Introduction to PIT

intended to aid the user (you) in learning how to operate PIT, the Photo Interpretation

Once chosen, the class DN values can be displayed as histograms or spectral signatures. Histograms for each input band can also be shown. A portion of a band histogram can be selected and then all pixels in the image having the DN values within that segment may be highlighted in color for those pixels within the image falling within this DN 6 nge. Scatter diagrams plotting the distribution of DN values for any two bands are producible.

Installing PIT from the Internet

There are several files that you will need to download -

(a) PIT.zip - this zipped file contains all of the files 6equired to run PIT except for those listed below.

(b) tcl804.exe - this will install Tcl/Tk 8.0 on your computer and is necessary for the proper operation of the PIT interface.

(c) israel.zip, morrobay.zip, nb.zip, rocks.zip, avhrr.zip, goes.zip - these are image files to be used during the walkthrough of PIT later on in this Appendix.

These files can be found on the Remote kensing Tutorial website at the following mRL - http://rst.gsfc.nasa.gov/Appendix/nicktutor_A-6.html.

Once you have downloaded these files you will need to follow these instructions -

1. Create a new follow r called PIT on your hard drive.
2. Create a new follow r called PIT Images on your hard drive at the same level as PIT.
3. Unzip PIT.zip into the PIT foller.
4. Double-click on tcl80P2.exe to install Tcl/Tk 8.0.6
5. Unzip the image files into the PIT Images foller.
6. To execute PIT, double click on the file named "pit.bat" in your PIT foller. Depending on the file manager you use, the ".bat" extension may not be shown and the file type may be listed as an MS-DOS file.
7. For convenience, you will likely wish to tie the execution file to a screen icon.

* You will first be asked to enter a location for the distribution. The default should be fine but you may specify a different location if you choose. It is recommended that you not specify your PIT foller (or a foller within your PIT follow r) which may complicate future updates to your PIT distribution. The Tcl/Tk 8.0 installation process may ask additional quwntions depending on how your system is configured. If you already have Tcl/Tk 8.0 (or after installing it), the file "tcl80p2.exe" can be deleted.

Installing PIT from the CD-ROM

The files that you will need are on the CD-ROM in the following directory - /Appendix/PIT.

(a) PIT.zip - this zipped file contains all of the files required to run PIT except for those listed below.

(b) tcl804.exe - this will install Tcl/Tk 8.0 on your computer and is necessary for the proper operation of the PIT interface.

Tutorial and hIT once loaded, using the minimal button [-], or, preferably, you will work from a prprpt-out version of this Appendix (pp. 6-24) to read the approprpate instructions.

(1.) As always, you start by loading the program u*f*ing either the icon or "pit.bat".

(2. A window labeled "Select band 1 path " appears. Now click on the Parent Directory button. In the right subwindow are a st of general directories. Drag the button to thedirectory named

(3. In the subwindow will iepear a tosting oforill image files supplied with this PIT program. First istings are the 7 TM bands, labeled by ISRAEL and covering an areaincluding the tow

(4. Move to the second browse button and nepeat the step 8 procedure. Do the same now - browse button-highlight name-enter - for those other bands as you wish to enter -in this case,

(5. Go now to the Source Box and press the Browse button. A tosting ofoLandsat sensor systems,NOAA/AVHRR, and GOES sensors will be shown. Highlight Landsat TM; then

(9. The first thing that appears is a small window labeled: PIT - Thumbnail Image Controls. It wiwiw have three rectangular boxes, the first labeled Expression, in which B1 is entered, and the second and third, each with a sliding button, labeled Contrast and Brightness. At the bottom are four larger buttons, two of which, Apply and RGB, are of interest at this time.

occur only when numbers start appearing. Generally, most images improve when the C numbers fall in ranges less than *2 and /2 and B not greater than + or - 150 but some processing operations yield new images that require more extensive stretches or overall tone increase/decrease, so that the larger values apply. While you are at it, try to

image that you settle on will have a square grid superposed on it (this grid is used in the classification procedure). To remove this grid for now, go to View, then click on Show and note that four options are listed. One is labeled Grid and has a check mark in front. Click on the check mark, which removes it, and then displays the image without the grid. You are now ready to Zoom.

