Quick Start

The various sample data files after expansion (use Zip):

Cc	Color wheel (8 bit BSQ, 440 pixels by 290 lines by 3 bands), 373 KB (binary).
Cc.hdr	Its header file (ASCII).
Cc.wav	and wavelength file (ASCII).
URBAN	HYDICE sensor imagery (16 bit BIL, 307 pixels by 307 lines by 210 bands), 40 MB (binary).
URBAN.hdr	The corresponding HyperCube header (ASCII).
URBAN.wav	The corresponding wavelength file (ASCII).
TERRAIN	HYDICE sensor imagery (16 bit BIL, 307 pixels by 500 lines by 210 bands), 64 MB (binary).
TERRAIN.hdr	The corresponding HyperCube header (ASCII).
TERRAIN.wav	The corresponding wavelength file (ASCII).
DTED	Digital terrain elevation file (binary, 572 KB).
DTED.hdr	Its corresponding header (ASCII).
Lidar.las	Lidar X, Y, Z and Intensity data in LASF 1.2 format. (139 MB)
Lidar 1.3.las	Lidar X, Y, Z, Intensity and waveform data in LASF 1.3 format. (210 MB)
Library.zip	Spectral library (49 signature files and 1 library list file, all in ASCII, 300 KB).
Duncan Knob.sdf	Lidar full wave form SDF file (60 MB).
Duncan Knob.idx	Required index file for Duncan Knob.sdf (4.5 MB).
sbet_mission 1.out	Smoothed Best Estimate of Trajectory file. Needed for Duncan Knob.sdf (98 MB).

Immediate scenarios that you can try (it's helpful to also have the documentation handy):

The color wheel (**Cc**):

1. Double click **HyperCube** to launch it.

2. If **Mac** then choose menu item **File > Open As...,** if **Windows** choose **File > Open...**
   A standard **Open File** dialog will appear.

3. Select **Multiband** as the file type from the popup menu.

4. Traverse the directories to find **Cc** and press **Open**.
   A dialog window will appear showing the contents of the header (hdr) file.

5. Press the **Load** button (no changes are needed) and the cube image will be displayed.

6. Select menu item **Image > Cube Color Composite > Specific Wavelengths** and a color image of the 3 bands of the cube will be generated (this isn't necessary but gives you a nice color image to select points from). If this menu item is dimmed, then click once on the image to activate it.

7. Position the cursor within the large yellow square on the color image and hold down the shift key while clicking the left mouse button. A small red crosshair will be set with the number "1" near it.

8. Select menu **Functions > Classify...** A new dialog will appear with a single point shown within a list and a magnified area displaying the selected point.

9. Press the **Classify** button in the dialog. A new image will be generated displaying the color regions matching the selected point within a tolerance. Move the cursor over this region and a label will dynamically appear with the number "1" in it.

10. You have just performed a single point classify using the **Vector Angle** algorithm with a tolerance of .08 radians.

11. Select several more points on the true color image or the cube itself by shift clicking the mouse. The additional points will be added to the classify dialog list. Press **Classify** and this time a multiple class map will be generated yielding the class as the cursor is moved over it.

12. Select **File > Close All** from the main menu to continue with the other data sets.

<u>The urban hyperspectral scene file (**URBAN**):</u>

1. These steps, using HYDICE imagery, are a bit more involved than those used in file **Cc**.

2. If **Mac** then choose menu item **File > Open As...,** if **Windows** choose **File > Open...**
   A standard **Open File** dialog will appear.

3. Select **Multiband** as the file type from the popup menu.

4. Traverse the directories to find **URBAN** and press **Open**.
   A dialog window will appear showing the contents of the header (hdr) file.

5. Press the **Load** button (no changes are needed) and the cube image starting at band 60 will be displayed.

6. Select menu item **Image > Cube Color Composite > Definitions...**

7. Check **Use histogram equalization** in the resulting dialog.

8. Click **Okay**.

9. Select menu item **Image > Cube Color Composite > Specific Wavelengths** to form a color composite image from the cube image bands.

10. Select main menu item **Windows > Show Info** and position it so it's not overlapping the images.

11. Reactivate the color composite image and move the cursor over the color image and while observing the x and y coordinates in the **Info** window shift click each of 3 points at coords [135,37], [87,134] and [213,124]. Exact positioning is not critical but these should be a road, a grassy area and a roof top respectively. You can clear all points and try again by selecting menu item **Edit > Clear**.

