

# **Professional Analyst, Flight Path Edition for X-Ray Sources**

## **User Manual**

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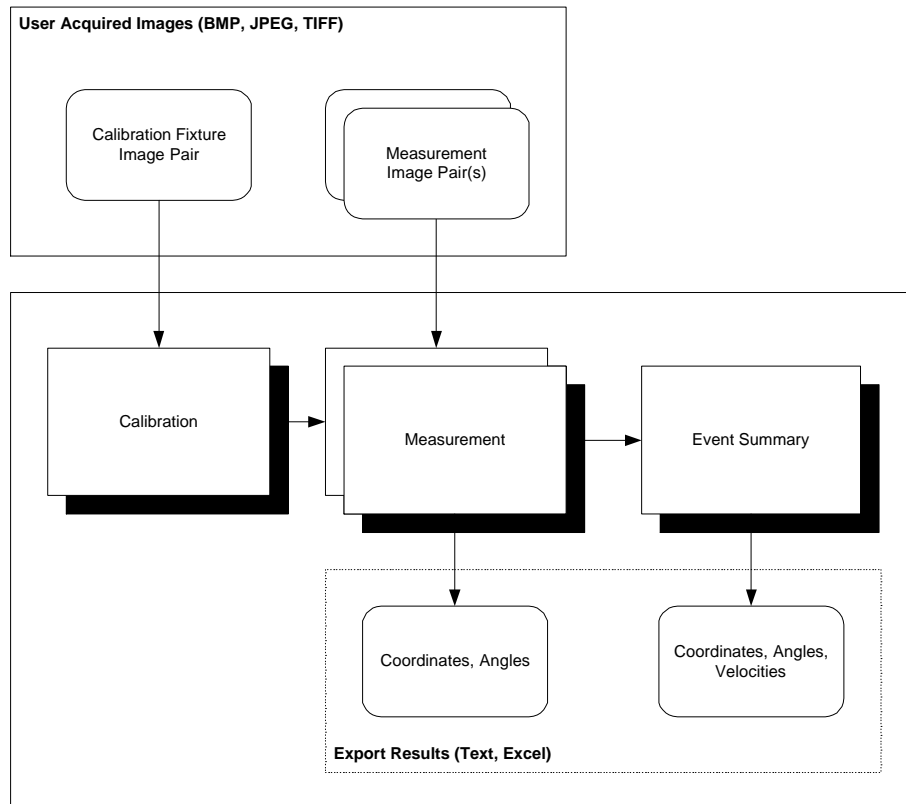
### ***Overview***

The Professional Analyst, Flight Path X-Ray Edition software can provide accurate 3-D measurements of points and angles using simultaneously acquired images from a pair of X-Ray systems. This document describes the application interface, the calibration and measurement procedure, and the data export capabilities of the software.

For more information on the technical background of this software and a discussion of the accuracy and sources of error, please refer to the *Professional Analyst, Flight Path Edition, Brief Technical Overview* document.

## ***Application***

The application has three main document types: Calibration, Measurement, and Event Summary. The Calibration document uses images of a calibration fixture taken by a pair of X-Ray systems and computes a calibration for each pair. The resulting calibration pair is used by the Measurement document to do precise measurements on a pair of images from an event. A sequence of Measurement documents is used to construct an Event Summary document that compares the results from each of the Measurement documents to produce a summary of the event.



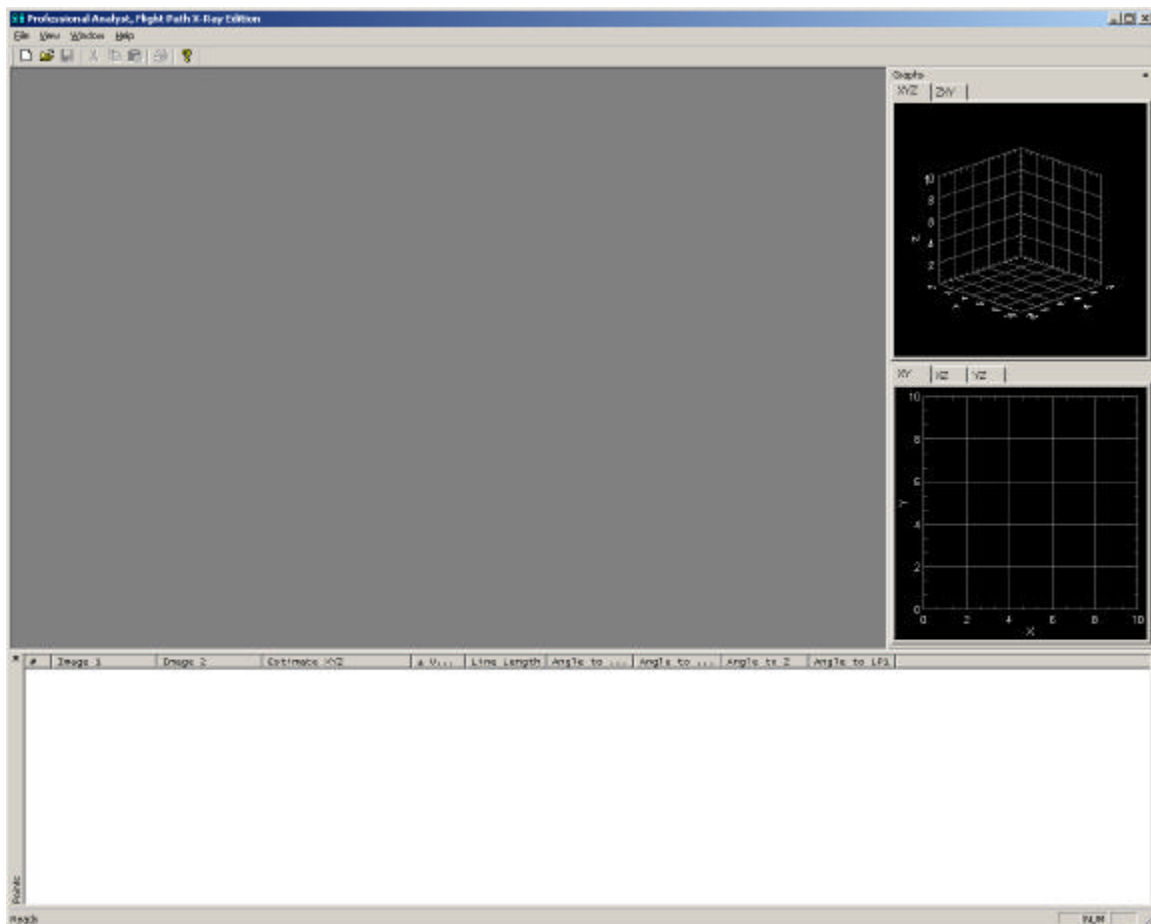
Each of these document types will be explained in more detail in the later sections.

## ***Application Windows***

The main application window has three primary sections: the main desktop area where documents appear, the Graph windows, typically docked on the right, and the Points List, typically docked on the bottom.

## User Manual

### Professional Analyst, Flight Path Edition for X-Ray Sources



The Graphs dialog contains a set of 3D graphs and a set of 2D graphs. The 3D graph can be rotated by clicking and dragging the left mouse button. To pan the 3D and 2D graphs, hold the **Shift** key while clicking and dragging the left mouse button. To zoom the 3D and 2D graphs, hold the **Alt** key while clicking and dragging the left mouse button. If your mouse is equipped with a wheel button, the wheel can also be used to zoom the graph windows. Additional options are available in the context menu by clicking the right mouse button over the graphs.












The Points List provides information about all selected points for the Calibration and Measurement Documents and it provides information about the Measurement Line Pairs for the Event Summary Documents.

Document windows typically have controls on the right and images on the left. The images can be panned and zoomed using the same controls as the graphs. **Shift** + left mouse button for panning, and **Alt** + left mouse button for zooming. The mouse wheel also controls zooming. When using the mouse wheel to zoom, the image will zoom in/out on the currently selected point. This allows the user to very quickly zoom in and out on a particular feature. Click where you would like to zoom, then use the mouse wheel. The application will automatically center the current selected point.


## User Manual

### Professional Analyst, Flight Path Edition for X-Ray Sources

Document windows will have a toolbar across the top of each window. The document toolbar typically contains some or all of the following controls. Many of the items below have separate settings for the top and bottom views. Click on the view that you wish to change the settings for and then click on the desired toolbar button. A green box in the upper right corner of each view indicates which view is currently active.

-  **Toggle Side Panel**  
Switch the side panel between a small toolbar version and the full size version.
-  **Image Settings**  
Adjust image settings such as brightness, contrast, gamma, etc.. This control has separate settings for the top and bottom views.
-  **Locate Point Settings**  
Adjust parameters for the automatic location of points for Calibration Documents. This feature will be discussed later in this document. This control has separate settings for the top and bottom views.
-  **Define World Reference Frame**  
Define the transformation to the world reference frame for Calibration Documents. This feature will be discussed later in this document.
-  **Enable Midpoint Finder**  
Enable the midpoint finder tool. This tool allows you to click and drag two endpoints of a line in the image. The program will draw a marker that indicates the center of the line. The program will also draw a circle through the two endpoints and centered on the center of the line. To hide the midpoint finder tool, click anywhere in the image, but do not drag.
-  **Enable Reticle**  
Show or hide the reticle (cross-hairs) in the view. This control has separate settings for the top and bottom views.
-  **Enable Rulers**  
Show or hide rulers along the edges of the view. This control has separate settings for the top and bottom views.
-  **Show Point Labels**  
Show point labels (numbers) next to each point in the view. This control has separate settings for the top and bottom views.
-  **Flip Vertical**  
Flip the image vertically. This control has separate settings for the top and bottom views.
-  **Flip Horizontal**  
Flip the image horizontally. This control has separate settings for the top and bottom views.
-  **View Actual Size**


Resize the displayed image so that it is shown at the actual resolution of the image. This control has separate settings for the top and bottom view.

 **Fit in Window**

Resize the displayed image so that the complete image is shown in the view. This control has separate settings for the top and bottom view.

