Derive Image Texture Information

Remote Sensing For Ranger Districts Using Image Analysis For ArcGIS

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It is assumed that you have a basic understanding of image texture. Image texture is a measure of variation between the spectral properties of a pixel and its neighboring pixels. High texture indicates large spectral changes between adjacent pixels, while low texture is more indicative of few spectral changes.

*Ensure the Spatial Analyst extension and toolbar are enabled: 1) Select **Tools | Extension** from **ArcMap's** Main Menu and check **Spatial Analyst**, 2) select **View | Toolbars** from **ArcMap's** Main Menu and check **Spatial Analyst**, and 3) dock the **Spatial Analyst** toolbar if necessary.*

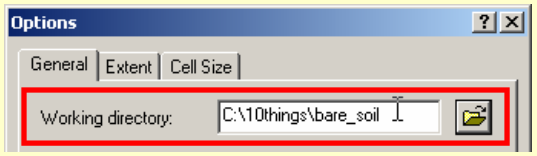

***Figure 1**. The location of the **Working Directory** and its associated **Yellow Folder** button in the **Options** dialog. The **Working Directory** is the default location for placing files using **Spatial Analyst** functions—especially useful when using the Raster Calculator.*

Objectives

- To create a texture image from DOQs (Digital Orthophoto Quads)
- To create a thematic texture layer from your texture image

Required Data

- A DOQ

Introduction and Overview of Procedure Steps

Image texture is a measure of spectral variability across an image. A texture image is useful for assisting visual interpretation and subsequent analysis of high resolution imagery (e.g., DOQs). The focus of this topic is 1) to describe how to create a texture image from a DOQ, and 2) to describe how to create a thematic texture layer of your texture image. The topics include:

1. Set-up ArcMap
2. Create Your Texture Image
3. Filter Your Texture Image
4. Smooth Your Texture Image
5. Rescale Your Texture Image
6. Create Your Thematic Texture Layer

I. Set-up ArcMap

1. Launch **ArcMap** from the **Start** menu (**Start | Programs | ArcGIS | ArcMap**).
2. Select the **Add Data** button from **ArcMap's Standard** toolbar.
3. Navigate to and select your **DOQ**.
4. Select **Add** to load your **DOQ** into **ArcMap's Table of Contents**.
5. Ensure the **Spatial Analyst** toolbar and extension are enabled (see note to left).
6. Select **Spatial Analyst | Options** from the **Spatial Analyst** toolbar.
7. Ensure the **General** tab is open in the **Options** dialog (if not, select the **General** tab).
8. Click the **Yellow Folder** button associated with the **Working Directory** (Figure 1).
9. Navigate to an appropriate directory in the **Choose a Working Directory** dialog.
10. Select **OK** in the **Choose a Working Directory** dialog.
11. Select **OK** in the **Options** dialog.

II. Create Your Texture Image

1. Select **Spatial Analyst | Neighborhood Statistics** from the **Spatial Analyst** toolbar. Set the following parameters in the **Neighborhood Statistics** dialog (Figure 2):

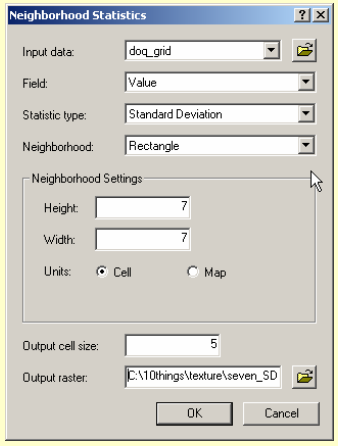

***Figure 2**. The **Neighborhood Statistics** dialog. Note that the parameters are set-up for a **7x7 analysis window** and a **Standard Deviation Statistic Type**.*

- **Input Data**: *your DOQ*
- **Field**: *Value*
- **Statistic Type**: *Standard Deviation* (used to evaluate texture)
- **Neighborhood**: *Rectangle*
- **Height**: *7*
- **Width**: *7*
- **Units**: *Cell*
- **Output Cell Size**: *Leave as default*
- **Output Raster**:
  - *Select the Yellow Folder button*
  - *Navigate to an appropriate output directory*
  - *Enter a File Name*
  - *Click the Save button*
- Select **OK**. Your **Texture Image** will automatically appear in the **Table of Contents** once the process completes.

