

ProAnalyst® Introductory
Edition Demonstration File
Quick Start Guide

1.0 Introduction

ProAnalyst® is a versatile video analysis suite consisting of multiple levels of software packages that are capable of automatically tracking objects in one- and two- dimensions, as well as performing contour tracking, particle tracking, image stabilization, and even 3-D tracking and analysis from stereoscopic video data. **ProAnalyst® Introductory Edition** is an introductory software package that is designed to enable the user to perform simple video analysis functions and retrieve useful data from their high speed video.

ProAnalyst® Introductory Edition is capable of automatically tracking one object, and manually tracking up to 32 objects in 2-D analysis for use in exporting data to programs such as Excel or Matlab for further graphing and analysis. **ProAnalyst® Professional Edition** includes the ability to automatically track an unlimited number of features automatically or manually, as well as construct virtual bodies from tracked points for use in determining distance, angles, and relationships in real time. Tracking and analysis data is able to be graphed, filtered, and exported in a variety of formats from within **ProAnalyst® Professional Edition**. Additional software packages are available for **ProAnalyst® Professional Edition**, including:

- the **Image Stabilization Toolkit** is able to remove unwanted jitter and vibration from a video. Simply select features within the image to stabilize upon and ProAnalyst will create a new, stabilized video for later analysis. Great for vibration environments, hand-held jitter, airborne testing, frequency analysis, and more. The **Image Stabilization Toolkit** is especially useful to those in the mining and explosives industries, as camera shake can affect the accuracy of tracking particle velocities.
- the **Contour Tracking Toolkit** is very useful for tracking the shape of expanding explosions or products of detonation. Trace shapes and compute their size, area, perimeter, center of gravity, and more. This feature is also commonly called "blob analysis."
- the **Particle Tracking Toolkit** is available to Users who wish to track the size and number of particles that are ejected from a blast or similar event that generates small objects that are difficult to count manually. This toolkit is able count fragments or parts in a flow environment where the User is able to classify parts by size, shape, eccentricity or axial orientation. Ideal for PIV, fragmenting ballistics, flow environments, and pressure analysis.

1.1 Getting Started

Please follow the **ProAnalyst® Introductory Edition Installation Guide** to install the **ProAnalyst® Introductory Edition** software package on your computer. The **ProAnalyst® Introductory Edition Installation Guide** is included in the **ProAnalyst®** box with the software. Once the program is installed, the user can open **ProAnalyst® Introductory Edition**, and find the **ProAnalyst® Introductory Edition Reference Guide** from the **Help** menu, or follow the instructions in the **Getting Started Guide** and **User Guide** to learn how to perform accurate video analysis.

Additionally, some helpful information is provided in **Chapter 1.2** to assist the User in navigating through **ProAnalyst® Introductory Edition**. There are two fully worked examples included in this operations manual, in order to better demonstrate the capabilities of your new software package as it applies directly to the mining and explosives industries.

Example 1 is included in **Chapter 1.4**. This example is a full analysis of video footage from an open pit mine, used to determine the free-face velocity of a bench blast. This example makes use of the **Auto-Tracking** feature provided in the **Introductory Edition** software package.

Example 2 is included in **Chapter 1.5**. This example is a full analysis of video footage from an experimental trial of an explosive disruptor device. This example makes use of the **Manual-Tracking** features provided in the **Introductory Edition** software package.

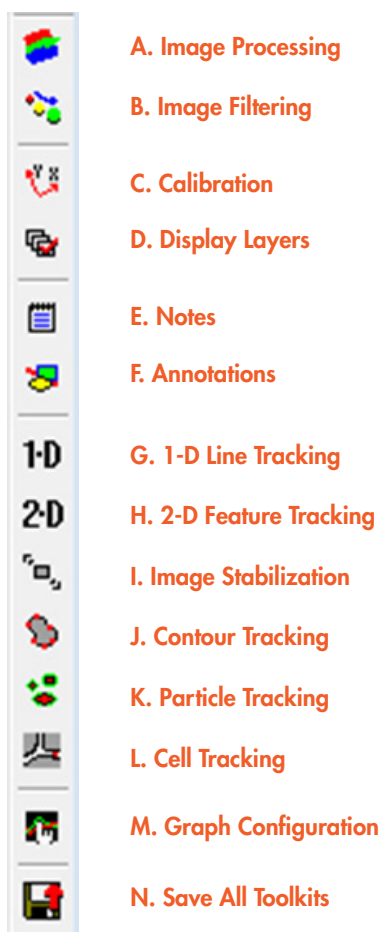
1.2 The ProAnalyst User Interface

All features and operations of the **ProAnalyst®** motion analysis suite are incorporated into two main toolbars within the user interface. There is a **Main Toolbar** across the top of the screen that provides functionality to the User in terms of creating projects, opening files, saving files, synchronizing files for simultaneous playback, and many other features at the administrative level of operation. The User is encouraged to explore the main toolbar, in conjunction with the **User Guide**, to learn how to perform the basic administrative functions relating to file structure, such as creating and managing a project and importing video and data. The **Main Toolbar** is complemented by the **Annotation Toolbars**, the **Visibility Toolbar**, and **Synchronized Play Controls Toolbar**.