 **Pan Mode**

Set the mouse mode to pan mode so that all left click and drag mouse operations will pan the image. This control has separate settings for the top and bottom views.

 **Zoom Mode**

Set the mouse mode to zoom mode so that all left click and drag mouse operations will zoom the image. This control has separate settings for the top and bottom views.

## ***Typical Test Scenario***

A typical test scenario has multiple steps. The first step is calibration. During calibration, you prepare the X-Ray systems to be able to perform precise measurements by determining properties of the X-Ray systems. This is typically done by capturing images of a calibration fixture and then analyzing these images to produce a calibration file. The next step is to run the actual projectile tests to conduct measurements. During measurement, images of the projectile are captured by the calibrated X-Ray systems. These measurement images, combined with the calibration file, are then used to produce 3D measurements of points on the projectile.

The calibration step only needs to be performed as necessary. If none of the X-Ray systems have been moved or changed since the last calibration, then the previous calibration should be satisfactory. The uncertainty in the measurements can be used to determine if a new calibration is required. If the uncertainty exceeds a desired limit, then a new calibration must be performed.

If there are multiple X-Ray stations located along the firing path, then calibration and measurement must be performed for each station. The measurements from each of the X-Ray stations are then combined to produce an event summary. An event summary is a collection of measurements from multiple camera or X-Ray stations for a single firing event. The event summary computes additional information by comparing the results from each of the measurements, such as velocity and angular velocity.

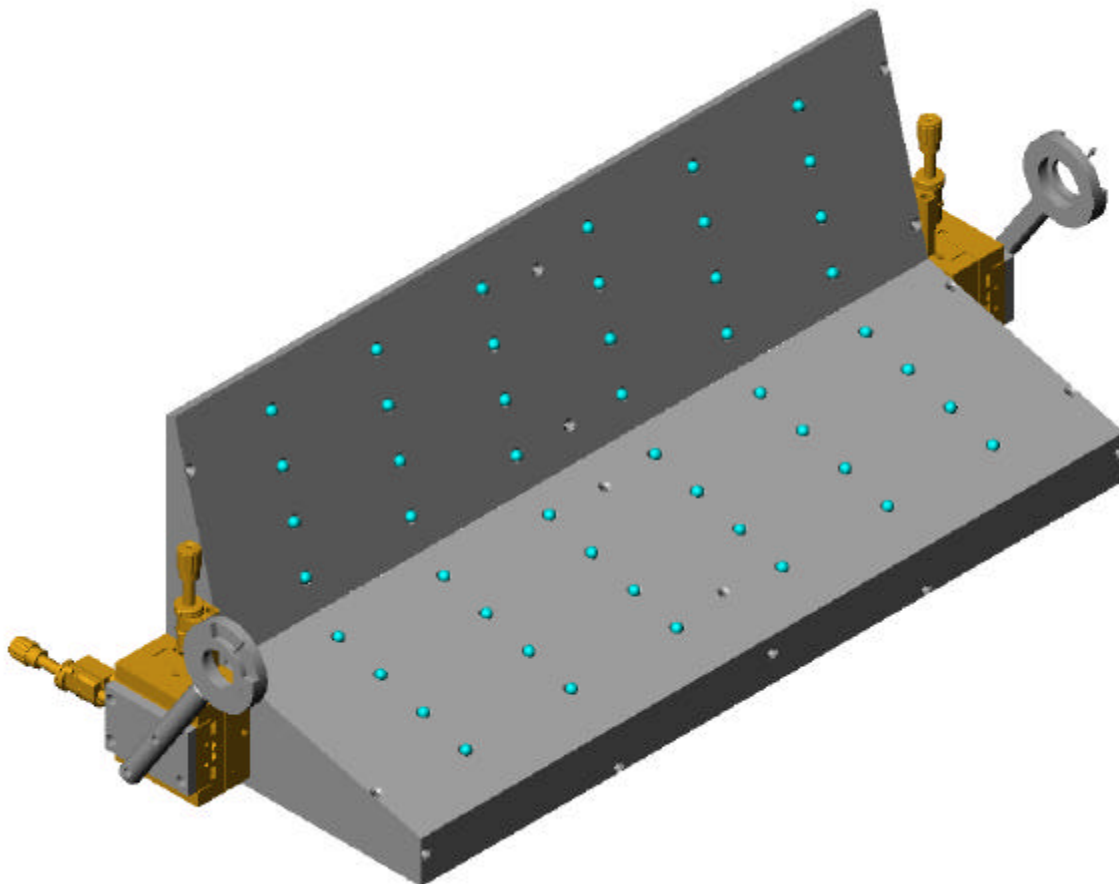
## ***Calibration***

In order to perform accurate measurements using the X-Ray system, a calibration must first be performed. This calibration computes necessary information about the properties

**User Manual**  
**Professional Analyst, Flight Path Edition for X-Ray Sources**

and location of each X-Ray system. If any of the systems are moved or changed after calibration, then a new calibration must be performed.

Calibration is performed by capturing images of special *calibration fixtures* that have fiducial markers at precisely known locations. These images can then be analyzed and the properties of the X-Ray systems can be determined.

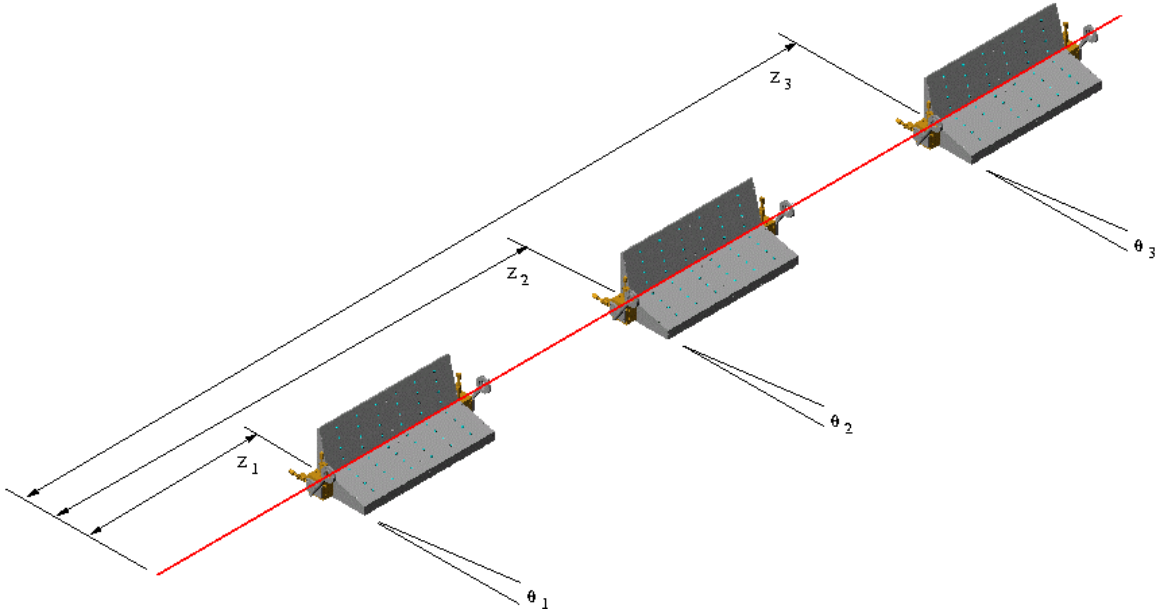


A typical calibration procedure for an event with multiple stations:

1. A laser should be used to ensure alignment of each calibration fixture relative to the firing path. Place the laser next to the gun barrel and shine it down the expected path of the projectile.
2. Place the calibration fixture in the center of the field of view of each X-Ray system, roughly aligned to the path of the projectile (within  $\pm 6-7$ mm). The entire calibration fixture (including irises) should be completely visible in both X-Ray views.
3. Adjust the position of the irises on the ends of the calibration fixture using the fine adjustment screws so that the laser passes through the exact center of both irises when they are closed. If the laser cannot be centered on the irises, then shift the whole calibration fixture so that the laser can be centered in the irises.

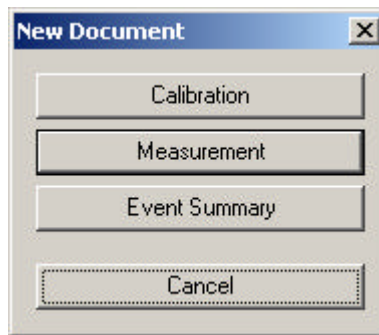
**User Manual**  
**Professional Analyst, Flight Path Edition for X-Ray Sources**

4. Measure the distance from the gun barrel to the first iris on each calibration fixture. This will be the *Z Coordinate of the First Point* for each fixture. This value is used to help define the world reference frame.
5. Measure the angle of each calibration fixture in the direction perpendicular to the path of the projectile. This will be the *Base Angle* for each fixture. This value is used to help define the world reference frame.
6. Capture images of each calibration fixture from each X-Ray system.



The resulting images are then used to create *Calibration Documents* for each X-Ray pair.