III. Filter Your Texture Image

1. Select **Spatial Analyst | Neighborhood Statistics** from the **Spatial Analyst** toolbar. Set the following parameters in the **Neighborhood Statistics** dialog:
   - **Input Data**: *your Texture Image*
   - **Field**: *Value*
   - **Statistic Type**: *Minimum* (used to remove high values of texture)
   - **Neighborhood**: *Rectangle*
   - **Height**: *3*
   - **Width**: *3*
   - **Units**: *Cell*
   - **Output Cell Size**: *Leave as default*
   - **Output Raster**:
     - *Select the Yellow Folder button*
     - *Navigate to an appropriate output directory*
     - *Enter a File Name*
     - *Click the Save button*
   - Select **OK**. Your **Filtered Texture Image** will automatically appear in the **Table of Contents** once the process completes.

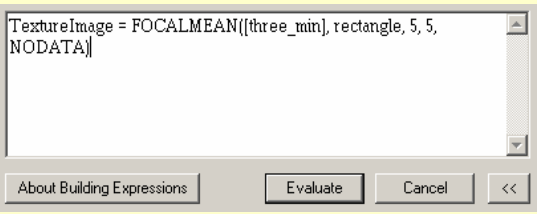

***Figure 3**. An example expression for the **FOCALMEAN** function in the **Formula Area** of the **Raster Calculator**.*

*Ensure when you develop an expression using the **Raster Calculator** that you put spaces between operators (e.g., +, -, etc.) and that your output file name has less than 13 characters.*

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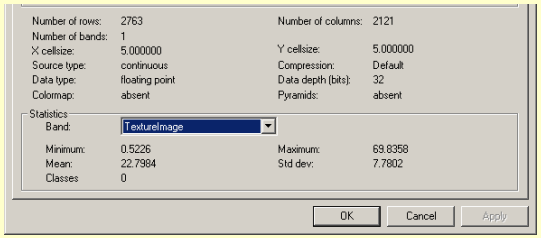

Figure 4. *This is part of the* ***Source*** *tab in the* ***Layer Properties*** *dialog. In this dialog, you can obtain important information about an image.*

Why is it important to convert your image from 32-bit, floating point to 8-bit, unsigned integer?

1) Reduce file size.

2) Can be required for subsequent analysis (data normalization).

Why must you use a work-around solution to convert the data? *When performing image processing with ArcGIS 8.3, the default data depth and type is typically 32-bit, floating point even when input data is 8-bit, unsigned integer. Other software programs (e.g., Imagine) allow the user to specify the output data type and depth.*

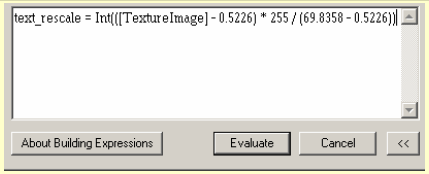

Figure 5. *Expression for rescaling your* ***Texture Image*** *in the* ***Formula Area***.

IV. Smooth Your Texture Image

1. Select **Spatial Analyst | Raster Calculator** from the **Spatial Analyst** toolbar.
2. Enter the following expression in the **Formula Area** of the **Raster Calculator** (Figure 3):
   TextureImage[a] = FOCALMEAN[b]([your3x3FilteredImage[c]], rectangle, 5, 5, NODATA)
   - [a] = The new file name for your **Smoothed Texture Image**.
   - [b] = The FOCALMEAN function is used to smooth your **Filtered Texture Image**.
   - [c] = The file name for your **Filtered Texture Image**.
3. Click **Evaluate** in the **Raster Calculator**. Your **Smoothed Texture Image** will automatically appear in the **Table of Contents** once the process completes.

V. Rescale Your Texture Image

1. Double-click your **Smoothed Texture Image's** file name in the **Table of Contents**.
2. Select the **Source** tab in the **Layer Properties** dialog.
3. Write down the following parameters from **Statistics** section of the **Source** tab (Figure 4):
   - **Minimum**: _____ (ensure that you include the sign if it's a negative value)
   - **Maximum**: _____
4. Note the **Data Type (bits)** and **Data Type**—they should indicate **32** and **floating point**, respectively. You need to rescale these values to **8** and **signed integer** (see comments to the left).
5. Click **OK** to close the **Layer Properties** dialog.
6. Select **Spatial Analyst | Raster Calculator** from the **Spatial Analyst** toolbar.
7. Enter the following expression in the **Formula Area** of **Raster Calculator** (Figure 5):
   RescaleTextureImage[a] = Int[b](([yourTextureImage[c]] - Min[d]) * 255 / (Max[e] - Min[d]))
   - [a] = The new file name for your **Rescaled Texture Image**.
   - [b] = **Int** stands for **Integer**.
   - [c] = The file name for your **Smoothed Texture Image**.
   - [d] = Enter your **Minimum** value.
   - [e] = Enter your **Maximum** value.
8. Click **Evaluate** in the **Raster Calculator**. Your **Rescaled Texture Image** will automatically appear in the **Table of Contents** once the process completes.

