# HexitecGigE User Manual LOGO

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1.1



# Introduction

This document describes the different elements of the HexitecGigE GUI, and how it can be used to acquire, process and display data. Each tab is described in turn, with all settings detailed and described. It also contains a list of known bugs and lists software dependencies for the host PC.

# GUI Main Window

A screenshot of the HexitecGigE GUI can be seen in Figure 1 below:

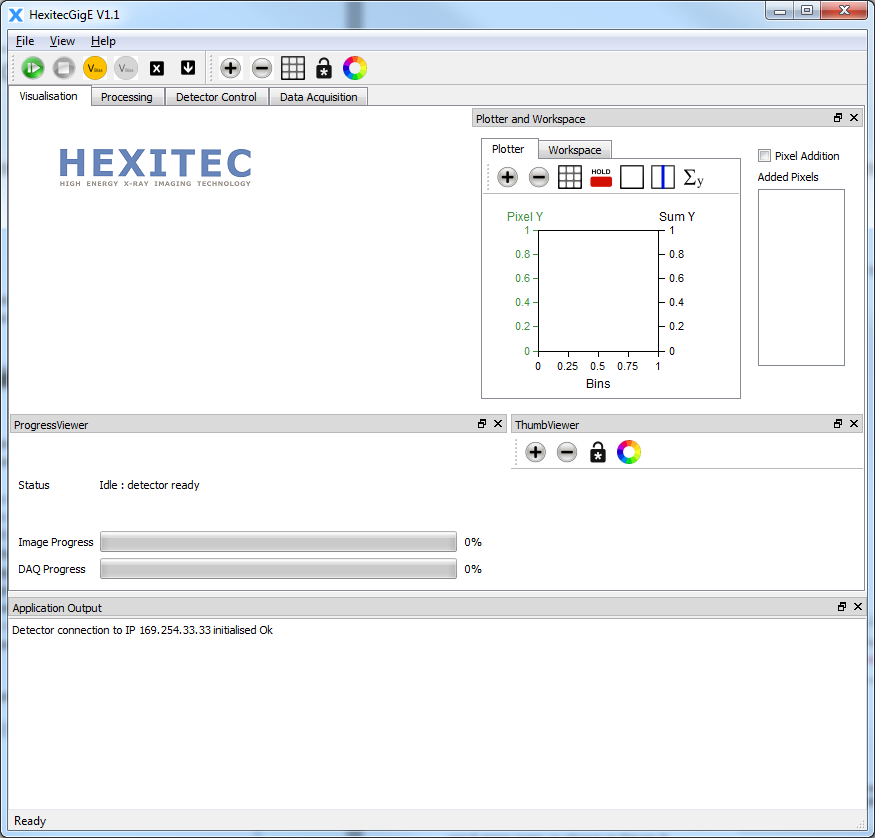


Figure 1 - the GUI Main Window.

Apart from the drop-down menus at the top, two elements of the Main Window are always visible. Firstly, the program toolbar seen in Figure 2:



Figure 2 - The program toolbar.

The icons of the toolbar provide the following functions, in order from left to right:

* Start DAQ - start data acquisition, more settings on the Data Acquisition tab.
* Stop DAQ - stop data acquisition.
* Turn on HV - Switch the high-voltage bias on.
* Turn off HV - Switch the high-voltage bias off.
* Clear active image - Remove the selected image.
* Load data or script – Display HXT file contents.
* Zoom in - Magnify currently selected image.
* Zoom out - Make currently selected image smaller.
* Toggle grid - Make grid visible between each pixel in the image.
* Toggle colour bar - Hide/Show the colour bar to the right of the image.
* Cycle colour map - Cycle through 8 different image colour map schemes, starting with grayscale, then jet and so on.

The second, always visible element is the Application Output pane seen in Figure 3.