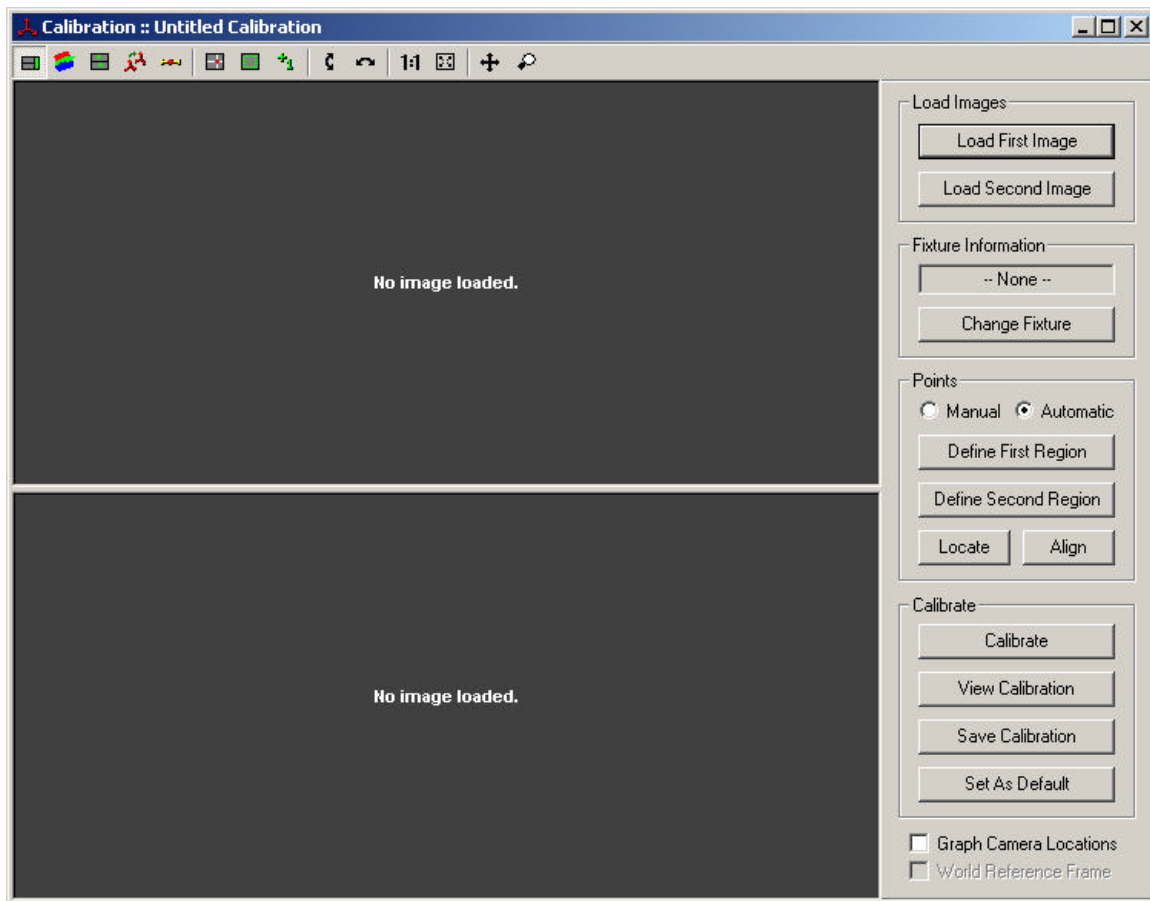
A Calibration Document is created by selecting **File** → **New**.



Then select **Calibration**. An empty calibration document will appear.

## User Manual

### Professional Analyst, Flight Path Edition for X-Ray Sources



All controls are located on the top toolbar and on the left panel of the Calibration Document window. The toolbar controls were described earlier in this document.

The standard procedure for calibrating X-Ray systems is as follows:

1. Load the first calibration image by clicking on the **Load First Image** button and select the correct image file (BMP, TIFF, or JPEG). This image should be the top view looking down upon the calibration fixture.
2. Load the second calibration image by clicking on the **Load Second Image** button and select the correct image file. This image should be the side view looking horizontally at the calibration fixture.
3. Load the fixture information file for the specific calibration fixture that is being used. The fixture file (\*.fixt) should have been supplied with each calibration fixture. The fixture file contains information about the location of the fixture points and the default units of measure.
4. Now the fixture points need to be identified in the top and bottom images. There are multiple options for locating the fixture points. It can be done manually or automatically.

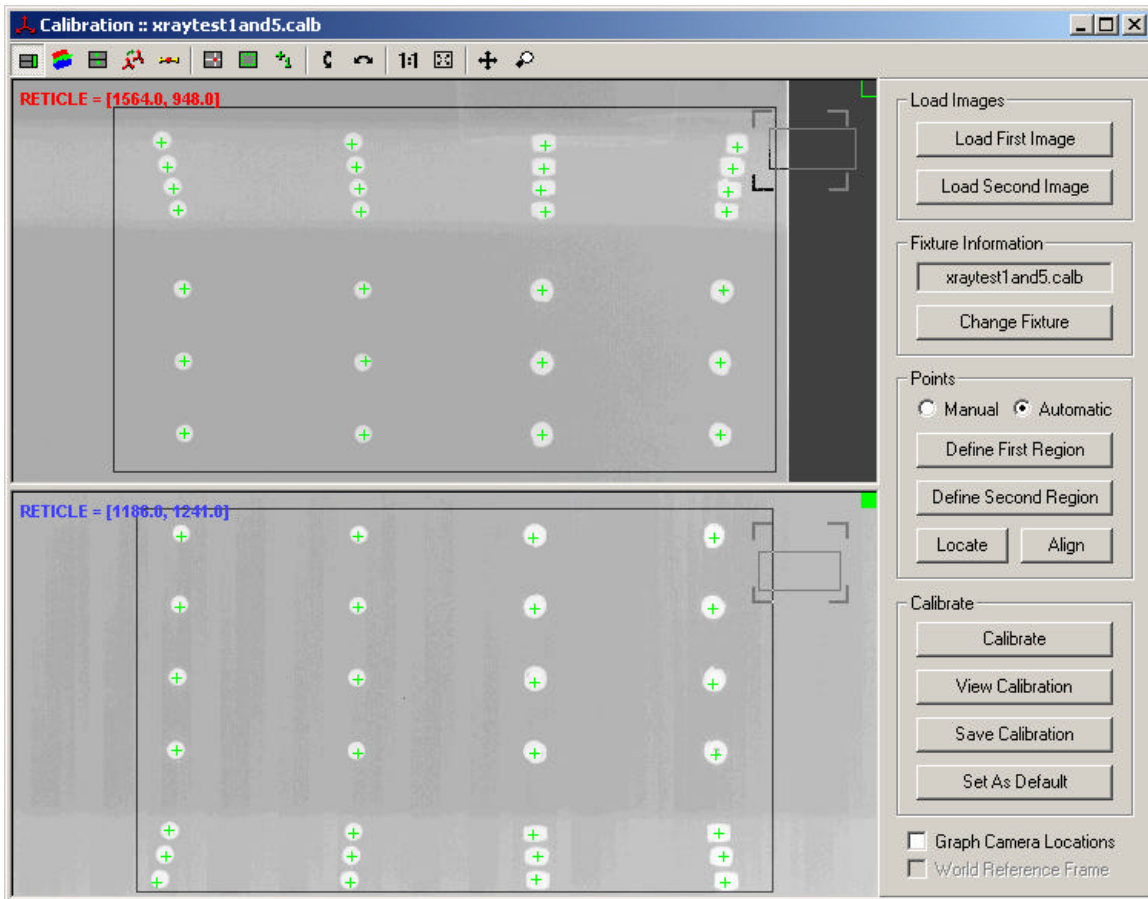
To locate points automatically:



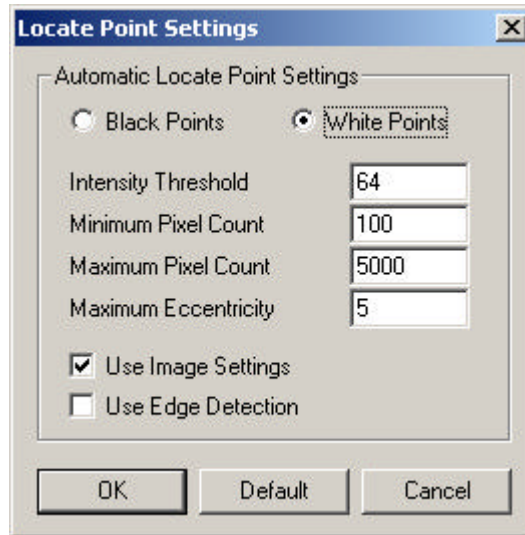
## User Manual

### Professional Analyst, Flight Path Edition for X-Ray Sources

- Select **Automatic** in the Points section of the right panel.
- Define a region around all the fixture points in the top image by clicking on **Define First Region**. Then click and drag the mouse to draw a rectangle around all the fixture points in the top image. If you make a mistake, click on **Define First Region** again and redraw the rectangle.
- Define a region around all the fixture points in the bottom image by clicking on **Define Second Region**. Then click and drag the mouse to draw a rectangle around all the fixture points in the bottom image.
- Click on **Locate** to automatically locate fixture points in both images.

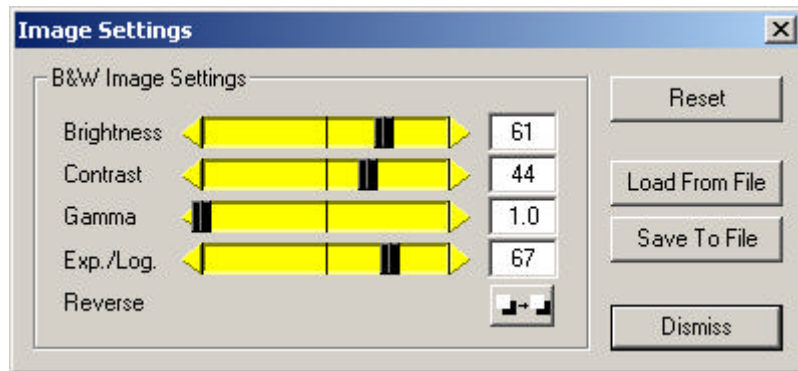


- If the automatic location of points fails, there are parameters that can be adjusted to change the behavior of the automatic location scheme.
  - i. Click on the **Locate Point Settings** icon on the toolbar, or right-click on the top or bottom image and select **Locate Point Settings** from the drop down menu.



There are different settings for the top and bottom images, so if necessary, change both settings separately.