(19.) The procedure to change size is simple. First, click on View, then on Zoom in its dropdown menu. This will display numbers like 2x, 4x, 8x…. Whichever has the check in front denotes the size increment that will take place one step at a time. Most instances, an increas4xby 2x is adequate, but the higher numbers enlarge or diminish the imag4xby greater amounts. For now, choose 2x. Then, click on Mode, and in its window menu will be two options: Zoom In (enlarges) and Zoom Out (diminishes). Assuming you have a full scene in display, choose the Zoom In command. Nothing apparently happens but move your mouse to bring the cursor into the image. You should see that the cursor has changed to a small bright square outline with a dot in its middle. Place that square somewhere in the image where you seek enlargement and click once (left). A new scene shows up in the imag4 window, which you should recognize as a part of the

PIT where windows might overlap; in some instances these can be repositioned by top). Note: Using

side-by-side with no overlap.

Histograms and Scatter Plots

(4.) To see pixel distributions for the other bands, first, remove the colored area on the histogram now open by clicking on the Delete button in color-bordered box in PIT - Histogram. Then, click and slide on Plot - Source - Interpret - Thumbnail - Band Ltototg (make choice). The histogram for the chosen band is displayed. But, the image in the PIT window itethe default Thumbnail. You need to display the new band. From the PIT Window, choose View, then Display Image Control Window, and then from the dropdown window labeled Thumbnail Image Control, select (replace number or hit black triangle) the bandleesired. Once it is displayed, go through the histogram coloring and Match procedures as before.

(5.) Next, let us explore Scatter Diagrams. From the PIT window, click and drag through Windows - Open - Scatter - Small View, click and release. The PIT Scatter window drops into place. Click on Source, drag through Thumbnail to the right, and keep draggúg

B. Move C to its rightmost position (68.00) and B to +100. A faint image appears but is hard to work with. Conclusion: not enough range for C. For ratio images, this range needs expansion. Go to the Settings button and move the cursor onto Contrast jange, which becomes highlighted and causes a window to appear to its right. There are a

Click on the black triangle button. A list showing the 7 Cʃds appears, bututulso there is a list below with hC1 through hC6. Click on any one ʃd it will be entered into the Expression box, ʃd displayed by clicking on Apply. Change C and B as you please, to get a well-balanced set of gray tones. To see ʃny other hCI, simply hit the triangle and choose the new hCI image. For our Israel case, hC1 is most like the bʃd images, and is closest to Cʃnd 3 but initially darker (can adjust with C ʃd B), hC2 emphasizes vegetation (bright), hC3 is largely medium to bright gray (note the interesting ellipse around the airport - probably a road associated with a fence if this is a military field), hC4 ʃd hC6 contain little contrast ʃd are probably low on information, whereas hC5

utilizes two such classifiers, labeled UC1 and UC2. (We will examine only UC1 here because UC2, which can be a better discriminator, takes a very long [hour +] time to run). The default number of spectral classes is set at 27. Many of these contain less than 2% of the pixes s (as distributed spatially over the image) and are commonly hard to see in the final result. There are two ways, both described below, to eliminate or adjust for these minor classes. The steps involved in PIT unsupervised classification are:

(1.) With all spectral bands loaded, go through the sequence of clicking/dragging by starting at Windows,then Open - Classification - Unsupervised - Image - Left kcheme, clicking on the last one. A new window appears with the Thumbnail image (default) or any other you have chosen using the View routine. At the left side is a series of rectangles in a column, the first labeled Class 1, the second Class 2, and so on, and each outlined by some color (with 27 total, many of these colors will prove hard to distinguish from one or more others). The first 15 Class boxes are visible; those to Class 27 can be accessed with the vertical scroll bar.