The most important toolbar that the User must familiarize him or herself with is the **Measurement Toolbar**. The primary objective of this Operations Manual is to focus on the actual motion analysis procedure so as to speed the learning process, and train the User in the most critical aspects of motion analysis and data extraction from video files. Extracting motion analysis data from your video is achieved in what can be simplified into four-step process. Each of these steps can be performed entirely from within the **Measurement Toolbar**.

- 1) Image Processing
- 2) Calibrating Distance to Real-World Values
- 3) Tracking the Motion (Automatically or Manually)
- 4) Report Generation

1.3 The Measurement Toolbar



The **ProAnalyst® Measurement Toolbar** is organized according to the natural work flow of the analysis process. The User will begin each analysis project by beginning at the top of the toolbar and working downward through the icons - following the necessary steps to prepare the image for tracking, then tracking the desired feature(s) and outputting the results. The process is ultimately simple and straight forward, however learning the best methods of image processing and feature tracking are critical for successful analyses.

A. Image Processing

Image Processing is the adjustment of video settings so that certain features become more pronounced on the screen. It is likely the most critical aspect of auto-tracking, for both 1-D and 2-D tracking. **Image Processing** is performed with the intent to enhance the contrast between the feature you intend to track and the background colour of the area surrounding that feature. The more stark the contrast between the target feature and the rest of the surrounding image, the more accurately the software will be able to track that feature automatically, and the higher the probability of a successful track.

B. Image Filtering

This tool is NOT available in **ProAnalyst® Introductory Edition**, however it is available in **ProAnalyst® Professional Edition**. Image Filtering is another powerful tool that lets the User apply a myriad of filters to the image, in order to enhance the feature(s) desired for tracking. Some of the available filters are: Despeckle, Strobe Effect, Local Background Removal, Edge Detector, Vertical Edges, Horizontal Edges, Sharpening, Smoothing, Lens Correction for Radial Distortion, and many more.

C. Multi-Plane Calibration

This feature is used to scale the recorded video image to the real world distances involved in the motion analysis. Setting any two points with known distance between them quickly accomplishes this task, with the added feature of being able to orient the coordinate axes at any location or rotation that the User desires.

D. Display Layers

This feature provides the option to display different types of information overlying the video image. For instance, the User can choose to display the coordinate axes of the multi-plane calibration, or draw graphic annotations that could be used to highlight certain features of the video. Simply draw the annotations, and check or un-check the boxes on the right-hand side of the screen to show or hide the different layers.

E. Notes

This feature allows the User to write notes in the **Notes Panel** for the video . The User can post a note for each frame individually, or as a **Global Note** that will stay posted throughout the entire video sequence. The notes are viewable in the **Notes Panel** during viewing in **ProAnalyst®**, and are included alongside their respective image in the **Report Generation** of **ProAnalyst® Professional Edition**. **Global Notes** are always displayed alongside the first frame of the sequence.

F. Annotations

The User is able to annotate the video image with several drawing tools, including arrows, lines, boxes, circles, etc. of all different colours and thicknesses. The **Annotations** may be used to highlight important features in a certain frame, or draw a dimension lines on the screen (that are automatically calibrated for distance if the User has performed a **Multi-Plane Calibration**).

G. 1-D Line Tracking

This tool is NOT available in **ProAnalyst® Introductory Edition**. **1-D Line Tracking** allows the User to draw a tracking line along the path of a particular feature that he or she wishes to analyze. The program will then scan each frame for the User-defined “peak threshold” or “peak value” from point 1 to point 2 along that line, and track its position as the video progresses. This tool is extremely useful for tracking features that are not well-defined objects. An example of the usefulness of **1-D Line Tracking** would be the ability to track the movement of a free face in a bench blast without having to use a physical marker on the free face during the blast. The **1-D Line Tracking** tool can distinguish the difference between the mass of rock and the sky in the background, anywhere along the tracking line. This can be very useful in tracking the velocities of stemming ejections or blowouts along the free face, where no markers were placed during the blast.

H. 2-D Feature Tracking

This tool is available in **ProAnalyst® Introductory Edition**. The User is limited to being able to **Auto-Track** one feature and **Manual-Track** up to 32 features in two dimensions. This tool is essential to even the most basic level User of **ProAnalyst®**, as it produces the important tracking data that will later be exported, or in the case of **ProAnalyst® Professional Edition** - be used in the **Graphing, Data Synchronization**, and **Report Generation** tools. By properly processing the video image ahead of time, the User can make **Auto-Tracking** a much more successful operation for his or herself. **Manual-Tracking** is also a very useful tool. Since the User defines the location of the feature in each frame, there is no requirement for **Image Processing** or **Image Filtering** to make the feature easier for the computer to track automatically. **Manual-Tracking** may even be performed through only a short segment of the video where **Auto-Tracking** is not possible. To resume **Auto-Tracking**, simply click the **Automatic** box in the **2-D Feature Tracking** toolkit and continue tracking as normal.