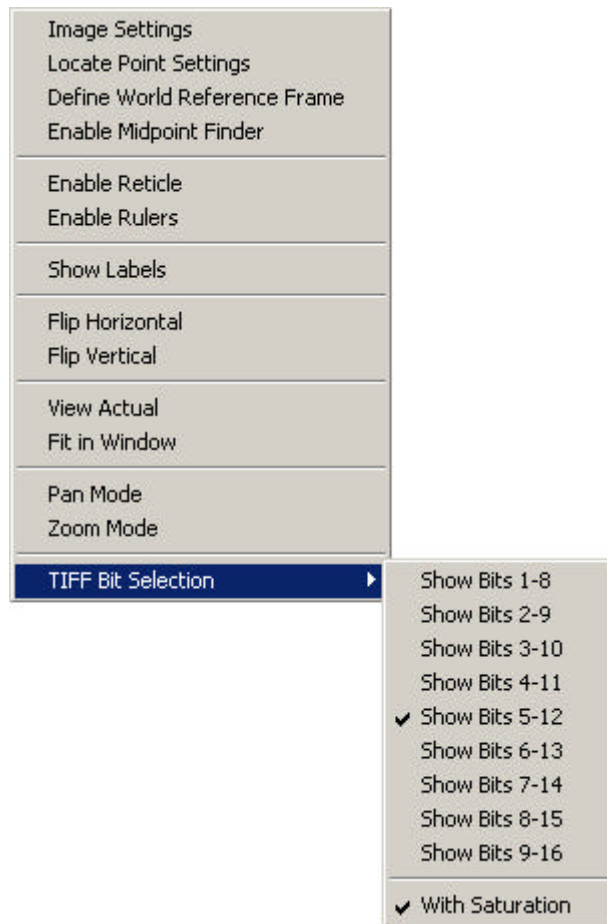
- ii. In addition, improving the contrast of the fixture points can also help in automatically locating them. You can change the image settings for the top and bottom images by clicking on the **Image Settings** icon on the toolbar, or right-click on the image and select **Image Settings** from the drop down menu.



- iii. If the image that has been loaded is a 16-bit TIFF file, you can also select which bits of the TIFF file to display. Right-click on each image and select **TIFF Bit Selection**.

## User Manual

### Professional Analyst, Flight Path Edition for X-Ray Sources

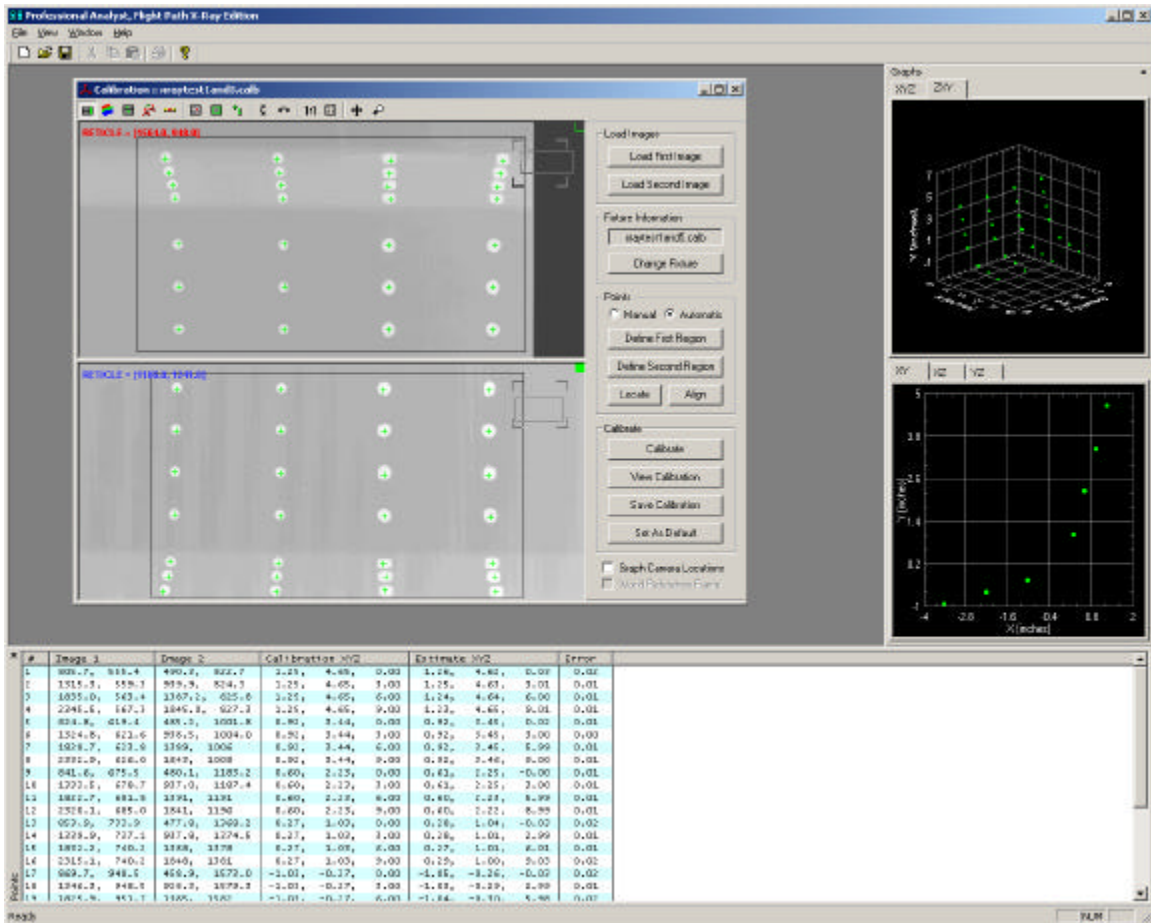


To locate points manually:

- Select **Manual** in the Points section of the right panel.
- Click on a point in the top image corresponding to a fixture point.
- Click on a point in the bottom image corresponding to the same fixture point.
- Click on the **Add Point** button.
- If you wish to adjust the coordinates of a point, select the point in the Points list. Click on the correct points in the top and bottom images. Then click on the **Update Point** button.

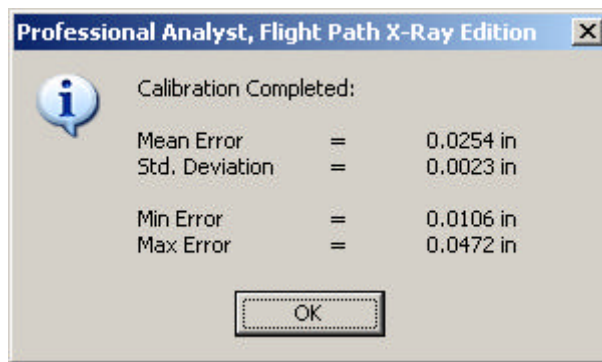
# User Manual

## Professional Analyst, Flight Path Edition for X-Ray Sources



- To remove a point, select the points to remove in the Points list. Then click on the **Remove** button.
- After you have set all the fixture points, if you wish for them to be automatically aligned to a standard grid pattern used by typical calibration fixtures, then click on the **Align** button.

5. Once all fixture points have been located, click on the **Calibrate** button.



## User Manual Professional Analyst, Flight Path Edition for X-Ray Sources

After a pair of X-Ray systems have been calibrated, you can view the results of the calibration by selecting **View Calibration**.

The screenshot shows a dialog box titled "Calibration Information" with a close button (X) in the top right corner. The dialog is divided into several sections:

- First X-Ray System:**
  - Location: -0.8630, 60.2043, 5.9397
  - Rotation: 0.0044, 0.0079, 1.0000; -0.9623, -0.2718, 0.0064; 0.2718, -0.9623, 0.0064
  - Translation: -6.4115, 15.4932, 58.1329
  - Center of Projection: 1893.05, -1597.79
  - Axis Scale Factors: 9258.75, 8930.34
- Second X-Ray System:**
  - Location: -44.4255, 1.9811, 5.1861
  - Rotation: -0.0107, 0.0049, 0.9999; -0.2885, -0.9575, 0.0016; 0.9574, -0.2885, 0.0116
  - Translation: -5.6690, -10.9283, 43.0451
  - Center of Projection: 1339.85, 3114.66
  - Axis Scale Factors: 6489.71, 6257.02
- Calibration Statistics:**
  - Mean Error: 0.0254
  - Standard Deviation: 0.0023
  - Minimum Error: 0.0106
  - Maximum Error: 0.0472

At the bottom of the dialog, there is a label "Units: Inches" and an "OK" button.

After the X-Ray systems have been calibrated, for every point that you click on in the top image, an epipolar line will be drawn in the bottom image and vice versa. The epipolar line indicates which points in the bottom image could correspond with the point that you have clicked on in the top image.