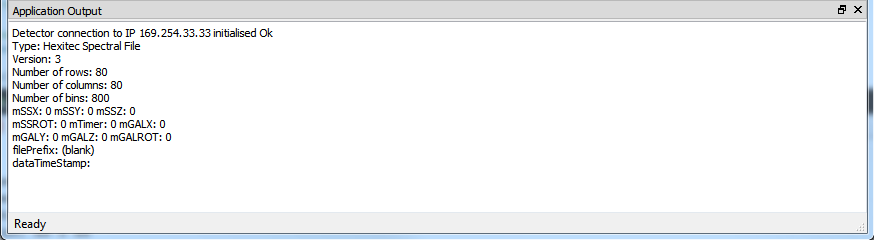


Figure 3 - the Application Output.

It will display information or error messages. When the detector is connected to the GUI the IP address will be shown here along with “initialised Ok”. But note that the connection can take up to a minute to establish as the detector is allocated an IP address from the host PC. Error messages will be highlighted in red where aSpect generally point to a detector error while Pleora implies an issue with the data connection. However, it’s not uncommon for an error to list both.

# Visualisation Tab

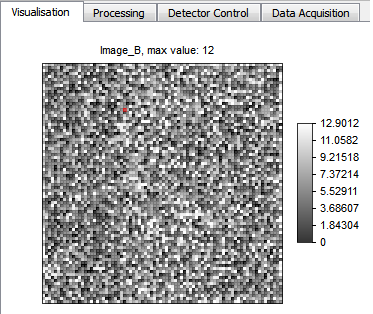
The Visualisation Tab is always shown first when the program has loaded. Its main task is to display data and allow the user to interrogate the collected spectra. Figure 4 shows the total spectrum for all pixels in black. To change the plot properties of the total spectrum, double-click on the colour bar to bring up the Colour Limits Editor. To see a pixel’s histogram, double-click on it. The selected pixel will become red, and its histogram, will appear in green in the Plotter. Data saved in HexitecGigE’s HXT format can be opened using the  icon in the program toolbar. The  icon is used to close an opened image. Alternatively, click on the File drop-down menu to access the same actions.

Figure 4 - Total Spectrum.

The Plotter is employed to further interrogate HXT data. As already mentioned, selected pixel(s)’ histogram(s) appear inside the Plotter’s graph, as seen in Figure 5. Right clicking on the Plotter’s axis produces a menu with three choices: **Set Axis...**, **Display Legends...** and **Display Plot Values**. It’s possible to zoom into greater detail by left-clicking and dragging the mouse across a portion of the plot. Alternatively, the + icon will also zoom in, while the - icon will zoom out. Apart from the two Zoom icons, there are 5 more icons as shown in Figure 6.

Figure 5 - The Plotter.

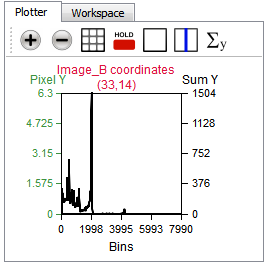
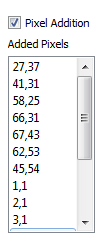


Figure 6 - The Plotter toolbar.

The two zoom icons aside, the others provide:

* Toggle Grid - Toggle a 5x4 grid across the plot.
* Toggle Hold - Hold more than one pixel histogram in the Plotter.
* Clear Plot - Clear all but the current pixel histogram from the Plotter.
* Toggle X Explorer - Highlight the value at a specific point of the black curve in the Plotter.
* Toggle Sum Explorer - Integrate the curve below the black shape in the Plotter.

The two toggle options can seemingly behave similarly. The Toggle X Explorer highlights the value of the curve corresponding to where the mouse pointer was double clicked. When this option has been selected, a spin box appears with an initial value of 0. By incrementing the spin box value, the width on either side on the X axis is increased. So if for instance the spin box is given a value of 3, then 3 bin widths on either side are used. Meaning, integration is performed beginning 3 bins below the selected value and ending 3 bins above it. Incrementing the spin box value means this behaviour becomes similar to that of the Toggle Sum Explorer. Although the Toggle Sum Explorer integrates beginning with the first visible X value, ending with the last visible X value. The exact behaviour both of these are more readily understood by playing around with each. Especially if highlighting a subsection of the Plotter area by left-clicking and dragging with the mouse from top left to bottom right.