I. Image Stabilization

This tool is NOT available in **ProAnalyst® Introductory Edition**, it is however available as an add-on package to **ProAnalyst® Professional Edition**. This tool allows the User to digitally eliminate unwanted camera movements from the video. This is completed by selecting and tracking a background feature that does not move during the filming. The software then shifts the entire image sequence in whichever directions necessary to cause this feature to remain stationary, thus “stabilizing” the image. **Feature Tracking** is now able to track the true trajectory of the object, not the combined trajectory of the object and camera shake.

J. Contour Tracking

This tool is not available in **ProAnalyst® Introductory Edition**, it is however available as an add-on package to **ProAnalyst® Professional Edition**.

K. Particle Tracking

This tool is not available in **ProAnalyst® Introductory Edition**, it is however available as an add-on package to **ProAnalyst® Professional Edition**.

L. Cell Tracking

This tool is not available in **ProAnalyst® Introductory Edition**, it is however available as an add-on package to **ProAnalyst® Professional Edition**.

M. Graph Configuration

This tool is NOT available in **ProAnalyst® Introductory Edition**, it is however available in **ProAnalyst® Professional Edition**. Clicking on the **Graph Configuration** button will provide the User with the ability to “add lines” to the graph that represent various properties of the tracked feature(s) over time, such as x-position, y-position, x- or y-velocities, speed, and accelerations, distances, and angles between features. These can all be displayed in real-time side-scrolling graphs, and are able to be displayed simultaneously with the playing video, complete with tracking annotations and measurements. **Graph Configuration** also provides the opportunity to synchronize video tracking data with sensor data acquired through instrumentation during the event.

N. Save All Toolkits

ProAnalyst® is a non-destructive motion analysis tool in the sense that the original video file is never altered or overwritten by any operation within the program. Each toolkit (Image Processing, Calibration, Tracking, etc.) saves its own set of operational parameters in an individual file that is stored in the same directory as the overall “project file”. By simply clicking on the **Save All Toolkits** icon the User can quickly save all of the data associated with these toolkits, all without affecting the original video file.

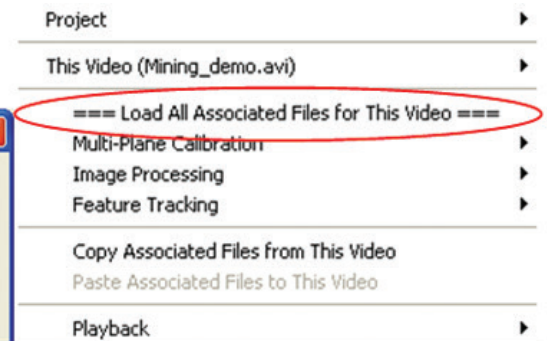
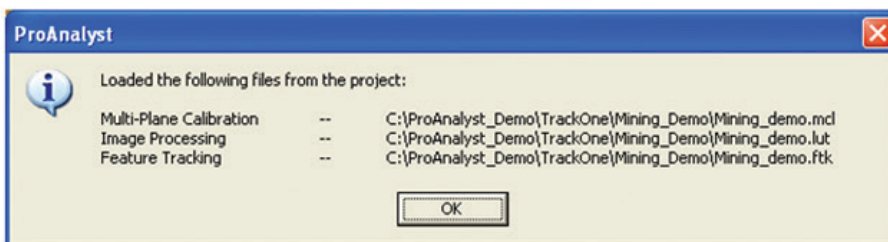
1.4 Example: Open Pit Mine

Note: This short tutorial only describes the features available in **Introductory Edition** that are used for this example. For all other features, please refer to the **ProAnalyst® User Guide**.

This Mining example is for the purpose of learning how to perform **Auto-Tracking** using **ProAnalyst® Introductory Edition**.

To Open the Project:

- Open **ProAnalyst® Introductory Edition**. Select **File, Open Project...**
- The example file can be found on the **MREL DVD**: in **ProAnalyst® Introductory\Mining_Demo**.
- Navigate to the directory where the files are stored and select **Mining_Demo.mpj** then click **Open**.
- The project file will open into its window called **Mining_Demo**.
- Right click on the video file and the menu below will appear:



- Click on **=== Load All Associated Files for This Video ===**
- This will load all of the data files associated with the example. These files include the original video file, as well as a **Multi-Plane Calibration file (.mcl)**, **Image Processing file (.lut)** and a **Feature Tracking file (.ftk)**.
- Once the operator clicks **OK**, the **Measurement Window** may be maximized.