12. Select menu **Functions > Plot > Spectra (Selected Points).** This will display a spectral plot of each point. Position it as necessary and reactivate the color composite image.

13. Select menu **Functions > Classify...** A dialog will appear with the 3 points shown within a list and a magnified area within the dialog displaying a highlighted point.

14. Press the **Classify** button in the dialog. A class map will be generated displaying 3 color regions matching the 3 selection points. Move the cursor over each region and a label will dynamically appear with a number matching the selection point.

15. You have just performed a 3 point classify using the **Vector Angle** algorithm with a tolerance of .08 radians.

The next continuing steps show how to classify the 3 selected image points against a library.

16. On the **Classify** dialog press **Load Lib...** button and open the folder containing the library signatures. All of the signatures and the **Alib** file must reside within the same folder.

17. Select file **Alib**, it will be the first line shown in the entire list, and **Open** it. The library will be processed (a progress indicator will be shown) after a few seconds.

18. Click on the **Library** radio button in the classify dialog (it's within the **Search Domain** outline box at the upper right). Leave the **Signature** outline box set at the **File** button.

19. Press the **Classify** button. Three new windows will appear, each representing the 4 closest library signatures that match the selected image points. Double click a line within any of the 3 windows and that signature will be displayed in a graph type window. Now, click the graph portion and drag it over the top of the main signature plot that was produced in step 12 and release the mouse. The signature will be added to the main plot window. It will be superimposed in black to show you how well it matched a selection point. Clicking the colored buttons on the right margin of the main plot window toggles a specific plot on and off. By using the **Options...** button in the **Classify** dialog you can change the number of closest matches (defaulted to 4).

20. You have now classified a spectral image against a library.

The next steps will perform the inverse of the above, i.e., classify a library signature against the image.

21. Scroll the **Alib** window to signature 41 (Trees 1). Double click it to select it.

22. On the **Classify** dialog window select the **Library** button in the **Signature** outline box and the **File** button in the **Search Domain** outline box so that you are classifying a library signature against the image.

23. Press the **Classify** button and shortly a single class map will appear. Compare it with the color composite image of the same area.

24. Move the cursor over the class map area (red) and the matching library name will appear.

25. You may select additional signatures in the Alib window and produce a multiple signature class map. Double clicking a chosen signature in the list deselects it.

This group dynamically searches the library for the best matches as a function of cursor position.

26. Assuming the state of the HyperCube program is unchanged to this point, select **File** as the **Signature** and **Library** as the **Search Domain** in the **Classify** dialog.

27. Press the **Options...** button on the **Classify** dialog. A lot of stuff will appear. Check **Enable dynamic display in File:Lib searches**. Press **Okay** to exit the options dialog.

28. Press the **Classify** button. Then, as you move the cursor over the **Urban** cube image window or its corresponding color composite window the 4 closest library names will be listed.

29. As an added visual feature, choose **Functions > Plot > Spectra (Dynamic).** A plot window will appear showing the image and the matching library signatures as the cursor is moved.

30. Try all of the above using the **TERRAIN** hyperspectral image data set.

31. Menu **Windows -> Show Band -> List** will display the listing of all of the cube bands indicate which are enable or disabled. Only enabled bands are used in a classification. Double clicking the right hand column toggles between the two. This takes immediate effect so you can redo a classification to see the result.

<u>The digital image data (**DTED**):</u>

1. Choose menu item **File > Close All** and answer "no" to any save dialogs.

2. Choose **File > Open As...** and select **Raw** as the type of file and load image **DTED**.

3. Click the **Load** button in the header dialog. A 512 by 512 representation of **DTED** will appear.

4. Choose menu item **Applications > Shaded Relief...** and check **Anaglyph**, then **Okay**.

5. Two images will be generated. The first is the shaded relief and represents a "Sun" angle of 45 degrees coming from the upper left. The second is an anaglyphic stereo of the data that may be viewed in 3D with typical red/cyan glasses.

The X,Y,Z,Intensity point cloud data (**Lidar.las**)

1. Choose menu item **File > Close All** and answer “no” to any save dialogs.

2. Choose menu **File > Open As...** and load image **Lidar.las**. Displays **Load LASF Data** dialog.

3. Select **Load Overview** from the dialog. Displays scaled elevation and intensity images.

4. Draw a small selection rectangle in the center of the intensity image.

5. Choose menu **File > Load Selection**. This re-displays the **Load LASF Data** dialog. This time check “**Load data as a point cloud and enable viewer**”. Select **Load Select**.