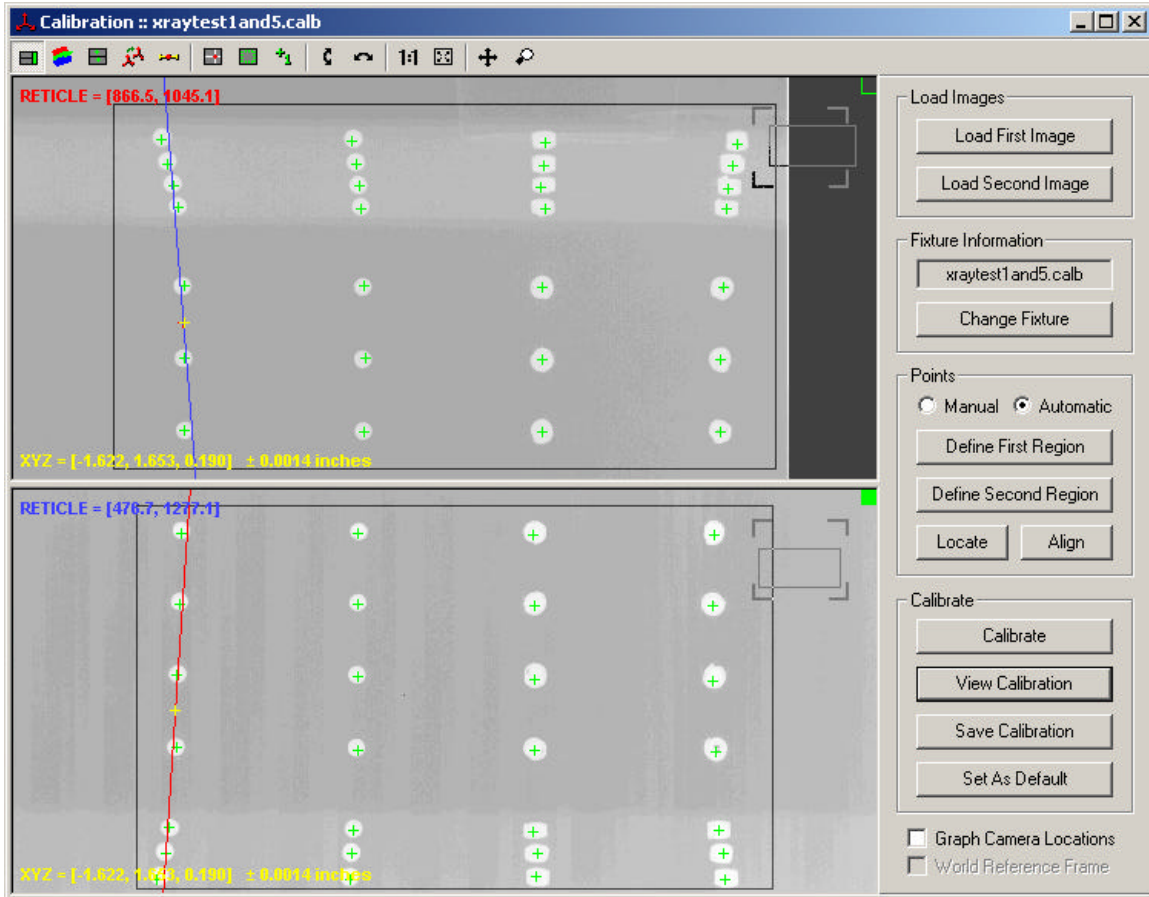
The current point in the top image is shown with a red plus symbol. The corresponding epipolar line in the bottom image is shown as a red line. The current point in the bottom image is shown with a blue plus symbol. The corresponding epipolar line in the top image is shown with a blue line.

The red plus and the blue line and the blue plus and the red line may not exactly intersect. The red and blue lines represent images of two rays coming from each X-Ray system. Since they do not exactly cross, the midpoint of the shortest distance between the two lines is shown with a yellow plus symbol in both the top and bottom views. The distance from the yellow plus to the red and blue lines is the uncertainty in the position estimate.

## User Manual

### Professional Analyst, Flight Path Edition for X-Ray Sources

Information along the bottom of each view indicates the 3D coordinates of the midpoint and the uncertainty associated with the 3D coordinates.



When you are satisfied with the calibration results, you can save the calibration to a file using the **Save Calibration** button. This will save all the calibration information to a calibration file (\*.calb) that can be used by the Measurement systems to perform measurements on other images taken by the same X-Ray systems.

If you would like the same calibration to be used for all newly created Measurement documents, then select the **Set As Default** button after the calibration has been saved to a file.

### **World Reference Frame**

The coordinate frame of the calibration is the coordinate frame that is used by the calibration fixture file that was loaded. All the coordinates in the fixture file are referenced from some point of origin on the fixture. In order to compare information from one pair of X-Ray systems to another pair of cameras or X-Ray systems, the coordinates need to be referenced to some mutual world reference frame. All coordinates



**User Manual**  
**Professional Analyst, Flight Path Edition for X-Ray Sources**

can then be transformed from the local calibration fixture reference frame to the world reference frame.

A tool is provided to help define the transformation between the calibration fixture and world reference frame. You can access this tool by selecting the **Define World Reference Frame** button on the toolbar, or by right-clicking in the image and selecting **Define World Reference Frame**.

**Define World Reference Frame**

World Reference Frame

Rotation and Translation ( $X_w = R * X_c + T_w$ )

Rotation (R)

0.997538	-0.069754	0.0071728
0.0697946	0.997546	-0.005475
-0.006773	0.0059630	0.999959

Translation (Tw) Units

0	0	50	Inches
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Two Points on Z-Axis (hit Apply to compute R, Tw)

First Point

-1.69946	2.39674	-8.09993	Get Current
----------	---------	----------	-------------

Second Point

-1.91497	2.56127	21.9444	Get Current
----------	---------	---------	-------------

Z Coordinate of First Point Units

50	Inches
----	--------

Base Angle (degrees, CW positive)

4
---

OK Cancel Apply

There are two methods for entering information about the world reference frame. You can directly type in the rotation and translation matrix used to transform calibration coordinates to world coordinates. Or you can select two points that lie on the world reference frame Z-axis and supply the Z coordinate of the first point and the base angle of the fixture.

For the first method, if the rotation matrix and translation vector are known, simply enter them into the appropriate boxes and hit **OK**.

## User Manual

### Professional Analyst, Flight Path Edition for X-Ray Sources

For the second method, the standard calibration fixture that was designed to be used with this software should be equipped with two adjustable irises, one on each side of the fixture. The calibration fixture should have been positioned so that the irises are aligned with the flight path and are visible in both the top and bottom views. To define the world reference frame:

1. The system should have been calibrated already, as described earlier.
2. Click on the center of the left iris in the top and bottom views of the calibration document window. Check the uncertainty in the coordinates to make sure that a suitable point has been chosen.
3. Click on **Get Current** for the **First Point** in the Define World Reference Frame dialog. An orange box should appear in the calibration document window to indicate the first point.
4. Click on the center of the right iris in the top and bottom views of the calibration document window. Check the uncertainty in the coordinates to make sure that a suitable point has been chosen.
5. Click on **Get Current** for the **Second Point** in the Define World Reference Frame dialog. An orange box should appear in the calibration document window to indicate the second point and a dotted line should be drawn between the first and second points.
6. Enter in the **Z Coordinate of the First Point** and the units of the Z coordinate. This should have been measured when the calibration fixtures were being aligned.
7. Enter in the **Base Angle** in degrees. This should have been measured when the calibration fixtures were being aligned.
8. Hit **Apply** and the equivalent rotation and translation will be computed and applied.

Once the world reference frame has been defined, the coordinates of all points can be displayed in either the local calibration reference frame or the world reference frame. You can select which frame to display in by checking the **World Reference Frame** checkbox in the side control panel. When displaying coordinates in the world reference frame, the graphs will label the axes as  $X_w$ ,  $Y_w$ , and  $Z_w$ .

The world reference frame must be defined for each calibration if you want to compare the measurements from one X-Ray pair to another camera or X-Ray pair. For example, the Event Summary document, that is described later, compares the results from multiple measurement documents to compute velocity and angular velocity. In order to compare these results, all the coordinates must be transformed into the same reference frame (the world reference frame).

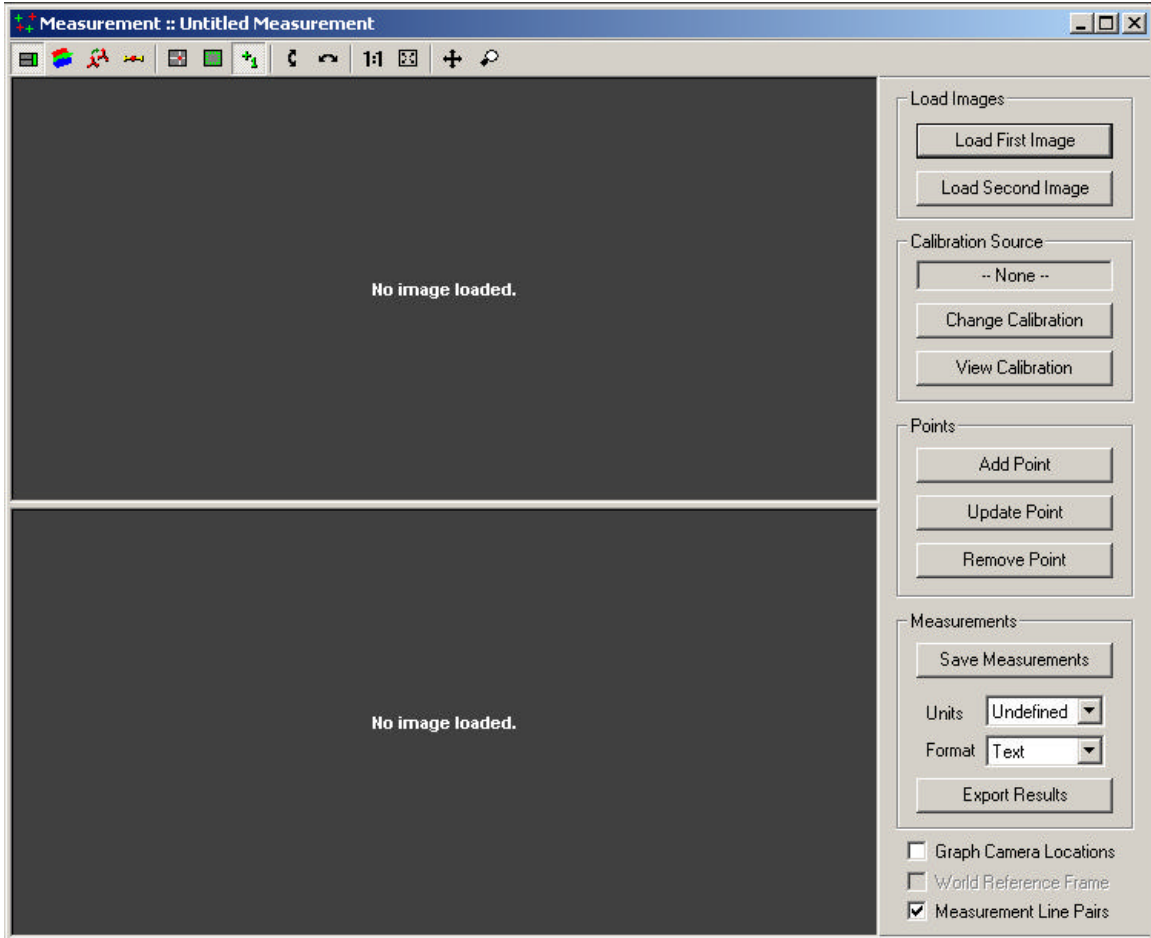
## ***Measurement***

After a calibration has been completed and a test has been conducted. The resulting images from the test can be used to perform measurements.