Note: If you would like to perform your own **Multi-Plane Calibration (Section 1.4.2)**, the following information is pertinent to you: The calibration of the video is as shown in the calibration tab with the distance between the two green markers being **12 meters (39.37 feet)**.

- To confirm the frame rate was entered into the software correctly, right click on the video and select **Modify Recorded Parameters**. This will allow the user to calibrate the time of the video. The user can also modify the shutter speed and select the position of frame 0.

Note: This example video was captured at **250** frames per second.

- With the window maximized, the user will notice along the left edge of the video that there are three tabs: **Raw**, **Processed**, and **Thumbnail**.
- The **Raw** tab is the original video with no modification which will be, in this example, the original coloring.
- The **Processed** tab is same video with the **Image Processing** applied.
- The **Thumbnail** tab is the video with thumbnails at particular points in the video.
- Pressing **Z** decreases the size of the thumbnail while **A** increases the size.
- Pressing **X** decreases the time between thumbnails while **S** increases the time.



1.4.1 Image Processing

Image Processing is likely the most critical aspect of auto-tracking, whether it be one- or two-dimensional. **Image processing** is performed with the intent to enhance the contrast between the feature you intend to track and the background colour or tone. The more stark the contrast between the target feature and the rest of the surrounding image, the more accurately the software will be able to track that feature automatically, and the higher the probability of a successful track.

To begin, click the **Image Processing** icon in the **Measurement Toolbar**. Here you will find the **Brightness**, **Contrast**, **Gamma**, and **Exp./Log** sliders. You can also reverse the Red/Blue/Green of the image to better express the feature you intend to track. **In this example you will find it useful to increase the Contrast slightly, and decrease the Brightness slightly.** This will help to enhance the definition for the green markers, which you will be tracking in later steps.

1.4.2 Multi-Plane Calibration

This feature is used to scale the recorded video image to the real world distances involved in the motion analysis. Setting any two points with known distance between them quickly accomplishes this task, with the added feature of being able to orient the coordinate axes at any location and rotation desired.

To begin, click the **Multi-Plane Calibration** icon in the **Measurement Toolbar** and click **Add Normal**. By clicking on the **Wrench**  you will open the settings for this specific calibration. Next, click on the top green marker and then click **Set Point #1**, then click the lower green marker and click **Set Point #2**. Below, in the **Distance Between Points** box, enter **12** and select **Metres** from the drop-down menu. Next, click **Apply Scale**. The real world distances have now been calibrated to your video image. Distances, speeds, velocities, and dimensions will now all be in terms of Metres. Clicking on the **Open Eye**  will cause the **Multi-Plane Calibration** to disappear from the video image, and the **Eye** to close.

1.4.3 Display Layers

This menu allows the user to change which layers are displayed and the information displayed on the screen.

1.4.4 Notes


This will allow the user to make notes on the video file. The area labelled **Video Notes** is information about the displayed frame, and the **Global Notes** area will display throughout the whole video sequence.

1.4.5 Annotations

The tab allows the user to draw and place text on the video frame.

1.4.6 Feature Tracking

This tool is available in **ProAnalyst® Introductory Edition**. The User is limited to being able to **Auto-Track** one feature and **Manual-Track** up to 32 features in two dimensions. This tool is essential to even the most basic level User of **ProAnalyst®**, as it produces the important tracking data that will later be exported, or in the case of **ProAnalyst® Professional Edition** - be used in the **Graphing**, **Data Synchronization**, and **Report Generation** tools. By properly processing the video image ahead of time, the User can make **Auto-Tracking** a much more successful operation for his or herself. **Manual-Tracking** is also a very useful tool. Since the User defines the location of the feature in each frame, there is no requirement for **Image Processing** or **Image Filtering** to make the feature easier for the computer to track automatically. **Manual-Tracking** may even be performed through only a short segment of the video where **Auto-Tracking** is not possible. To resume **Auto-Tracking**, simply click the **Automatic** box in the **2-D Feature Tracking** toolkit and continue tracking as normal.

To begin **Auto-Tracking**, click the  icon in the **Measurement Toolbar** and then click **Enable**. One feature will already be added to the **Features** box. To begin the tracking process, click **Define Region** and then draw a box closely around the green marker of your choice and then click **Set Region**.

