# IST 562 Programming 2

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## Methodology

We model this problem as a signal processing problem and treat the orthogonal edges of a thread as the signal, while the paint itself as noise.

To extract the signal, we use FFT to calculate the 2-D DFT of the input image. Assume the threads are perfectly aligned with the horizontal and vertical axis, the resulting FFT magnitude spectrum should have a most intense point on either the two axis. Figure. 1 is the FFT result of "s0049V1962-4.portion.tif". The two most intense points on the two axis are highlighted.

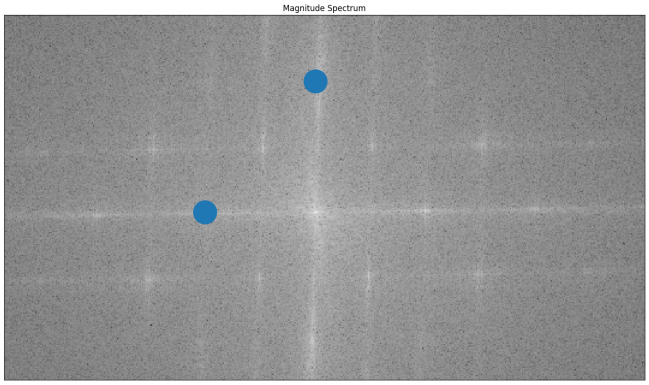


Figure 1: FFT of the test image

If we remove the signal that is not near any axis (with threshold 4 pixels), we remove all the paints (noise). The resultant image is obtained from inverse FFT and the result is shown in Fig. 2. If we remove everything but the two most intense points on the axis, we get the ideal grid image of the threads, as shown in Fig. 3.

To calculate the exact thread density, we find how far in pixels is the most intense point from the origin. Then we divide this value by the actual length of

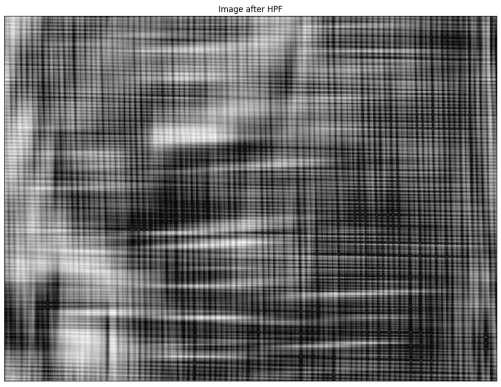


Figure 2: iFFT of the test image, after filtering

the patch (calculated using pixels and dpi) and get the density. For example, in the above patch patch, the most intense point on the x-axis is 93 pixels from the origin, and this patch is 1909 pixels in width, which is roughly 8cm. Thus we get the horizontal thread density to be $93/8 = 11.6cm^{-1}$.

To process the entire image, we first slice the entire input image into 2cm * 2cm patches and process them one-by-one. We calculate both the horizontal and vertical thread density for every patch.

To make a tinted super-imposed image, we rank the thread density in order and assign a corresponding color. Red represents larger (than average) values and blue represents smaller values. The farther the thread density deviates from the average, the more intense the color.

## Result

The resulting super-imposed images are shown in Figure 4-7. Also, we calculate the average thread density as the following table:

| | s0195V1962-3 | s0049V1962-4 |
|---|---|---|
| horizontal | 16.00 | 13.32 |
| vertical | 12.25 | 16.12 |

