

## CORRELATION SIGNAL TO NON-STATIONARY NOISE RATIO PERFORMANCE

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This visualization is used to demonstrate performance of image correlation in the presence of non-stationary colored noise. The noise pattern is generated based on the “Non-Stationary Colored Noise” visualization available on the EE640 website: (<http://www.engr.uky.edu/~lgh/classes/ee640/ee64009.htm>)

1. Input reference data is used to create a detection filter from: FSMC\_Subject0000\_0001\_01.bmp. Note that this is scan 1 of finger 1 (i.e., right thumb)

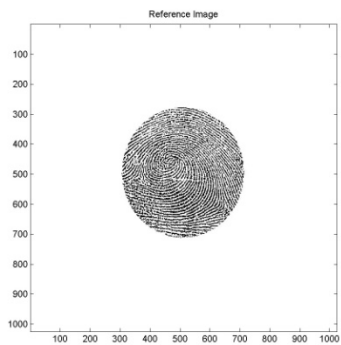


Figure 1: Reference Image

2. A rectangular section is cropped from the image in Figure 1. This will be used as the filter. However, as is, it will respond to “dc” or constant intensity regions. To fix this, subtract its average value out so that its dc response will be zero. Specify size, location and show your crop region.

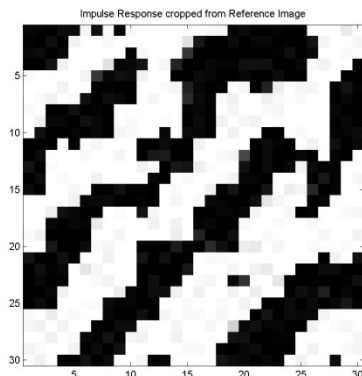


Figure 2: Cropped section used to create the detection filter.

- The test image is a different scan from the same subject and the same finger: FSPA\_Subject0000\_0002\_01.bmp. Note that this is scan 2 of finger 1 (right thumb).

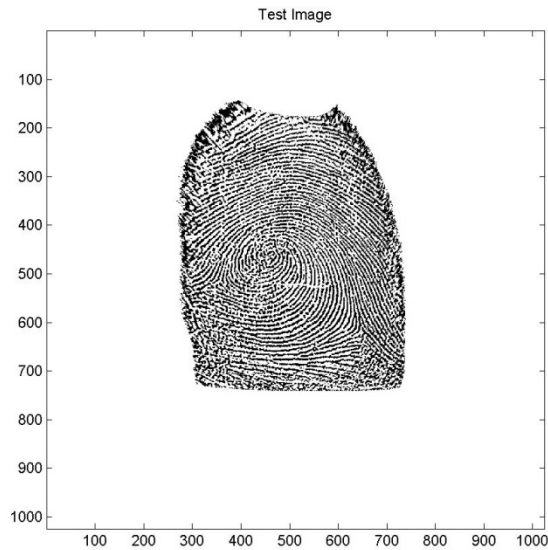


Figure 3: Test image is input to the matching system.

- Zero pad the cropped region with zero values. The size of the final image is that of the test image. For matlab, we used the fftshift function to put the origin in the center. For many applications, you need to center the cropped section about the corner  $\{1,1\}$  and distribute in quadrants to the other corners. The zero padding is everything else. The reason that you want the cropped impulse response to be centered is so the correlation peak will occur at the center position of where the match occurs with the test image. Thus, with correlation you not only get detection but you also get location of the match.

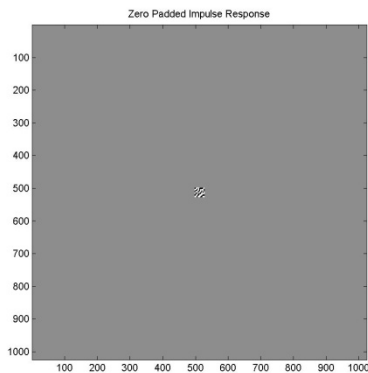


Figure 4: Zero padded impulse response.

- Correlation response from test image and detection filter is shown in Fig. 5. The white spot is the location of the match. Sometimes this is visualized by using “vga” like colors, marking the peak with cross hairs and/or using a dB based plot. Also, a negative image can be used to visualize a response that is predominantly black which also saves ink in printing out the results.

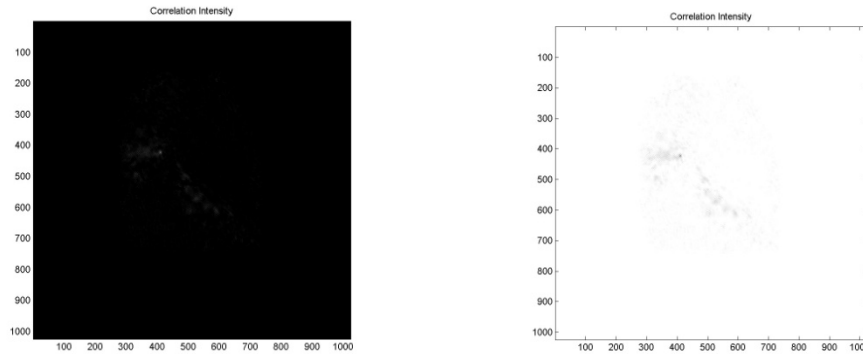


Figure 5:(left) Correlation Response. (right) Negative image.

- The correlation is commonly viewed in 3-Dimensions as shown in Fig. 6.

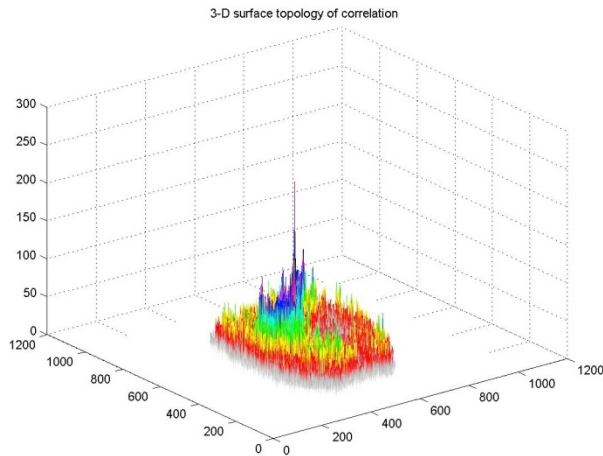


Figure 6: 3-D visualization of correlation response.

- Perform the steps 1 through 6 but with a non-stationary colored noise image added to a 3x3 augmentation of the test image in Fig. 3. Adjust the size of the crop so that at the worst response, the peak is still visible when displayed as in Fig. 6.

## APPENDIX: MATLAB CODE

1. Correlation code: Cbw is the correlation filter impulse response and Abw is the test image.

```
FCbw=conj(fft2(Cbw));  
FABw=fft2(Abw);  
FCcorr=FABw.*FCbw;  
corr=abs(fftshift(iff2(FCcorr)));
```

2. Code for visualizing correlation in 3-D in MATLAB. The correlation is real only and stored in “corr”.

```
figure (5)  
%colormap(gray);  
colormap(vga);  
surf(corr);  
shading interp  
title('3-D surface topology of correlation')  
print -djpeg figure6
```