Make sure that the **Mode** in the **Feature Tracking** toolkit window is set to **Automatic** and then click the wrench to open **Settings**, and observe the many options that are presented. Please note that these settings will work well for most Users as they are, but in the special case of tracking an object amidst the background of an open pit mine, we will need to be sure that the **Search Parameters** suit our application. The **Search Region Multiplier** indicates the size of the area around the region that you defined earlier. This is the area that the program will search to find the exact same image that exists inside that region currently. The **Threshold Tolerance** indicates the required likeness of the region in the next frame to the region in this frame (value of 1 meaning an identical match). In this example, the standard **Search Region** of **250%** will be sufficient, but the **Threshold Tolerance** should be increased from 0.75 to **0.85** in order to prevent the software from accidentally tracking the wrong nearby region that is less than 85% similar. The User is encouraged to experiment with **Frames to Search After Loss**. This represents the number of frames the program will skip to find the region that is more than 85% similar to the defined region. It is normally set to **zero** if the User prefers the program to halt when the software has lost the target **Region**. It can be set to **2** in this example with good success, as the program might lose the green marker momentarily, but within 2 frames from losing it, it is able to find it again nearby and continue tracking. If the program cannot find the green marker within 2 frames, it will halt. This can give you the opportunity to redefine **Search Parameters** or even redefine the target **Region** itself to get a better track from that point forward.

You may find it necessary to stop the automatic tracking at certain points in the later frames of the sequence, in order to re-define the **Region** of interest and continue tracking from that point. Feel free to experiment with the **Angular Range** (the amount of rotation the searching program will allow between the current frame and the next frame of the sequence) as well as the **Trajectory Prediction**. These features can increase the probability of the software being able to track the feature from beginning to end. Along with redefining the target **Region** of interest, **Search Parameters**, **Feature Rotation**, and **Trajectory Prediction** can also be adjusted at future frames in the sequence if the Auto-track has lost the target **Region**.

After making adjustments in the **Feature 1 Track Settings** menu, be sure to click **Apply** before clicking **Close**. If you find that your settings are not working for you and you would like to return them to default, simply delete **Feature 1** by clicking **Remove** and then **Add** to replace it with a fresh tracking feature with new default settings. This is normally not necessary, as a slight adjustment to **Search Parameters** or redefining the target **Region** is usually sufficient to continue tracking.

In the **Feature Tracking** toolkit window, the drop down menu **Show Points** can be changed to Show All Points, Current Point, or Past Points

only. Under the **Tracking** heading, the buttons from left to right are: **Track Backwards**, **Track One Frame Backwards**, **Stop**, **Track One Frame Forward** and **Track Forward**.

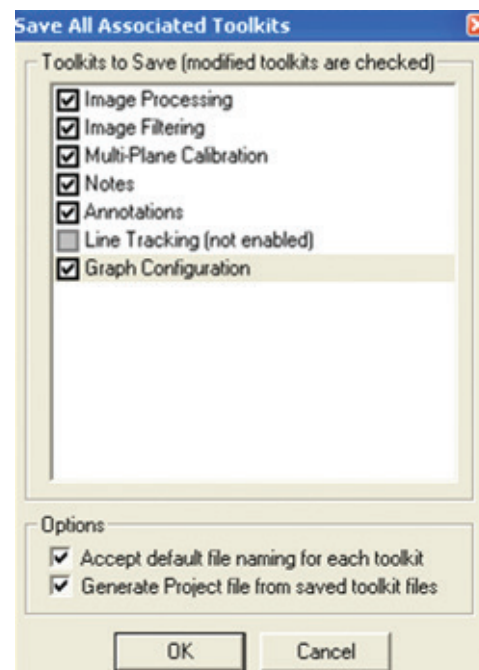
Once the object is tracked, the **Padlock** between the **Eye** and the **Wrench** should then be clicked to the closed (locked) position to avoid any changes to the tracking points. The **Units & Export** section will allow the user to select the units to export the data to as well as the form that the file will be in when exported. In this example, the setup was **Meters** and **Text**. The text file was placed in the same directory labelled **Mining_Demo.txt**.

The **Introductory Edition** does not offer graphing, therefore, for this example the data was imported and graphed in **Excel**. The file is labelled as **Mining_Demo.xls**.

1.4.7 Save All Toolkits

ProAnalyst® is a non-destructive motion analysis tool in the sense that the original video file is never altered or overwritten by any operation within the program. Each toolkit (Image Processing, Calibration, Tracking, etc.) saves its own set of selected parameters in an individual file that is stored in the same directory as the overall "project file" for the motion analysis at hand. By simply clicking on the **Save All Toolkits** icon, the User can quickly save all of the data associated with these toolkits, all without affecting the original video file.

After all of the analysis has been performed, it is very important to associate each of these files to the video. It is important to select all of the boxes because then the software will save everything. The bottom two boxes under **Options** are also very important because the file names will be the same as the video file name. This will allow opening of the analyzed video as easily as was possible for this example. Associated settings and parameters can be opened by clicking **=== Load All Associated Files for This Video ===**. **Generate Project** is also very important because it controls the overall association of each of these files with each other. This is the *.mpj file which will keep everything neat and tidy.



1.4.8 Excel Spreadsheet – Mining_Demo.xls

This spreadsheet was generated from the exported file from **ProAnalyst® Introductory**. On the first sheet (Mining_Demo) displays the data from the text file with a red shading. Everything with the red shading of the cell was imported from the **ProAnalyst®** text file. All of the white (unshaded) cells were calculated within Excel.

