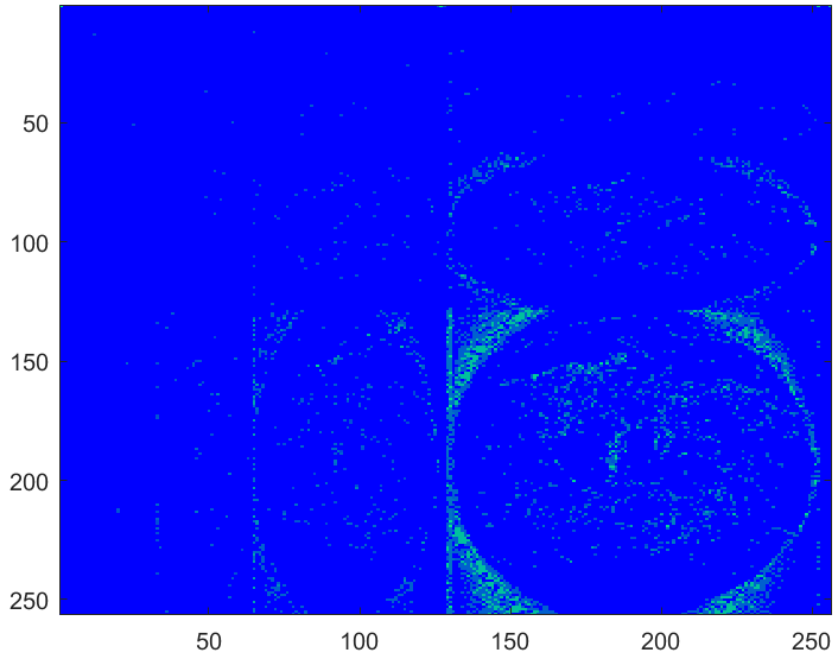
Threshold of 50: No points are visible.