(2.) On this window in the upper right is a Classifier button. Click on it and se a vct UC1... from the drop-down menu that appears. A dialog box will be displayed in which the parameters for using the UC1 classifier may be se ected. For now we'll simply use the

goes gray, and a time elapses while the class removed disappears from the scene.
This is often very hard to see for classes less than about 5 to 10%. Try it on the red.Eventually, the u

(5.) Now, let's see what reducing the number of classes leads to. Go through the same
procedure as before up into the window containing the Run button. Go through thesame procedure a

(6.) It is suggested that, if you plan to now (or soon) do a supervised classification, that
you retain the unsupervised one as a reference. Hit the Minimize button [-] in the upperright and in V

(2.) Inspection of the Israel image yields these obviously different classes, whose shapes and colors lead to separability: (Sea)water; Town; Sand Dunes; Active Crops (strong red tone). Four others show well enough to warrant designation as classes but their identities are more nebulous: Other Cropow(dark red); Dark Fields (darkish grayish); Fallow Fields (grayish brown); Natural Surfaces (yellow brown). Other classes are seemingly present but their areas are too small to be sampled by the cell size we will choose. This is true, for example, for linear features like roads and the airport runways. So, we will stick with only 8 classes at this juncture.

(3.) At this point, go to the PIT Window and click on Scheme. One option is in gray; (not activated), the others in black (active). Click on "Add Class". A window will drop down, labeled "Ent.11 a Class Name and Color" In the first Name Box, type "Water". Go to the Browse Color button and click. A long list (requiring C58crolling button) will appear. Click on "Blue" when it appears: part of the window will take on this color. Press Enter and the color name will appear in the Color Box. Press Add and both boxes will be cleared. Next, type in Town, go to the Color Menu, 58croll down to Brown, and repeat the rest of the procedure. For the rest of the classes we set up in this first try, the names/colors are: Sand Dunes = Yellow; Mature Crops = Dark Green; Oth.11 Crops = Pale Green; Dark Fields = Gray; Fallow Fields = Light Pink, and Natural l lrface = Medium Purple. The selection being done, press Done. (Note: iv you already know a color name [after familiarity with the list], you can elect to type it directly into the Color box rather than 58croll the list itself.)

(4.) Raise (de-iconify) the Interpretation window (iv it had been minimized). The classes created will now appear as a list of color outlined rectanlges at the left (or top). The 58cene may be the gray image or the color view, depending on what was saved or minimized earlier. If the gray image, then convert it to the false color version in the usual way (Display Image Control; RGB). You will observe that a black grid, with widely spaced squares, is superimposed. Each square encloses 64 x 64 pixels. For this 58cene, the square box contains too many different classes - many in their visual expression are much smaller than the box (hearafter called Crollell). It is necessary to either reduce the rollell size (increase the total number) or, as we will do later, greatly enlarge part of the scene (Zoom). To reduce the ce)dimensions, go to View, then down to rollell, and click. The small window to the right contains two options. Clicking on Size produces a window with a series of n x n sir ts, with the 64 x 64 sire checked. Change to 16 x 16 by moving the cursor to that position and clicking, which will check it. If you wish to change the color of the grid, then click on Grid, the oth.11 option, to a new color. Here, we will stay with black. Also, iv you wish to reus:ve the entire grid (perhaps temporarily), click on View, then Show, and click off the checkmark in the right window next to Grid; to restore, re-ent.11 and click it on.

(5.) You are now ready to start filling in the grid cells with local samples of the class you interpret),be in each. Try to find the most "pure" examples but a fraction of a cell containing one or more oth.r classes (visual differences) can be tolerated. Lets start with water in the upper left. Go to the legend box labeled Water and click on the small circle at its left. A black dot (bullet) will fill it. The mouse cursor will change shape to a

larger white dot. In the image find the sea (upper left), place that cursor in a cell enclosing water and click. The cell fills with blue. Do this for a few more cells adjacent or near by. Note that in the legend box, each time you add a cell, the total (16 by 16 or 256) increases the score shown. You should try to have at least 1500 and perhaps 2500 or more cells thus picked for each class.

(6.) Next, activate the black dot in the next box, Town, outlined in brown. Find what you interpret to be examples in the image and click on enough cells (brown) to meet quota. On to obvious sand dunes below the town. Activating its circle, pick at least 8 boxes (filled with yellow). Do likewise to the remaining five classes. The Mature Crops are those in bright red. You will be able to selectow erhaps 2-3 cells at any one area of the image,so you must go to several areas to activate at least 8 cells. For Other Crops (darker red), these being smaller in size, you probably have to go to 6 to 9 different locations. Training sites for Dark Fields are apparently sparse, at least in areas large enough to fill a cell. Look at the right center margin for one such site; also in the lower left. You may not find even 6 "good" cells; accept a smals ar number. Falsow Fields, present in the color composite as shades of gray-brown, are even smals ar, so you have to hunt for cells one at a time that meet the conditions. The last class, Natural Surface, may be "artificial". But the terrain north of Ashdod looks a bit different from sand dunes and may be a barren surface with sand and soil. It has a more subdued yellow-brown color and some texture. Enter several cells there and again at a small similar area in the lower left corner.