In close approximation of the Plotter, is the Pixel Addition shown in Figure 7. By ticking it, the user can add spectra of similar features to the Plotter by double-clicking on different pixels. This increases the spectral counts and statistics; The address of each pixel is listed as seen in Figure 7.

Figure 7 - Pixel Addition.

The ProgressViewer shows the detector status as seen in Figure 8. Additionally, two progress bars indicate progress. The first shows the progress of the current image, or data, collected between the last and the next bias refresh time. The second represents the DAQ progress, i.e. the total collection time specified by the user. For further details, see the Data Acquisition tab.

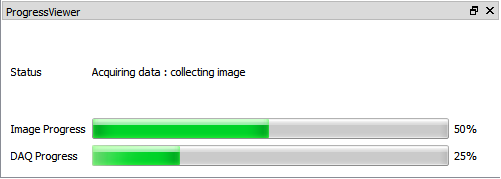


Figure 8 - The ProgressViewer.

The ThumbViewer contains a list of thumbnails as seen in Figure 9. These enable the user to select which image to be displayed in the Visualisation Main Window, along with which spectra to be shown the Plotter. There is also an associated toolbar. The + and - icons provide zoom in and zoom out respectively. The padlock toggles the colour bar on and off and the colourful wheel will cycle through 8 possible colourmaps. Note that by default new images are loaded in greyscale. So if the colour map of an existing image or thumbnail has been changed, loading a new image will see its thumbnail in greyscale. But the first thumbnail will retain its altered colour map.



Figure 9 - The ThumbViewer.

# Processing Tab

Figure 10 shows the Processing Tab and the processing options. These determine how the data is to be processed, whether processing data as it is collected or post processing from a saved binary file.

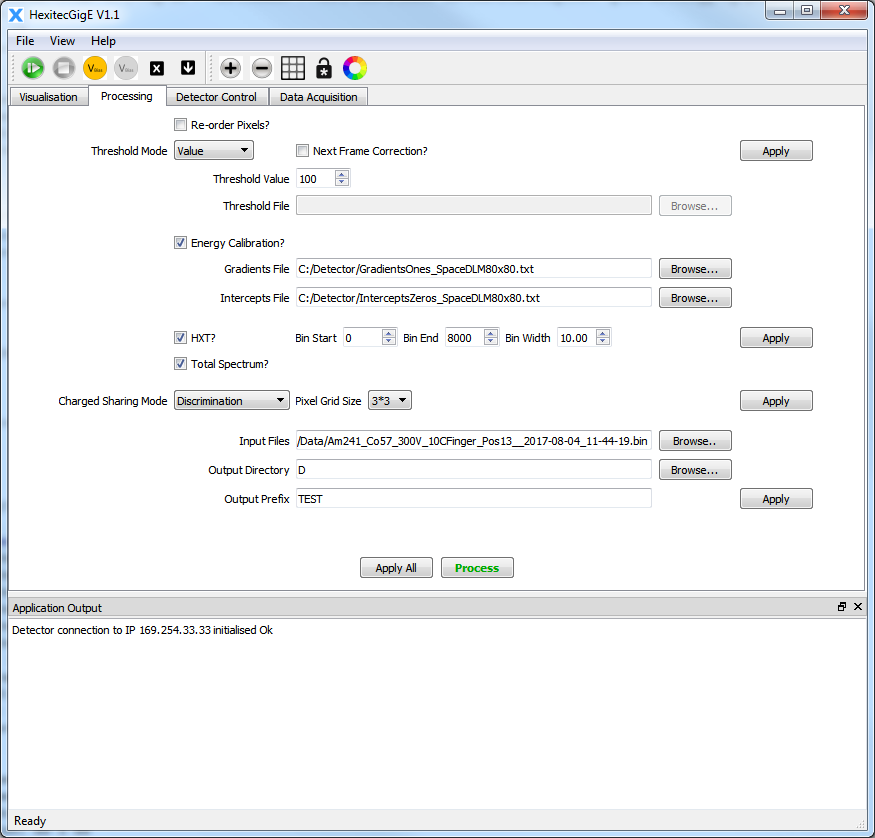


Figure 10 - The Processing Tab.

