GEO/EVS 427/EVS 527
Exercise 9: Texture

Texture refers to the process by which a pixel is compared with its surrounding neighbors to determine the degree to which the area of the image in question is homogeneous (i.e. smooth texture) or heterogeneous (i.e. coarse texture). It operates on imagery by sending a filter, which is typically 3x3, 5x5, or 7x7, across the input image and recording the digital numbers of the pixels in each part of the filter. The appropriate statistical moments are calculated and placed in the pixel-of-focus of the output image. The statistical moments that can contribute to our understanding of texture are:

- Mean – This is the average value of the digital numbers in the filter pixels. It is the first statistical moment, but it does not contribute to texture.
- Variance – The second statistical moment measures how far a set of numbers is spread out. A variance of zero indicates that all the values are identical. Variance is always non-negative: A small variance indicates that the data points tend to be very close to the mean, and hence to each other – i.e. that the image is very smooth in area of this pixel-of-focus, while a high variance indicates that the data points are very different from the mean and from each other – i.e. that the image has a very coarse texture in the area of this pixel-of-focus.
- Skewness – The third statistical moment measures the asymmetry of the distribution of digital numbers in the filter pixels. The skewness value can be positive or negative, or even undefined. The qualitative interpretation of the skew is complicated. For a unimodal distribution, negative skew indicates that the tail on the left side of the probability density function is longer than the right side – it does not distinguish these shapes. Conversely, positive skew indicates that the tail on the right side is longer than the left side. There are other complexities inherent in skewness, but for our purposes it is sufficient to consider that it refers to the degree of asymmetry in the probability density function.
- Kurtosis – The fourth statistical moment measures the peakiness of the distribution of the digital numbers in the filter pixels. There are many ways of interpreting kurtosis, but for our purposes, it is sufficient to consider that higher kurtosis means more of the variance is the result of infrequent extreme deviations, as opposed to frequent modestly sized deviations.

It should be clear from these definitions that the size of the filter used will have a significant impact on the calculation and interpretation of any of these statistical moments – and hence of texture. It should also be clear that one can obtain textural information from both single-band and multispectral imagery.

Exercise

You should experiment with the texture tool in ERDAS Imagine (Raster → Spatial → Texture) to determine the implications of window size, pixel size (i.e. spatial resolution), and band number on calculations of texture.

You should use at least 3 images for your experimentation:

- A thematic mapper image such as Shaker Heights, Lanier, or something of your own choosing
- A multi-band aerial photograph such as generated by OSIP or NAIP
- A single-band aerial photograph

On all of these images, you should try several window sizes (e.g. 3, 7, 13). Evaluate all of them as to which window(s) produce the most meaningful results.

On all of these images, you should generate texture images of variance, skewness, and kurtosis. Again, you should evaluate each of these outputs as to which produce the most meaningful results.

You may wish to layer-stack the output images into a single multi-band image (especially for the single-band gray-scale image).

You should print out the imagery that you feel best deals with texture. You might wish to explain how the texture of a landscape contributes to your understanding of the grain of the ecosystem. Plan to include at least 4 images and your discussion in your portfolio.

Portfolio

9-1   4 (or more) images showing the effects of texture on different sorts of imagery, including Landsat
9-2   and Aerial Photography, both single-band and multi-band.
9-3
9-4

9-5   Your verbal discussion of the insights gained from the images you've shown in 9-1 through 9-4