Explanation of the Unshaded Cells

Feature 1 Values:

Feature 1 (Top_Marker) Vector (column E): This column is the vector sum of the X and Y.

Equation: $E\# = \sqrt{C\#^2 + D\#^2}$ where # is the current cell in the E column

The Graphs tab has all of the measurements in a graphical solution.

The graph on the left is the final solution produced by MREL to show the user what a completed graph could look like. The two white lines and text boxes were manually generated by hovering the cursor over the graph to record the values. This can be done on the graph on the right.

The points used in this example are:

Lower Line:

Point #1: (0.984, 2.034001316)

Point #2: (1.600, 9.266355494)

Therefore, the average velocity between these two points is:

$$\text{Velocity} = (9.266355494 - 2.034001316) \text{ meters} / (1.600 - 0.984) \text{ second} = 7.232254178 / 0.616 = 11.74 \text{ m/s}$$

Upper Line:

Point #1: (1.656, 9.650500598)

Point #2: (2.956, 23.96412087)

Therefore, the average velocity between these two points is:

$$\text{Velocity} = (23.96412087 - 9.650500598) \text{ meters} / (2.956 - 1.656) \text{ second} = 14.3162027 / 1.300 = 11.01 \text{ m/s}$$

Two lines were chosen because of the 'bump' in the data graph near 1.6 seconds. As well, the slope of the line needs to match the data.

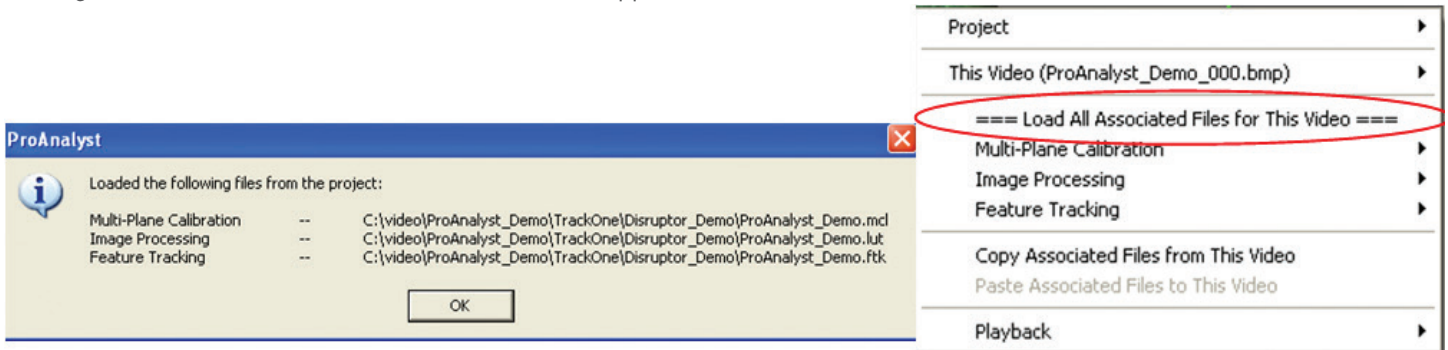
1.5 Example: Explosive Disruptor

Note: This short tutorial only describes the features available in **Introductory Edition** that are used for this example. For all other features, please refer to the **ProAnalyst® User Guide**.

This Disruptor example is for the purpose of learning how to perform **Manual Tracking** using **ProAnalyst® Introductory Edition**.

To Open the Project:

- Open **ProAnalyst® Introductory Edition**. Select **File, Open Project...**
- The example file can be found on the **MREL DVD**: in **ProAnalyst Introductory\Disruptor_Demo**.
- Navigate to the directory where the files are stored and select **ProAnalyst_Demo.mpj** then click **Open**.
- The project file will open into its window with the file called **ProAnalyst_Demo_000.bmp** or **ProAnalyst_Demo.avi**
- Right click on the video file and the menu below will appear:



- Click on **=== Load All Associated Files for This Video ===**
- This will load all of the data files associated with the example. These files include the original video file, as well as a **Multi-Plane Calibration file (.mcl)**, **Image Processing file (.lut)** and a **Feature Tracking file (.ftk)**.
- Once the operator clicks **OK**, the **Measurement Window** may be maximized.

Note: If you would like to perform your own Multi-Plane Calibration (Section 1.6.2), the following information is pertinent to you:

The calibration of the video is as shown in the calibration tab with the distance from the edge of the blue container to the third sensor (which is a third of the distance from the tip to the pole) is **5 meters (16.5 feet)**.

- To confirm the frame rate was entered into the software correctly, right click on the video and select **Modify Recorded Parameters**. This will allow the user to calibrate the time of the video. The user can also modify the shutter speed and select the position of frame 0.

Note: This example file was captured at **1000 frames per second**.