The HEXITEC detector reads out pixels in four parallel blocks of 80x20 pixels. The default pixel order of the for instance six first pixels is: (1,1);(1,21);(1,41),(1,61);(1,2);(1,22), were the format is (row, column). Tick **Re-order Pixels?** to have the pixels placed in logical order, i.e.: (1,1);(1,2);(1,3);(1,4);(1,5);(1,6). At times erroneous measurements occur where a pixel is read out while the signal is still rising or charge may still linger from the previous frame in the pixel. It is not possible to distinguish between these two types of errors but the **Next Frame Correction?** will remove them if ticked. The **Threshold Mode**’s three choices are no threshold, a uniform value threshold or individual pixel thresholds from file. If threshold is used, only pixels with values equal to or greater will be treated as a real event, processed and saved to the HXT file. Events below the threshold are ignored but retained in the raw binary file. **Energy Calibration** can be toggled on or off. A **Gradients file** and an **Intercepts file** provide an individual value for each pixel. The calibration is calculated as y = m\*x + c, where x is the pixel value in ADU, m is the Gradients value, c is the Intercepts value and y is the energy calibrated value in keV. The **Bin Start, Bin End** and **Bin Width** set starting, ending and width parameters of the pixel histograms. Use the **“HXT?”**option to control whether an HXT file is written or not. Ticking the **Total Spectrum**? option produces an additional CSV file that adds up each pixel and histogram. **Charged Sharing Mode** compares events against the threshold and looks at the neighbouring pixels. The “pixel neighbourhood” can be selected to be either the 3x3 or 5×5 surrounding pixels. If the user selects **Addition** from the drop-down box, the energy of all the events within the neighbourhood are added up and assigned to the pixel containing the highest fraction of the energy. If **Discrimination** is chosen and more than one pixel in the neighbourhood detects an event then all of the neighbourhood’s pixels are set to zero. This means that only single pixel events would be recorded to the HXT file. The typical operating energies of HEXITEC would see ~30-40% of single events being shared between more than one pixel. The three edit lines labelled **Input Files**, **Output Directory** and **Output Prefix** control manual processing. They specify the location of binary file(s) to be processed, where the resulting HXT file should be placed and any prefix to said HXT file. Note that there is no progress indication for processing data from file. Large files may take some time to process. Finally, each **Apply** button is used to commit the settings on the same line. The **Apply All** button will commit all changes and the **Process** button will commence manual processing of the selected file(s). Do note that no configuration changes will occur until the user has clicked either the corresponding **Apply** button on the same line, or the **Apply All** button.

# Detector Control Tab

Figure 11 shows the Detector Control tab which provides access to different detector settings, as well as environmental variables and the detector status.