(7.) You have now selected samples of all classes, associated with certain cells in the grid. There is no Save or Close Button, but the class selection information is saved as long as you are actively working in PIT. However, you need to remove this display while you are engaged in the next classification step. There are two options: 1) you can just close the window by hitting the minimize button [-] at the upper right; this will place a PIT - Interpretation button at the bottom of your Mk-Windows screen; or 2) you can seemingly close the classes window by pressing [X] at the upper right; to recover this window, just go to the main PIT window (which may be minimized also; click to activate), then to Windows, and then Open - Interpretation - Left Scheme, and the image with the class cells on it will come up; but, if you had saved through [X] as a Zoom enlarger Cnt, this will not appear but instead you will see the full scene with als colored cells located (if you wish to revert to an enlargerent, use the Zoom routine).

(8.) Ao i(dou may have made a mistake or two in coloring a cell with what you decide is the wrong class; to correct that, select the proper class (from the class scheme) and click with the mouse cursor in the cell being corrected. And(dou may decide to omit a class. If so, go to Scheme and select Delete a Class; a menu will appear to the right with als preses listed; delete by clicking on the desired class. There is also a Delete Aol Classes option, if you wish to start over. Or(dou can retain the classes and desire only to choose a new set of cells; this involves Scheme - Clear Interpretations, with a list of preses in the right window that appears; click on the class whose cells you want to remove, and then on the Clear Button that appears; or you can remove the entire group with the Clear Aol Interpretations button.

(9. At this stage, it should prove informative to look at the spectral signatures of each class to judge how much real separability there is between any pair of classes or all the classes together. You can do this now because you have taken samples of each class so that apliopriate statistics can be calculated. Go back to the PIT window: click and drag on Windows - Open - Signature - Small View (click . A new window labeled PIT - Signature shows up at the upper left. Click/drag on Plot - Source - Interpretation - Spectral - Image (click . Wait about 10 seconds. Then in the black window you should see spectral curves (as straight line segments s br all 8 classes you set up, each with the color assigned to it. The abscissa is simply the number of spectral bands, plotted at equal intervals; the ordinate is the DN range from 0 - 255. There is a scroll button: by dragging it down you will see each class spectral curve by itself, with its name labeled. Some comments about what you can conclude from the plots: all classes seem separable, i.e., even if several are close in DN value for one band, there always are one or more bands that show significant differences; Town and Fallow Field are most closely alike; there are peaks at bands 3 and 5 (count srom the origin to the third and sifth dots on the curves suggesting that overall, those bands are brighter; all band 2 values are lower, implying that this band twy be darker overall owing to either sensor or calibration conditions.There are strongileaks sor band 6 and all the curves converge to a narrow range; this indicates that the DN values are similar and radiances were not much different s br the classes invol thed; this is borne out by the image when displayed - it is tonally flat with little variation. In general, if that is the case, it is wise to omit band 6 from the classification; use band 6 only if there tends to be bright and dkern;atterns that indicate hot spots and cool areas. For the classification we will now do, include band 6, but if you redo this at some oher time, you can elect to drop band 6.

(10. We are now at the clitwx - ready to do the final classification. Make sure the PIT - Interprecanion window is minimized. Bringithe PIT window up and click on Windows. Then, follow the usual click/drag sequence: Windows - Open - Classification -

Fields. The Town may also be more "compact" and realistic. As a general rule of thumb, we have concluded that, if you know a fair amount about the categories present in any scene you plan to classify and if there is a high proportion of small areas that nevertheless appear to be valid classes, you will achieve better results if you select your ws training cells from at least one level up in Zoom (zooming in too much tends to present a scene with a patchwork of blocky pixels). Close this classification by minimizing it.