- With the window maximized, the user will notice along the left edge of the video that there are three tabs: **Raw**, **Processed**, and **Thumbnail**.
- The **Raw** tab is the original video with no modification which will be, in this example, the original coloring. T
- The **Processed** tab is same video with the Image Processing applied.
- The **Thumbnail** tab is the video with thumbnails at particular points in the video.
- Pressing **Z** decreases the size of the thumbnail while **A** increases the size.
- Pressing **X** decreases the time between thumbnails while **S** increases the time.



1.5.1 Image Processing

Image Processing is likely the most critical aspect of auto-tracking, whether it be one- or two-dimensional. **Image processing** is performed with the intent to enhance the contrast between the feature you intend to track and the background colour or tone. The more stark the contrast between the target feature and the rest of the surrounding image, the more accurately the software will be able to track that feature automatically, and the higher the probability of a successful track.

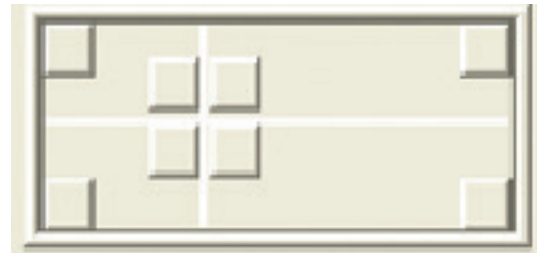
it will be impossible to **Auto-Track** the expanding explosion since there are no well defined features that maintain their shape throughout the video. Since this example makes use of **Manual-Tracking** and not **Auto-Tracking**, the User will now adjust the **Image Processing** settings to best suit their own ability to see the features they intend to track. To begin, click the **Image Processing** icon in the **Measurement Toolbar**. Here you will find the **Brightness**, **Contrast**, **Gamma**, and **Exp./ Log** sliders. You can also reverse the Red/Blue/Green of the image, or convert it to Black and White in order to better express the feature you intend to track.

1.5.2 Image Processing

This feature is used to scale the recorded video image to the real world distances involved in the motion analysis. Setting any two points with known distance between them quickly accomplishes this task, with the added feature of being able to orient the coordinate axes at any rotation desired.

To Begin, click the **Multi-Plane Calibration** icon in the **Measurement Toolbar** and click **Add Normal**. By clicking on the wrench () you will open the settings for this specific calibration. Next, click on the top green marker and then click **Set Point #1**, then click the lower green marker and click **Set Point #2**. Below, in the **Distance Between Points** box, enter **12** and select **Metres** from the drop-down menu. Next, click **Apply Scale**. The real world distances have now been calibrated to your video image. Distances, speeds, velocities, and dimensions will now all be in terms of Metres. Clicking on the **Open Eye** () will cause the **Multi-Plane Calibration** to disappear from the video image, and the **Eye** to close.

The origin of the coordinate system can be set in a similar method. Click the location on the image where you would like the origin to be. Next, click **Set Origin** and select the orientation of the axes from the menu, as shown in the image below:



Each of the corner buttons will set the origin of the coordinate system in the respective corner. The positive orientation of the two axes will be along the edges of the frame. For example, the top left button will set positive X direction to the right and the positive Y direction down while the bottom right button will set the positive X direction to the left and the positive Y direction up. The four buttons around the **reticle** will set the positive orientation around the button pressed from the **reticle** position. If the orientation of the X axis is not horizontal, from the origin of the coordinate system place the **reticle** on the horizontal line and then click Set X Direction. Once the Origin and positive axes are set, the user **MUST** click **Apply Origin and Tilt >>** button. After the button is clicked, the pixels (origin) will be displayed as well as the degrees (tilt). The user **MUST** then click **Apply** to set the changes and then click **Close**. The user can always remove calibrations if they were made in error.

1.5.3 Display Layers

This menu allows the user to change which layers are displayed and the information displayed on the screen.

1.5.4 Notes

This will allow the user to make notes on the video file. The area labelled **Video Notes** is information about the displayed frame, and the **Global Notes** area will display throughout the whole video sequence.

1.5.5 Annotations

The tab allows the user to draw and place text on the video frame.

1.5.6 Feature Tracking **2-D**

This tool is available in **ProAnalyst® Introductory Edition**. The User is limited to being able to **Auto-Track** one feature and manually track up to 32 features in two dimensions. This tool is essential to even the most basic User of **ProAnalyst®**, as it produces all of the tracking data that will later be exported, or in the case of **ProAnalyst® Professional Edition** - be used in the **Graphing** and **Data Synchronization** features. By properly processing the video image ahead of time, the User can make **Auto-Tracking** a much more successful operation for his or herself. **Manual-Tracking** of a feature is still a very useful tool and the **Introductory** User will likely make much use of it, as no **Image Processing** is required for the human eye to accurately track the feature of interest across the image as frames progress through the sequence. **Manual Tracking** is of course a much slower operation, but may yield as accurate results as Auto-Tracking with little or no involvement in **Image Processing** or **Image Filtering**.