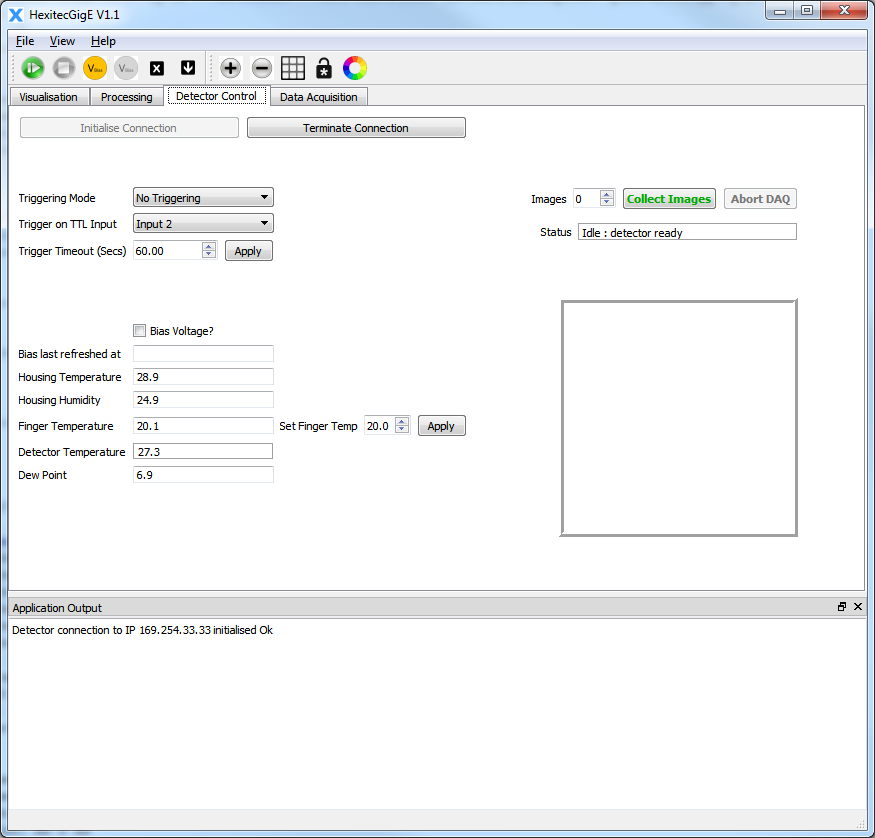


Figure 11 - Detector Control.

**Initialise Connection** and **Terminate Connection** open and close the detector connection. **Triggering Mode**, **Trigger on TTL Input** and **Trigger Timeout (Secs)** configures the detector’s trigger setup. **Bias voltage?** toggles the high-voltage bias on and off and replicates the operation of the Vbias buttons on the main toolbar.

There are a set of read only information: **Bias last refreshed at**, **Housing Temperature**, **Housing Humidity**, **Finger Temperature**, **Detector Temperature** and **Dew Point.** With the exception of when the bias was last refreshed, these report on the operating conditions of the detector. The set temperature of the thermal electric cooler inside the detector is set with **Set Finger Temp** by changing its value and clicking **Apply**. The HexitecGigE.ini file determines the limit on this value to prevent over cooling or thermal runaway scenarios. The Detector Temperature displayed will typically be 8°C higher than the set-point of the thermal electric cooler, or cold finger. The right side of the Detector Control tab shows the current detector Status. It’s also possible to collect a fixed number of images which are displayed in rapid succession, but without data reordering. These preview images can be used to assess the number of x-rays hitting the detector in each frame and allows the user to see if there is too high an occupancy, no events and so on.

# Data Acquisition

The Data Acquisition Tab is shown in Figure 12. It provides access to acquisition specific settings.