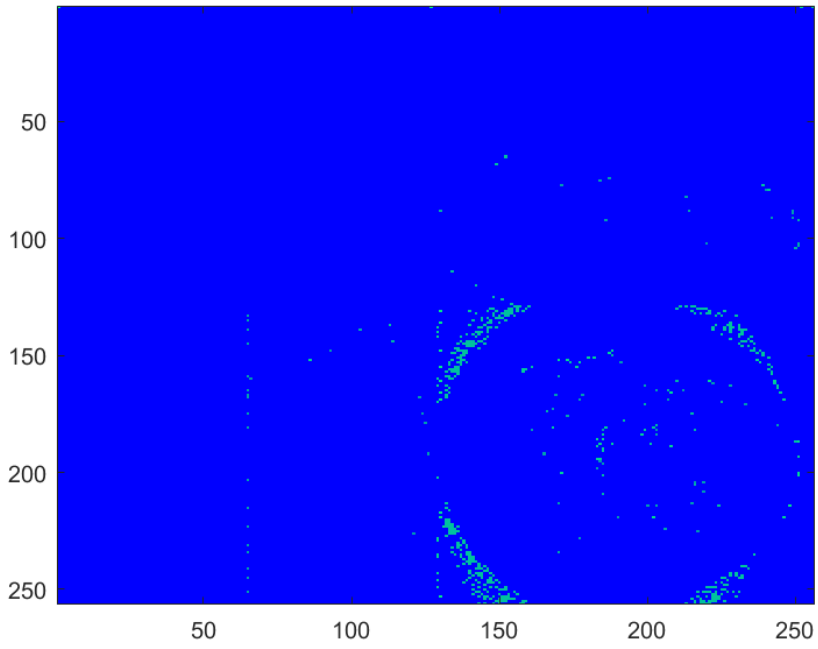
Threshold of 100: Same Image



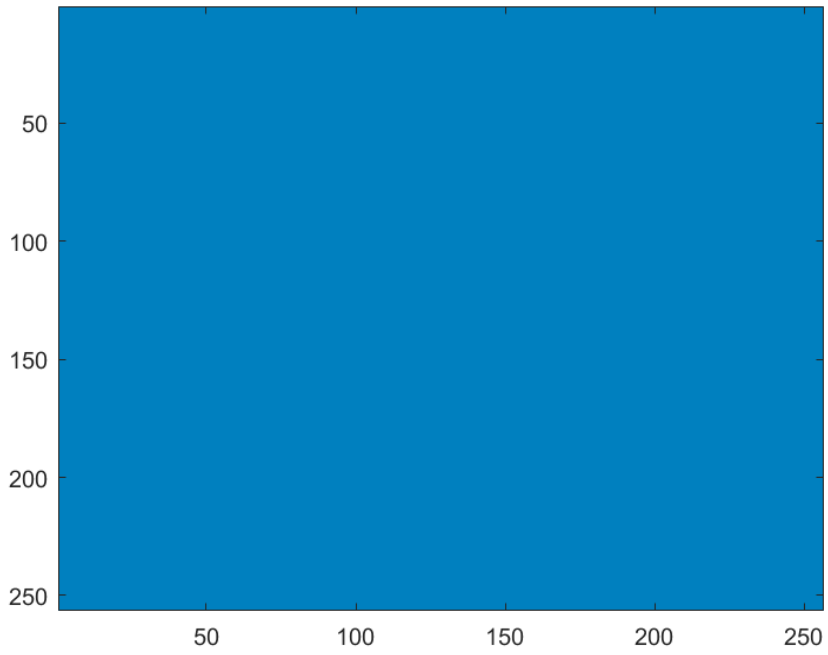
Using a threshold with colormap winter, we set the absolute value coefficients of the transformed image to zero.
Threshold of 10: Points are still clearly visible.



Threshold of 20: No points are visible. Fewer points are visible.



Threshold of 50: No points are visible.



Conclusion: The larger the threshold of zero value coefficients, the more irreversible the image becomes due to more pixels becoming visibly and structurally removed.

Part III:

Use *haar2d_n* to compute the normalized matrix *C* of Haar coefficients of *A*:

1. Apply *haar2D_n* to *A*, obtaining *C0.*

```
C0 = [682.1250   51.8750   15.2028   21.3900   6.2500    2.7500   8.2500   8.0000
      77.8750    5.6250    -7.7782   22.0971   -5.2500   -4.2500  1.7500   7.5000
       7.7782   -13.7886   -7.7500   6.7500    0.7071   -5.3033  -1.4142   2.4749
      38.3605   -0.5303    -3.2500   2.0000   -3.1820    1.4142  -1.7678   0.3536
     -17.0000   11.5000    6.7175   -1.0607   -4.0000    6.5000  -5.0000  -4.5000
       3.5000   -9.5000    -2.8284  -2.1213   -10.0000   6.0000  -5.0000   6.0000
       8.2500    4.7500    -2.8284   1.7678    1.5000   -0.5000  -1.0000   0.5000
      15.0000    4.5000     6.0104   6.0104    3.0000   -1.5000  -0.5000   4.0000]
```

2. Apply the command round to C0 to obtain a matrix C1 with integer entries.

```
C1 = [682   52   15   21    6    3    8    8
      78    6    -8   22   -5   -4    2    8
       8   -14   -8    7    1   -5   -1    2
      38   -1    -3    2   -3    1   -2    0
     -17   12    7    -1   -4    6   -5   -5
       4   -10   -3   -2   -10   6   -5    6
       8    5    -3    2    1    0   -1    0
      15    5     6    6    3   -1    0    4]
```

3. Set to zero all entries of absolute value strictly less than 10 in C1 to obtain C2.

```
C2 = [82   52   15   21    0    0    0    0
      78    0    0   22    0    0    0    0
       0   14    0    0    0    0    0    0
      38    0    0    0    0    0    0    0
      17   12    0    0    0    0    0    0
       0   10    0    0   10    0    0    0
       0    0    0    0    0    0    0    0
      15    0    0    0    0    0    0    0]
```