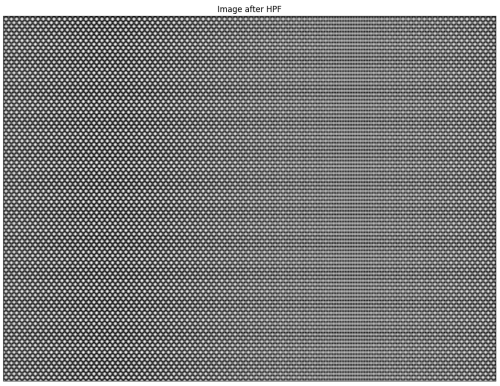


Figure 3: iFFT of the two most intense points

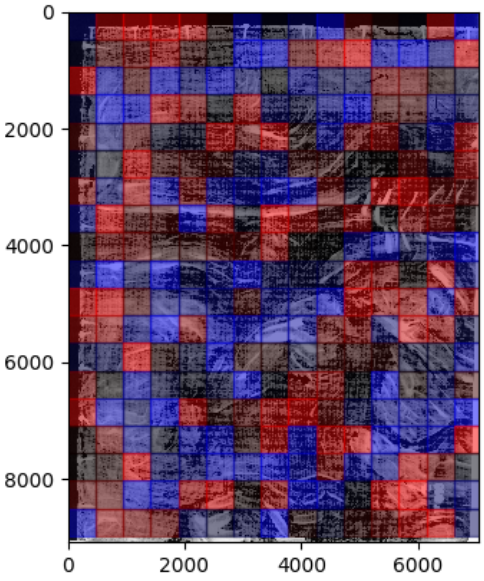


Figure 4: Horizontal thread density of s0195V1962-3.tif

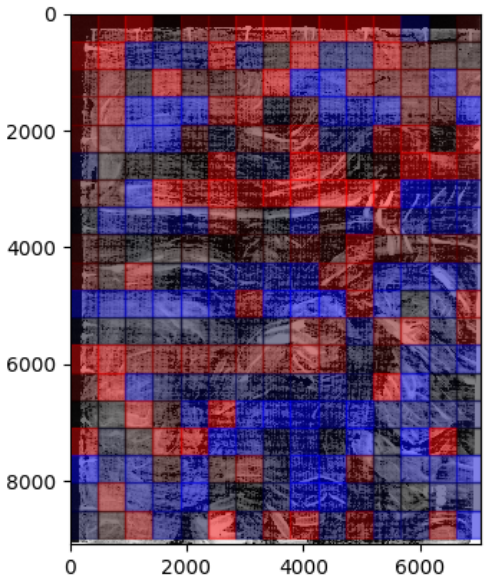


Figure 5: Vertical thread density of s0195V1962-3.tif

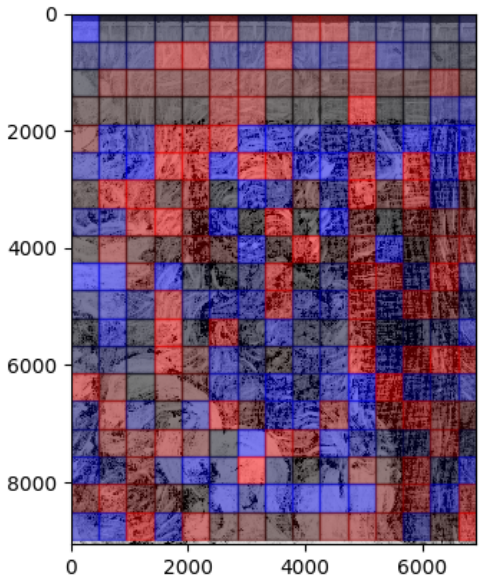


Figure 6: Horizontal thread density of s0049V1962-4.tif

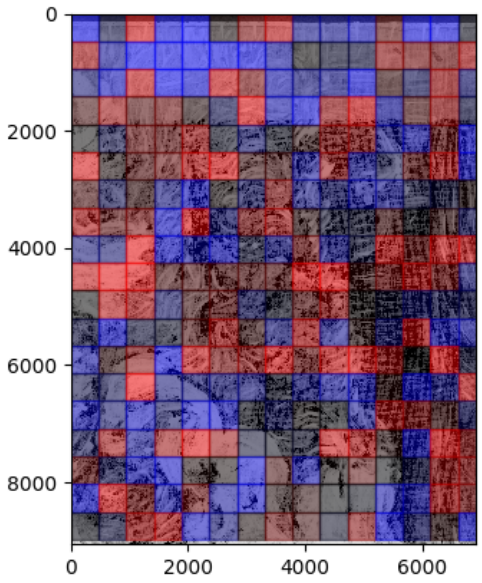


Figure 7: Vertical thread density of s0195V1962-3.tif