## User Manual Professional Analyst, Flight Path Edition for X-Ray Sources

A Measurement Document is created by selecting **File** → **New**. Then select **Measurement**.



All the controls are located on the toolbar or on the panel on the right. The toolbar controls were described earlier in this document.

A pair of images from an actual test should be loaded into the Measurement document. An image from the top X-Ray system should be loaded using the **Load First Image** button. An image from the side X-Ray system should be loaded using the **Load Second Image** button.

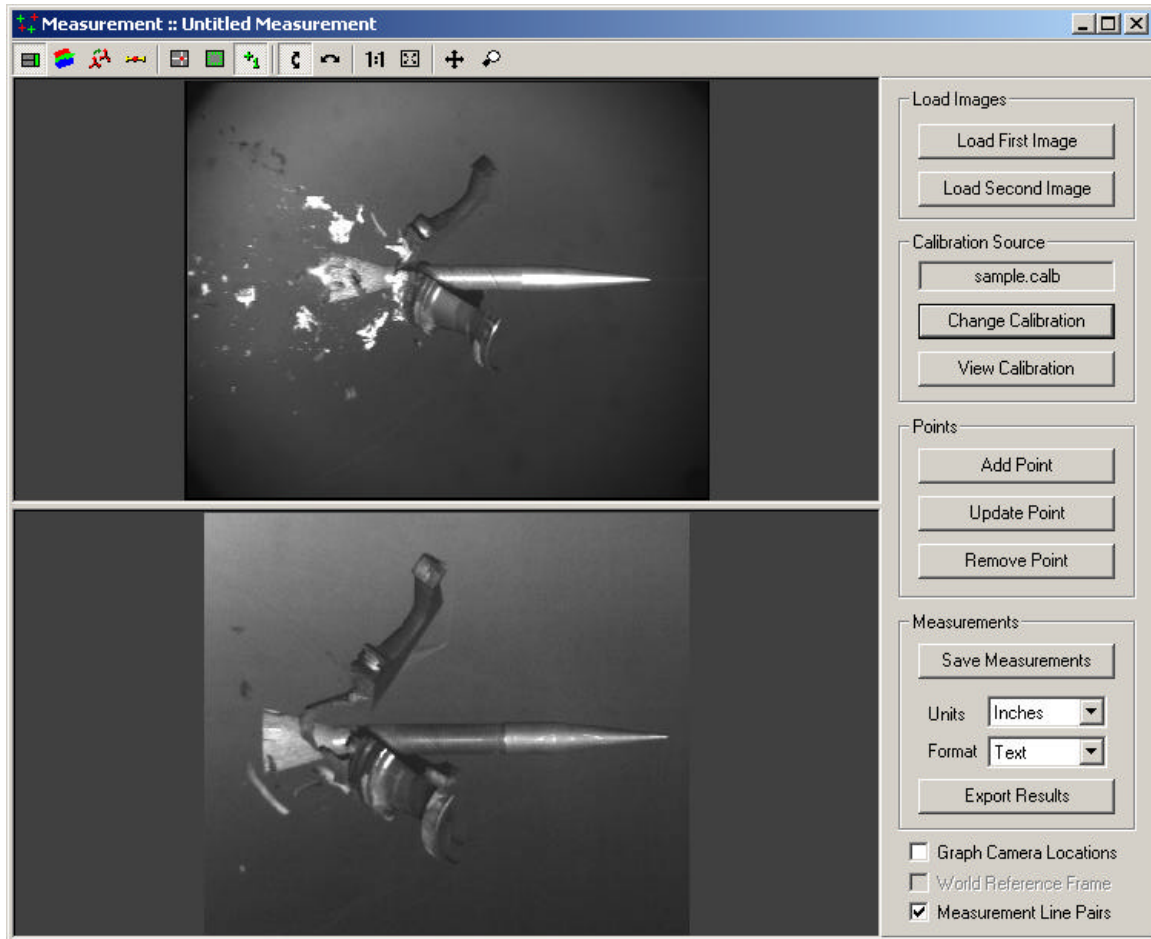
To perform measurements, a calibration must have already been performed for the X-Ray systems being used. If a default calibration had been set, the default calibration is automatically loaded. If a default has not been set, then a calibration must be loaded by using the **Change Calibration** button.

The units of measure and the world reference frame transformation are also loaded from the calibration file. The units of measure that are displayed can be changed by changing

## User Manual

### Professional Analyst, Flight Path Edition for X-Ray Sources

the units in the panel on the right. The world reference frame transformation can be viewed or modified using the toolbar button or the right-click context menu.



If you would like to review the calibration information, select the **View Calibration** button.

Measurements can either be the 3D location of a single point, or the 3D locations of the end points of a *Line Pair*. A line pair is a grouping of two sequential measurement points (points 1 and 2, 3 and 4, 5 and 6, ...).

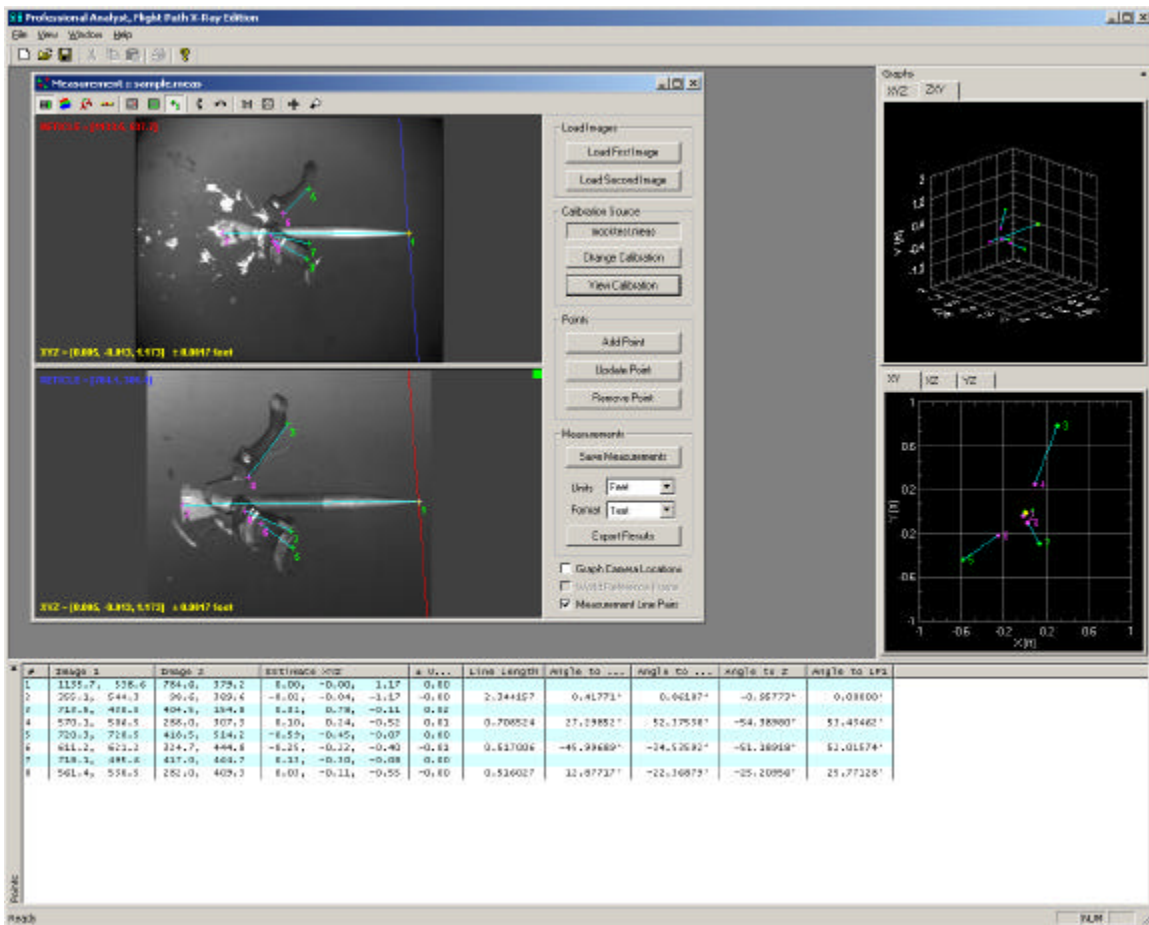
Each Measurement document can display information as single point measurements or as line pairs. To change the display, click on **Measurement Line Pairs** checkbox in the right hand panel. When the Measurement document is set to show information as line pairs, additional orientation and length information is computed for each line pair and displayed in the Points listing. In addition, the first point in a line pair is shown in green and the second point in a line pair is shown in magenta. The connecting line is shown in cyan.

Typical steps to perform a measurement:

# User Manual

## Professional Analyst, Flight Path Edition for X-Ray Sources

1. Click on a feature point in the top image. Zoom in using the mouse wheel to accurately select a feature point. The mouse wheel will zoom in/out on the currently selected point. It is always a good idea to zoom in on a feature point to ensure that you have selected the proper point.
2. Click on the corresponding feature point in the bottom image. Zoom in using the mouse wheel to accurately select a feature point. Verify that the uncertainty in the resulting image coordinates is acceptable. The uncertainty is shown on the bottom of each view. The red, blue, and yellow points and lines should be near one another in both images.
3. If you are satisfied with the feature points and uncertainty, click on **Add Point**.
4. If you would like to update the coordinates of a point, select the point in the Points list. Click on the correct feature point in the top and bottom image, then click **Update Point**.
5. To remove a point, select the point in the Points list and then click on **Remove Point**.