To begin **Manual Tracking**, the User must first click on the **2-D** icon and then click **Enable**. Be sure to select **Manual** in the **Mode** box in the top right hand corner of the **2-D Feature Tracking Toolkit**. The process of Manual Tracking is as simple as repeatedly clicking on the feature's location in the present frame and then clicking **Set Point**. Clicking **Set Point** will automatically advance the video sequence to the next frame. Instead of moving the mouse over to click the **Set Point** button, the User also has the option of holding the **Ctrl** key and performing a Right-Click simultaneously. By pressing **Ctrl + Right-Click**, the next tracking point will appear and the video will automatically advance to the next frame, as would be the case by clicking **Set Point**. This can make for a much faster analysis using **Manual Tracking**. Remember to **Left-Click** the location of the feature in each frame before setting the point location by either of these two methods.

In the **Feature Tracking** toolkit window, the drop down menu **Show Points** can be changed to **Show All Points**, **Current Point**, or **Past Points**

only. Under the **Tracking** heading, the buttons from left to right are: **Track Backwards**, **Track One Frame Backwards**, **Stop**, **Track One Frame Forward** and **Track Forward**.

Once the object is tracked, the **Padlock** between the **Eye** and the **Wrench** should then be clicked to the closed (locked) position to avoid any changes to the tracking points. The **Units & Export** section will allow the user to select the units to export the data to as well as the form that the file will be in when exported. In this example, the setup was **Meters** and **Text**. The text file was placed in the same directory labelled **ProAnalyst_Demo.txt**.

The **Introductory Edition** does not offer graphing, therefore, for this example the data was imported and graphed in **Excel**. The file is labelled as **ProAnalyst_Demo.xls**.

1.5.7 Save All Toolkits

ProAnalyst® is a non-destructive motion analysis tool in the sense that the original video file is never altered or overwritten by any operation within the program. Each toolkit (Image Processing, Calibration, Tracking, etc.) saves its own set of selected parameters in an individual file that is stored in the same directory as the overall "project file" for the motion analysis at hand. By simply clicking on the **Save All Toolkits** icon, the User can quickly save all of the data associated with these toolkits, all without affecting the original video file.

After all of the analysis has been performed, it is very important to associate each of these files to the video. It is important to select all of the boxes because then the software will save everything. The bottom two boxes under **Options** are also very important because the file names will be the same as the video file name. This will allow opening of the analyzed video as easily as was possible for this example. Associated settings and parameters can be opened by clicking **=== Load All Associated Files for This Video ===**. The Generate Project is also very important because it controls the overall association of each of these files with each other. This is the *.mpj file which will keep everything neat and tidy.

1.5.8 Excel Spreadsheet – ProAnalyst_Demo.xls

This spreadsheet was generated from the exported file from **ProAnalyst® Introductory**. On the first sheet (ProAnalyst_Demo) displays the data from the text file with a red shading. Everything with the red shading of the cell was imported from the **ProAnalyst®** text file. All of the white (unshaded) cells were calculated within Excel.

Explanation of the Unshaded Cells

Feature 1 Values:

Feature 1 (Right_Side) X (corrected) (column D): This column is used to correct the offset of the data points from the origin of the coordinate system. Equation: $D\# = (C\# - C12)$ where # is the current cell in the D column.

Feature 1 (Right_Side) Y (corrected) (column F): This is the same process as X (corrected).

Feature 1 (Right_Side) Vector (column G): This column is the vector sum of the X (corrected) and Y (corrected).

Equation: $G\# = \sqrt{D\#^2 + F\#^2}$

Feature 2 Values:

Feature 2 (Left_Side) X (corrected) (column J): This column is used to correct the offset of the data points from the origin of the coordinate system. Equation: $J\# = (I\# - I12)*(-1)$ where # is the current cell in the J column.

The values are required to be multiplied by negative 1 (-1) because the coordinate system was defined with Positive X to the right, the left side positive motion is to the left.

The other solution is to define another calibration for the Left_Side measurement.
All of the other measurements are as described above.

The **Graphs** tab has all of the measurements in a graphical solution.

Contacting MREL for
Technical Support

2.1 Contacting MREL

MREL Group of Companies Limited

Blasting Instrumentation Team

1555 Sydenham Road
Kingston, Ontario K7L 4V4
Canada

Toll Free Canada/USA: +1-877-544-MREL

Tel: +1-613-545-0466

Fax: +1-613-542-8029

Email: support@mrel.com

MREL looks forward to providing you with assistance.



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MREL GROUP OF COMPANIES LIMITED

1555 Sydenham Road Kingston, Ontario K7L 4V4 Canada

T: +1-613-545-0466

F: +1-613-542-8029

E: blasting@mrel.com

www.mrel.com