VI. Create Your Thematic Texture Layer

1. Double-click your **Rescaled Textured Image** in the **Table of Contents**.
2. Select the **Source** tab from the **Layer Properties** dialog (see critical comment to right).

Some of you may find that even after the rescale your Data Type is ***Signed Integer*** *and the Data Depth (Bits) is* ***16****. Recall that you should scale your image to* ***Unsigned Integer*** *and* ***8****. The problem is that NODATA pixel values in a GRID are output as -9999 and not 0. Converting your GRID to an ERDAS IMAGINE file format using ArcToolbox will appropriately scale the image to* ***Unsigned Integer*** *and* ***8-bit****.*

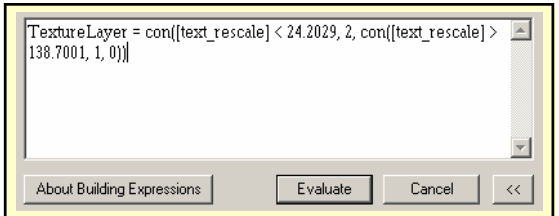

***Figure 6**. This is an example of an expression for creating a **Thematic Texture Layer**. This expression says that if a pixel value is less than 24.2029 (the Low Texture Threshold Value) it will be classified as 2. If a pixel value is greater than 138.7001 (the High Texture Threshold Values), it will be classified as 1. If a pixel value meets neither of these conditions, it will then be classified as 0. In your **Thematic Texture Layer**, you can interpret the following classes:*

***0** = Pixel does not have high or low texture*
***1** = Pixels with high texture values*
***2** = Pixels with low texture values*

3. Write down the following parameters from the **Statistics** section of the **Source** tab (Figure 4):
   - **Mean**:_____
   - **Std dev**:_____ (for standard deviation)
4. Select **OK** to close the **Layer Properties** dialog.
5. Calculate and write down the answers to the following expressions:
   Mean - (Std dev * 2.0[a]) = _____[b]
   Mean + (Std dev * 2.0[a]) = _____[c]
   - [a] = These are the **Threshold Value Factors**. These values can be described as the number of standard deviation values from the mean of your **Rescaled Texture Image**.
   - [b] = This is your **Low Texture Threshold Value**.
   - [c] = This is your **High Texture Threshold Value**.
6. Select **Spatial Analyst | Raster Calculator** from the **Spatial Analyst** toolbar.
7. Enter the following expression in the **Formula Area** of **Raster Calculator** (Figure 6):
   TextureLayer[a] = con[b]([yourRescaledTextureImage[c]] < Low Texture Threshold Value[d], 2, con([yourRescaledTextureImage] > High Texture Threshold Value[e], 1, 0))
   - [a] = The new file name for your **Thematic Texture Layer**.
   - [b] = **con** indicates you are creating a **Conditional** statement.
   - [c] = The file name for your **Rescaled Texture Image**.
   - [d] = Enter your **Low Texture Threshold Value**.
   - [e] = Enter your **High Texture Threshold Value**.
8. Click **Evaluate** in the **Raster Calculator**. Your **Thematic Texture Layer** will automatically appear in the **Table of Contents** once the process completes.
9. Inspect your results. Feel free to experiment by adjusting the **Threshold Value Factors** from step 5 of this section to create a new **Thematic Texture Layer** (e.g., change the low value to –2.2 instead of 2.0, and the high value to 1.8 instead 2.0). Keep experimenting until you are satisfied with your **Thematic Texture Layer**.

In Summary, you

1. Created a Texture Image from your DOQ;
2. Filtered your Texture Image using the Neighborhood Statistics function;
3. Smoothed your Texture Image using the FOCALMEAN function in the Raster Calculator;
4. Rescaled your Texture Image using the Raster Calculator; and
5. Created a Thematic Texture Layer that assigned pixels to a low, high, or neither category.