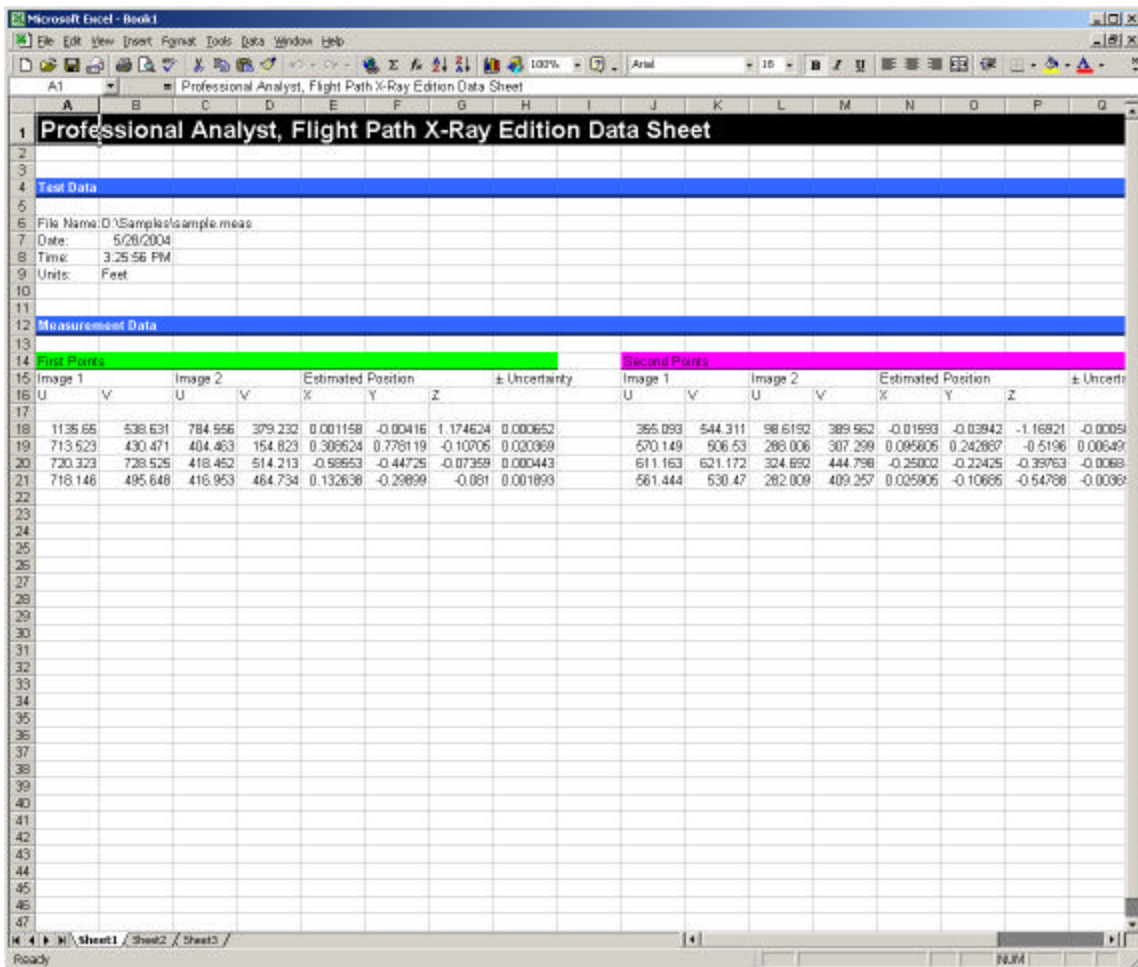


## User Manual Professional Analyst, Flight Path Edition for X-Ray Sources

When you have selected all the points of interest, you can save your measurement results to a file. This will save the calibration information and measurement information to a measurement file (\*.meas).

Note that the measurement file contains a copy of the calibration information. Once it is saved to the measurement file, the measurement does not use the original calibration file. If you make any changes to the original calibration file, you must reload the calibration into the measurement document using the **Change Calibration** button in order to apply the changes.

You can also export the measurement results to a Text document or to an Excel spreadsheet. First select the units and the export format and then hit the **Export Results** button. Here is a sample of the export results in Excel format. The sections are color coded to correspond to the first and second points in the line pairs and the line information for each pair.



Professional Analyst, Flight Path X-Ray Edition Data Sheet															
Test Data															
File Name: D:\Samples\sample.meas															
Date: 5/28/2004															
Time: 3:25:56 PM															
Units: Feet															
Measurement Data															
First Points							Second Points								
Image 1		Image 2		Estimated Position			± Uncertainty	Image 1		Image 2		Estimated Position			± Uncertainty
U	V	U	V	X	Y	Z		U	V	U	V	X	Y	Z	
1135.66	538.631	784.956	379.232	0.001158	-0.004116	1.174624	0.000652	365.093	544.311	98.6192	389.962	-0.01993	-0.03942	-1.16821	-0.00051
713.623	430.471	404.463	164.823	0.309624	0.778119	-0.10705	0.000369	570.149	906.53	288.006	307.299	0.095605	0.242657	-0.5196	0.006497
720.323	728.525	418.462	514.213	-0.98653	-0.44725	-0.07359	0.000443	611.163	621.172	324.692	444.798	-0.25002	-0.22425	-0.39763	-0.0068
718.146	495.648	416.953	464.734	0.132638	-0.29899	-0.081	0.001893	561.444	530.47	282.009	409.257	0.025905	-0.10685	-0.54768	-0.00392

If the same calculations are always done in Excel, the export feature can also be told to use an existing Excel file as a template for the export results. This template can contain

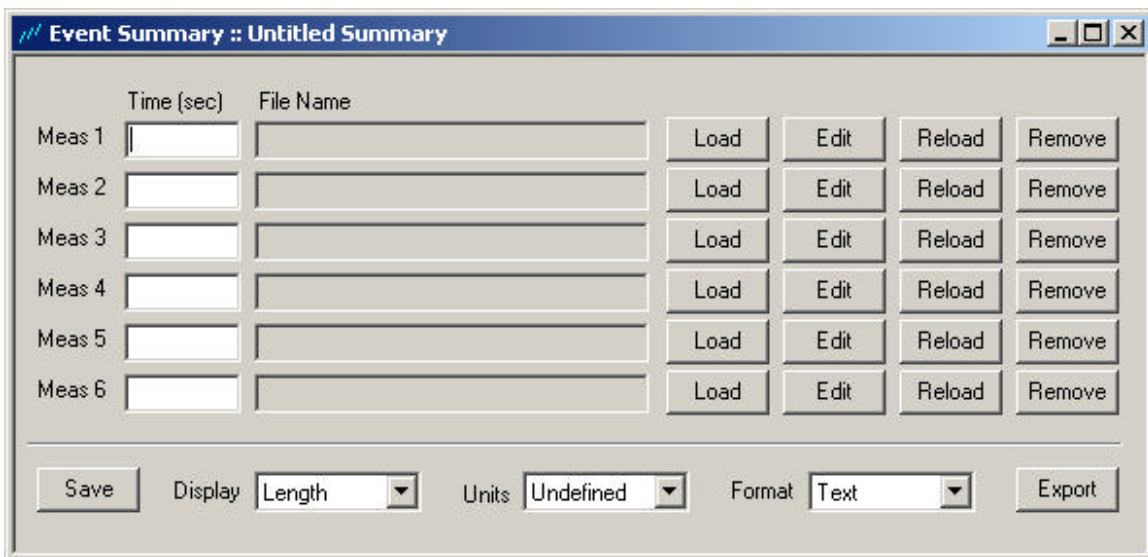
## User Manual Professional Analyst, Flight Path Edition for X-Ray Sources

formulas, graphs, or any other Excel elements. Select **Excel Template** as the **Format** type before exporting. Then select the Excel file to use as a template.

### **Event Summary**

After you have created a set of Measurement documents for one event, you can combine these all in one Event Summary Document. An Event Summary document loads a set of Measurement documents and displays a summary of all the measurements contained in each of the Measurement documents.

An Event Summary Document is created by selecting **File → New**. Then select **Event Summary**.



Load each measurement document by clicking on the corresponding **Load** button. For each measurement document, you must specify the time associated with that measurement. This allows the application to compute velocity information between measurements.

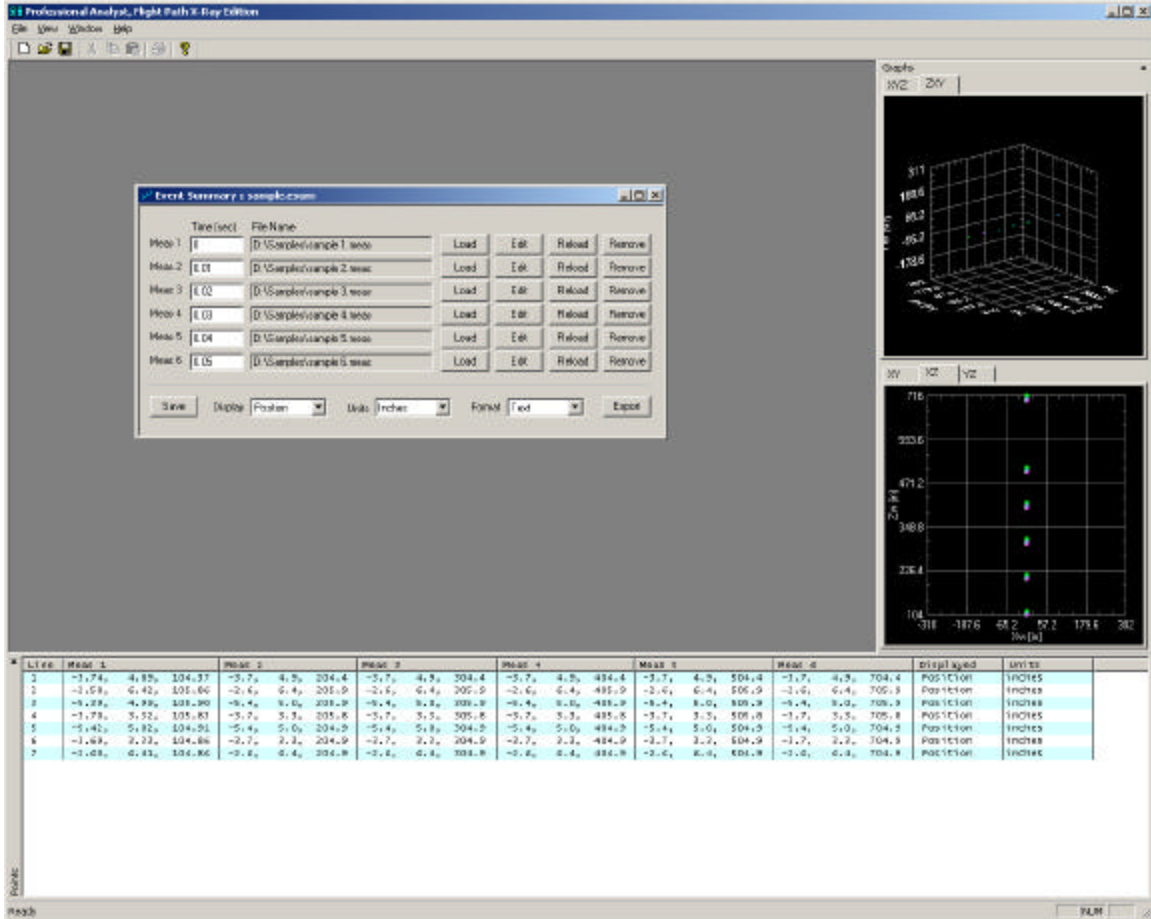
Up to six (6) measurement documents can be combined into an event summary. After you have loaded all the measurement documents, you can save the event summary information by clicking on the **Save** button. All the time and measurement document information will be saved to an event summary file (\*.esum).