6. The **Overview** and **View** windows and **Point Cloud Viewer** dialog will be displayed. The **Overview** contains a default selection rectangle of the data projected on the **View** window.

7. Type 60 into the **omega** edit field and 45 into the **kappa** edit field followed by enter/return.

8. The **View** window now shows this projection.

9. Try pressing the interactive spin controls to see their effect.

10. Resize the selection rectangle shown on the **Overview** and enter new values or press the controls.

11. Press the **Point Cloud Viewer Options…** button and try the various options. In particular, select **Display anaglyph 3D view**. This opens another view window that displays the current point cloud in 3D using red/cyan glasses. Also, select **Limit view**... and enter "2" in the return number. The view will now only show 2nd return cloud points. **Colorize**... mixes color with the intensity or elevation points.

13. The **Reset** button is used to return everything to the appearance shown in **Step 6**. above.

The X,Y,Z,Intensity and waveform data (**Lidar 1.3.las**)

1. Open the file as described in the previous Lidar section.

2. Select **Form image of n'th waveform sample** and enter **19** in the edit box. After a few seconds an image composed of just the 19'th sample will be displayed behind the primary intensity and elevation images. Any waveform sample within the bracketed limits may be displayed. It will be geo referenced.

3. Select **Save waveforms as a geo ref cube**. This will take a while and when complete all of the waveforms will be extracted and placed in a multiband file representing a cube matching the size of the intensity and elevations images and having a depth equal to the maximum number of samples in the waveforms. It too, will be geo referenced. This cube can be exploited as if it represents spectral signatures by using **Classify** described above.

The Riegl (www.riegl.com) Lidar full wave form data (**Duncan Knob.sdf**)

1. This example is only applicable to the Windows version of HyperCube.

2. Place a **sdfifc32.dll** or **sdfifc64.dll** in the same folder as the corresponding HyperCube executable.
   If not in same folder then you'll be asked to browse for the dll.
   Each dll is included in the **HyperCube.zip** download.

3. Place **Duncan Knob.idx** and **sbet_Mission 1.out** in the same folder as the **Duncan Knob.sdf** file.
   These files are included in the **Duncan Knob.zip** download.

4. Choose menu item **File > Close All** and answer "no" to any save dialogs.

5. Choose menu **File > Open As...** and select file type SDF in the open file dialog.
   Choose file **Duncan Knob.sdf.** The program will immediately start parsing the file and display a progress window. This takes a few minutes. When complete, a very busy dialog will appear.

6. For this data set: enter 220 in '**# of scan lines:**' edit box of the **Parameters** section and enter 1 in the **'Process channel #'** edit box.
   In the **Outputs** section select: **Elevation image**, **Interpolation**, **FWF cube** and **Geo cube** check boxes.
   Also, check the **LAS file** box. The **Intensity image** check box should already be selected.
   Leave all other dialog values as they are.
   Click the **Process** button. After several minutes the **Intensity** and **Elevation** images will appear.
   The **LAS** file and both **cube** image files are written to disk.

7. Choose menu **File > Open As...** and select file type Multiband in the open file dialog.
   Choose file *** geo cube .** The resulting image cube window will appear to be black.
   Scroll through the bands and the image will start to appear and reach maximum brightness around band 18.
   With the window selected, chose menu **Function -> Plot -> Spectra (Dynamic).** When the plot window appears check **Scale** and uncheck **[0,1].** Move the cursor over the **geo cube** window.
   The plot will dynamically display the full wave form return signature at each position.
   The last band (right side of plot) is not part of the signature, it contains meta data.

8. Although the **geo cube** is not spectral you can still perform any type of classification on it using the steps described in **The urban hyperspectral scene file** section above. Be sure to disable the last band using step #31 in that section to prevent it from being used in a classification.

9. The three LAS outputs will save the results in LASF 1.2, LASF 1.3 (internal waveform) and LASF 1.3 (external waveform) respectively. These act as an SDF to LASF converter.

10. The **LAS** files generated in step 6 can be viewed using the steps outlined in section **X,Y,Z,Intensity point cloud data** in the previous example.

    See the **HyperCube.pdf** for a description of **SDF** and **LAS** file processing.

These steps represent a tiny fraction of the capabilities of **HyperCube**. The documentation describes each function in detail plus numerous visual examples.

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