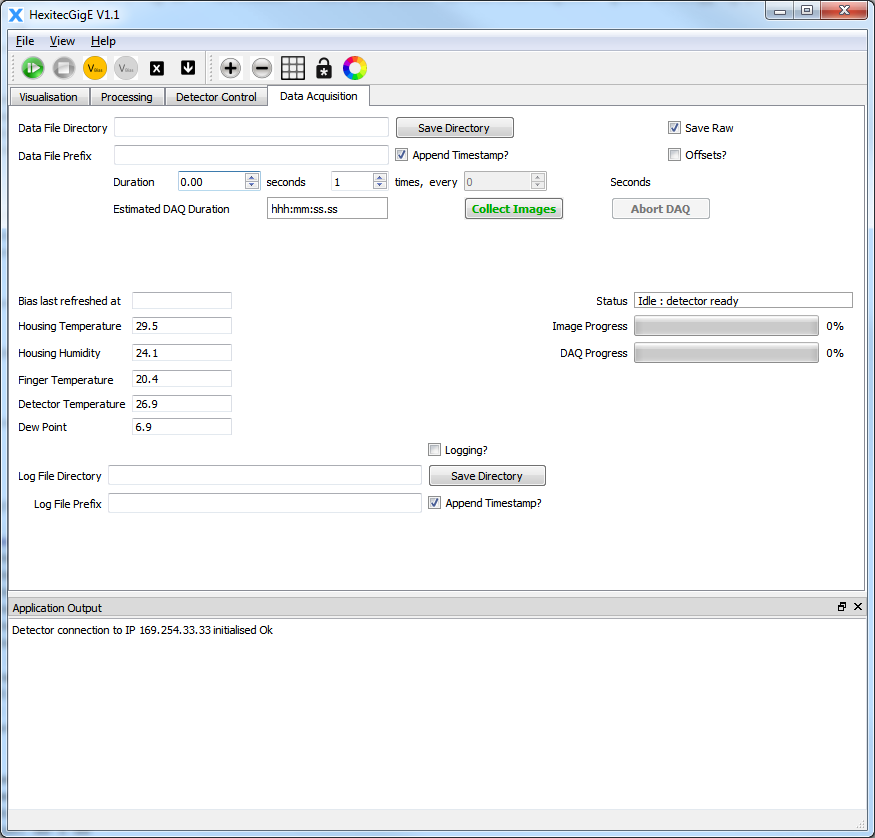


Figure 12 - Data Acquisition.

**Data File Directory** and **Data File Prefix** determine directory and prefix for the file(s) containing acquired data. **Append Timestamp?** toggles adding a timestamp to the saved file name. **Save Raw** will save raw binary files of unprocessed acquired data. **Offsets?** toggle whether the detector will collect a set of offsets before actual data acquisition commences. If gathered, these offsets are saved to the FPGA and used against subsequently acquired data. The duration, number of times and optional pause in between each acquisition, are set by the spin boxes between the labels **Duration, seconds**, **“times, every”** and **Seconds**. There is also an **Estimated DAQ Duration** and two buttons **- Collect Images, Abort DAQ** - to begin and abort data acquisition respectively.

Six of the environmental parameters from the Detector Control Tab are duplicated here, as is the detector Status information. The two progress bars which are duplicated on the Visualisation Tab are also present. Logging can be toggled on or off. If logging is selected then timestamps may be appended to the log file name. The log file directory and log file prefix name are set using **Log File Directory** and **Log File Prefix**. **Append Timestamp?** toggles adding a timestamp to the log file’s name.

# Software Dependencies

For the HEXITEC detector to communicate with a host PC, the PC requires aSpect message DLL version 1.0.1.9 to be installed along with Pleora eBus 64-bit 5.0.0.4100.

Rather confusingly, the 32 bit version of the aSpect DLL should be copied to the C:\Windows\syswow64 folder, whereas the 64-bit version should be copied to C:\Windows\system32 folder. Please follow these instructions to the letter. This version of the message DLL requires version 5 of the Pleora drivers, as outlined above. Previous version of these DLLs required an older version of the Pleora drivers (4.0.8.3423). So be careful checking DLL versions and Pleora driver versions if a pre-December 2017 version of HexitecGigE is to be run. Be aware that only one version of Pleora drivers may be installed at any given time on the same PC.

# Known Bugs

* **Workspace:** If the user clicks on the Workspace part of the visualisation Tab, there is some image specific information here. But clicking on any of the parameters, such as File Name will crash the GUI.
* **ThumbViewer:** Toggling the colour bar on (using the “padlock” icon), dramatically changes the currently selected thumbnail. But toggling the colour bar off will restore its original appearance.
* **Detector Control**: The option **Bias Voltage?** and the **Turn on HV**/**Turn off HV** perform the same function. However, while clicking on the 2 Vbias icons in turn will tick and untick **Bias Voltage?** accordingly, ticking and unticking **Bias Voltage?** doesn’t change the Vbias icons in the same fashion. But either method will control the HV bias as intended, this is merely a cosmetic bug.