If you wish to make changes to a measurement document, you can hit the **Edit** button next to the measurement document file name. After you have finished making changes and have saved the measurement document, you must hit the **Reload** button so that the new changes are loaded by the event summary.

# User Manual

## Professional Analyst, Flight Path Edition for X-Ray Sources

The Points listing will display information about each line pair contained in each measurement document. Which quantity is displayed is controlled by the **Display** drop down control in the Event Summary document window.



The Event Summary results can also be exported to a Text document or to an Excel Spreadsheet.

Select the units and the export format and then hit the **Export** button. This will export all available information about the measurement line pairs. The current display setting is not used during export. All possible display values are exported simultaneously.



# User Manual

## Professional Analyst, Flight Path Edition for X-Ray Sources

The screenshot shows an Excel spreadsheet with the following sections and data:

**Professional Analyst, Flight Path X-Ray Edition Data Sheet**

**Test Data**

File Name: D:\Samples\sample.esum  
 Date: 5/28/2004  
 Time: 3:24:03 PM  
 Units: Inches

**Measurement Files**

Meas 1 Time: 0 File Name: D:\Samples\sample 1 meas  
 Meas 2 Time: 0.01 File Name: D:\Samples\sample 2 meas  
 Meas 3 Time: 0.02 File Name: D:\Samples\sample 3 meas  
 Meas 4 Time: 0.03 File Name: D:\Samples\sample 4 meas  
 Meas 5 Time: 0.04 File Name: D:\Samples\sample 5 meas  
 Meas 6 Time: 0.05 File Name: D:\Samples\sample 6 meas

**Length**

Line	Meas 1	Meas 2	Meas 3	Meas 4	Meas 5	Meas 6
1	11.523129	11.52313	11.52313	11.52313	11.52313	11.52313
2	5.002484	5.002484	5.002484	5.002484	5.002484	5.002484
3	5.0037875	5.003788	5.003788	5.003788	5.003788	5.003788
4	4.9964411	4.996441	4.996441	4.996441	4.996441	4.996441
5	3.1109862	3.110988	3.110988	3.110988	3.110988	3.110988
6	2.4222407	2.422241	2.422241	2.422241	2.422241	2.422241
7	3.2668137	3.266814	3.266814	3.266814	3.266814	3.266814

**Position**

Line	Meas 1 X	Meas 1 Y	Meas 1 Z	Meas 2 X	Meas 2 Y	Meas 2 Z	Meas 3 X	Meas 3 Y	Meas 3 Z	Meas 4 X	Meas 4 Y	Meas 4 Z	Meas 5 X	Meas 5 Y	Meas 5 Z	Meas 6 X
1	-3.735762	4.884277	104.3671	-3.73576	4.884277	204.3671	-3.73576	4.884277	304.3671	-3.73576	4.884277	404.3671	-3.73576	4.884277	504.3671	-3.73576
2	-2.9526431	6.421658	105.856	-2.95264	6.421658	205.856	-2.95264	6.421658	305.856	-2.95264	6.421658	405.856	-2.95264	6.421658	505.856	-2.95264
3	-5.3910453	4.987868	105.9017	-5.39105	4.987868	205.9017	-5.39105	4.987868	305.9017	-5.39105	4.987868	405.9017	-5.39105	4.987868	505.9017	-5.39105
4	-3.6971304	3.319653	105.8341	-3.69713	3.319653	205.8341	-3.69713	3.319653	305.8341	-3.69713	3.319653	405.8341	-3.69713	3.319653	505.8341	-3.69713
5	-5.4196495	5.021864	104.9117	-5.41965	5.021864	204.9117	-5.41965	5.021864	304.9117	-5.41965	5.021864	404.9117	-5.41965	5.021864	504.9117	-5.41965
6	-3.6880189	3.327907	104.8634	-3.68802	3.327907	204.8634	-3.68802	3.327907	304.8634	-3.68802	3.327907	404.8634	-3.68802	3.327907	504.8634	-3.68802
7	-2.6023769	6.409805	104.8602	-2.60238	6.409805	204.8602	-2.60238	6.409805	304.8602	-2.60238	6.409805	404.8602	-2.60238	6.409805	504.8602	-2.60238

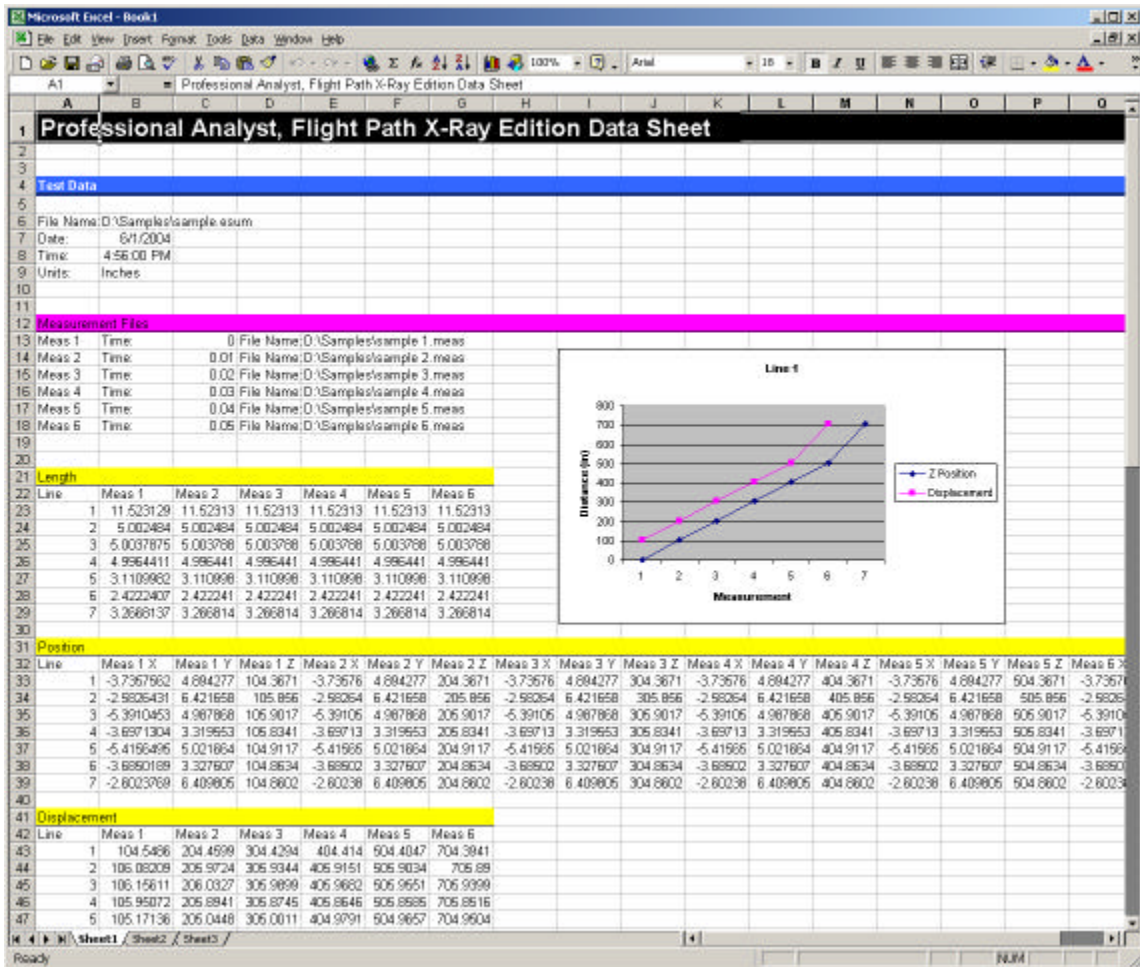
**Displacement**

Line	Meas 1	Meas 2	Meas 3	Meas 4	Meas 5	Meas 6
1	104.5496	204.4599	304.4294	404.414	504.4047	704.3941
2	105.88209	205.9724	305.9344	405.9151	505.9034	705.89
3	105.15611	205.0327	305.9899	405.9682	505.9651	705.9599
4	105.95072	205.8941	305.8745	405.8646	505.8585	705.8516
5	105.17136	205.0448	305.0011	404.9791	504.9657	704.9504

If the same calculations are always done in Excel, the export feature can also be told to use an existing Excel file as a template for the export results. This template can contain formulas, graphs, or any other Excel elements. Select **Excel Template** as the **Format** type before exporting. Then select the Excel file to use as a template.

# User Manual

## Professional Analyst, Flight Path Edition for X-Ray Sources



All the information is exported into the template file in Excel, with any calculations or graphs being automatically populated.