Remote Sensing, Fall 2016: Lab 5
Ratios, Indices and Transforms

There is a general purpose in the operations in this lab:

to enhance or extract features and patterns which are 'latent' in the image channels

Start Geomatica from the Linux window using the PCI local launch icon

In Focus, Open your copy of the **Prince George Landsat TM scene 2011**

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1. Ratios and Indices

Display band 4 in grayscale
layer-> add-> grayscale -> next->band4-> finish
You also have a NIR/Red ratio from Lab 4; display it in grayscale by ticking that channel in the 'RGB' display table
Investigate the DN in water and in shadow (north of the eskers) in band 4 and the ratio ... you should be able to see how the ratio has 'upped' the DN in shadow to 'compensate for topography'

Normalised Difference Vegetation Index NDVI

The NDVI is the most commonly used modified ratio (index) to identify vegetation biomass the formula is as below:

Use the raster calculator to create a NDVI channel: NDVI = (TM4-TM3)/(TM4 + TM3)
Output to a 32 bit channel and save the resulting layer in the PIX file ... describe/name it suitably - NDVI
what is the range of values for deciduous (broadleaf) vegetation?
what type of land cover have values below 0 ?
what is the correlation between NDVI and the 4/3 ratio ? (**Layer-> Scatterplot**) - it should be very high.

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2. Tasseled cap : TASSEL

The tasseled cap is a transformation used in ecosystem and habitat studies. This operation will produce 3 new data channels equated to brightness, greenness and wetness (BGW) – we have used the greenness channel to try to explain black bear sightings and behaviour.

Lets try something no rightous IKEA assembler would never do – lets look at the help for this operation. While we are at it, look at the help for the NDVI. Many people complain about the help in PCI – but as it is kind of geeky , Scott likes it.

Look through the help and see if we can do this transformation using the landsat 8 data. We wil discuss this in lecture.

use these options :
Input: 1,2,3,4,5,7 (EXCLUDE Band 6)
Output: grayscale and tick the file option and change the file to your copy of the PG .pix file
Sensor: TM
SMOD: AUTO

Label/describe the channels in your dataset or this will all get confusing
Check the resulting 3 image channels, and display each in grayscale
Examine the spread of data using right-click or **layer-> histogram**, and the correlation between them (Right-click or **Tools-> Scatterplot**) - they should be uncorrelated (view B v G; B v W; G v W … using their respective channel numbers)

Check also the correlation between **greenness and the 4/3 ratio** (it should be high … why ?)
and the correlation between **wetness and band 5 -** can you explain why you get this general value ?

Add a RGB layer and display the three tassel channels BGW as a colour composite - it has high contrast, but the colours are tough to interpret ...it might be easier if you reverse the channels (try BGW -> BGR instead of RGB) ... but not by much!

Run an **unsupervised classification (**we told you there would be plenty classifications in this class) using only the 3 TCA channels as input with K-means and 12

classes .. use an empty channel for output (create if needed by clicking on the 'add layer' in the classification session pop-up box)
... is the classification output better than we did using bands 3-4-5 in lab 3 ? In theory it could work better as the channels are 'more different' from each others = less correlated, but it may be tough to tell

If Scott (not Roger – he would never be some mean) determined the coefficients for performing the Tassel Cap Tranformation for Landsat 8 – could you do it?.. How. See:

http://community.hexagongeospatial.com/t5/tkb/articleprintpage/tkb-id/KS_SpatialModeler_AnalyticalRecipes/article-id/29

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3. Principal Components Analysis: PCA

Run PCA - as with Tassel, input bands 1,2,3,4,5,7 (NOT Band 6)
Output: grayscale and save to your pix file
Parameters:
Eigenchannels: 1,2,3,4,5,6
Output raster type: 8U
Report: LONG

Run

This creates 6 new channels - they display with PC6 on top down to PC1, and a text report - DON'T close it (yet)

The first table gives input bands mean and standard deviations, which show bands 4 and 5 have higher SD than the others - histograms would also show this. Below, the covariance matrix is repeated (not sure why) ... it displays a cross-multiplication of SD values

Below that, the eigenvalues show the relative % variance in each of the new PC channels for the entire dataset. PC1-3 contain most of the variance (actually here they add to more than 100% !).
The last table is the most interesting - each row is for a PC channel, each column is the weighting for each input band.
PC1 is a weighted average with the two original bands with more variance having greater weight
PC2 is the contrast between Band 4 and the rest = 'greenness' (the largest component remaining after what is common to all bands)
PC3 is the contrast between VNIR bands and the MIR with more influence from Band 5 (= 'wetness')
PC4 is band 5 v band 7 (the two MIR bands)
PC5 is Red v Blue/Green
PC6 is Green v Blue

Save this report as a text file (copy and paste into an editor or Libre writer)

Each successive channel is 'less informative' and more noisy as you can see in the images, and the low DN range for high-numbered components; in most cases PC1-3 contain most of the info, and could be used to classify a TM dataset.
Use the scatterplot option (right-click-> scatterplot)

Add a colour composite display (layer-> add etc..) and display PC1,2,3 in RGB - also reverse the colours. Like Tassel, it's hard to interpret, but the software can work better on these, than 3 bands as it works on DN contrast, not human vision.

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4. McBride: PCA

Load the mcbride pix file - its least confusing to either use file->new project or start a second session of Focus. Otherwise if the PG file remains loaded in the same Focus application, you see too many input channel options.

We would run TASSEL, but we can't as no one has calculated the coefficients (yet)

Run PCA on this dataset, but input bands = 1-7 (1,2,3,4,5,6,7) - we don't need 8 (PAN) or 9 (Cirrus)
Eigenchannels = 1,2,3,4,5,6,7
Output raster type = 16U (to match OLI data)
report = LONG

Output to grayscale and your McBride pix file

Review the output image results and the LOG report (don't close it !!)

The first table looks a bit different - all bands about equal except band 7 (lower)
Covariance matrix 16 bit harder to read in scientific notation (maybe not for you young folk ?)

Eigenvalues show even higher % variance explained by PC1-3 compared to PG ... why ? (Clue: it's McBride not PG !)

Can you explain what each PC is, as was done for the PG scene above (review the relative eigenvector 'loading' values? - they are not in the same sequence as for PG .. and remember that there is one extra band in the blue wavelengths (Band 1).

You can also see which one is 'greenness' by its correlation with the near IR band or NIR/Red ratio.

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5. Environmental Change Images – Part Two 10%

The rest of the lab time could include downloading your environmental change pair - see outline

The first part of the assingment was a gimme assignment - so easy once you get started

The second part of the assingment is not much harder – but it may get you into creative messing around

Using the same data you chose for the first assingment – take two of the years tested and create enviromental change channels derived from classifications. This involves several steps you may want to perform:

1. Using the data from assignemnt 1 perform unsupervised classifications to produce differences in classes (i.e the shapes of the raster polygons created through classification) between two scenes.
2. The results should be sieved to present the data with a minimum of 1 hectare in size for each grouping
3. Take a crack at creating a supervised classification for each scene to bring out these changes
   - you can provide the classes that changed by producing null classification only if you wish
4. Perform a NIR/Red band ratio and/or a NDVI for a second classification (unsupervised/ supervised -
   - no reseeding necessary.
5. Create you output the same as the first assigment – zoom or clip an area and screen shot or export results
6. Forshadowing – we will learn how to add all the channels to our datasets (as we have in the files for the lab) and work with the other pre-classification transformation for future assignements...