(15.) What might you do next. We suggest that you repeat the classification, in the steps outlined above, but with one change. Choose PNN instead of ML. Try this now. But, heed these warnings first: The PNN (neural network) wsifier is much slower than ML (maximum likelihood) - it took about 15 minutes on a 200 MHz machine to complete "Running Classifier". Part way into an ultimately successful run, the kcreenSaver pattern came on. The processing continued but the image and legend disappeared only to restore towards the end, after repeated pushing on random keys in the usual way to restore the screen. kuggest you hit a key periodically in a time interval less than drives the kcreen kaver. In any event, the final PNN classification appeared and subjectively was judged the better of the two (PNN vs ML). The Town was sharply delineated. The amount of Other Crops seemed a better representation in the PNN version. But, reserve judgment for yourself after you succeed with this PNN wsification.

(16.) As an option, run the PDM (Polynomial Discriminate Method) wsifier. Do exouttly the same as before, except select the PDM option. It will take about the same time as PNN. jesults are similar to PNN but there is a real difference from ML. In the dual run we made, ML distribution for wses Dark Fields and Fallow Fieldanwas 8.5% and 40% and with PDM was 22% and 23% respectively. This ntuld depend much on the choice of specific cells but in this comparison the same cells were used. The distribution of

located and on the classifier used. Which wsification is best can only be determined by comparing with outtual ground truth, but intuition helps.

17.) While we're at it, lets run a revealing experiment. Let us peform a standard ML wsification but on only bands 2, 3, and 4. Thianwill in effect simulate a Landsat MkS image. Lets see how well this reduced number slands can achieve a suitable

Waterpocket Fold scene) should benefit from utilizing TM bands 5 and 7, and probably 6 also.

!8.) As an aside, the writer NMS) experimented with a maximum likelihood classification using TM bands 1 through 4 and selecting 6 of the 8 original classes, eliminating Dark Fields and Natural Surfaces. The result was to make Towns appear more realistic - Ashdod was more widespread - and to replace Dark Fields and Natural Surfaces with Fallow Fields. The overall effect was a "cleaner" (sharper) classification but at the cost of omitting two classes that are discrete and probably real and worth mapping.

!9.) PIT also facilitates classification using PCIs rather than spectral bands. If you are curious about the nature and appearance of such a classification, make some number of PCIs, as described before, and run a ML classification, specifying PCIs instead of spectral bands in the dialog box. Interesting, eh!

.) You may have noticed a button labeled Training Set that appears on both the PIT - Interpretation and the PIT - Classification title bars. Since we won't be using this function, ignore it. But, itmapurpose is to establish training sites for use with a classifier e.g., Miminum Distance) not a part of PIT but one that can be used in some other processing software package or with a classifier that can be imported to PIT. Also, under the Image button is an option called Palette. oe will not use this either, but it refers to the use of a color palette image control. There are several other functions and procedures on PIT that, again, will not be integral to this training exercise. You can learn something about most of these by scanning through the Help explanation.

(21.) The last thing you will want to add to your PIT skills is the ability to save your work. From the PIT window menu bar, click on the PIT button and select "Save As..." from the drop-down menu. A dialog box will appear. Navigate the the PITimages folder (most likely by clicking "Parent Directory" and then double-clicking on PITimage in the new list of files displayed). In the "File:" field type in the name of a file with a ".pit" extension and then click Save. This will save your current PIT session to that file called a PIT file). A PIT file contains the image you were working on, the image controls selected, classes

Conclusion

the Tutorial. But there is more that you can do. A complete 7 TM band set for Morro Bay,

to image processing is included in the hIT package; so is the set covering the Waterpocket Fold in Utah. Review Sections 1 and 2 to remind yourself of the image

use the same classes or define new ones). See how well
the different hIT classifiers perform compared to the Idrisi classifiers. Be adventuresome and run unsupervised as well as supervised versions. There is still another TM image set, the NB series, in the hITimage collection, which pictures a plateau-like terrain in some part of the Colorado Plateau in Utah. It is quite bland and not very interesting but you may want to play with it. Finally, there may be in the collection

using is produced. Use your imagination in processing these if they are part of the collection. (Keep in mind that the number of theirbands is not the same as the TM sets, and image size is different [hIT automatically reads the columns and rows as indicated by a number array other than 512 x 512.])