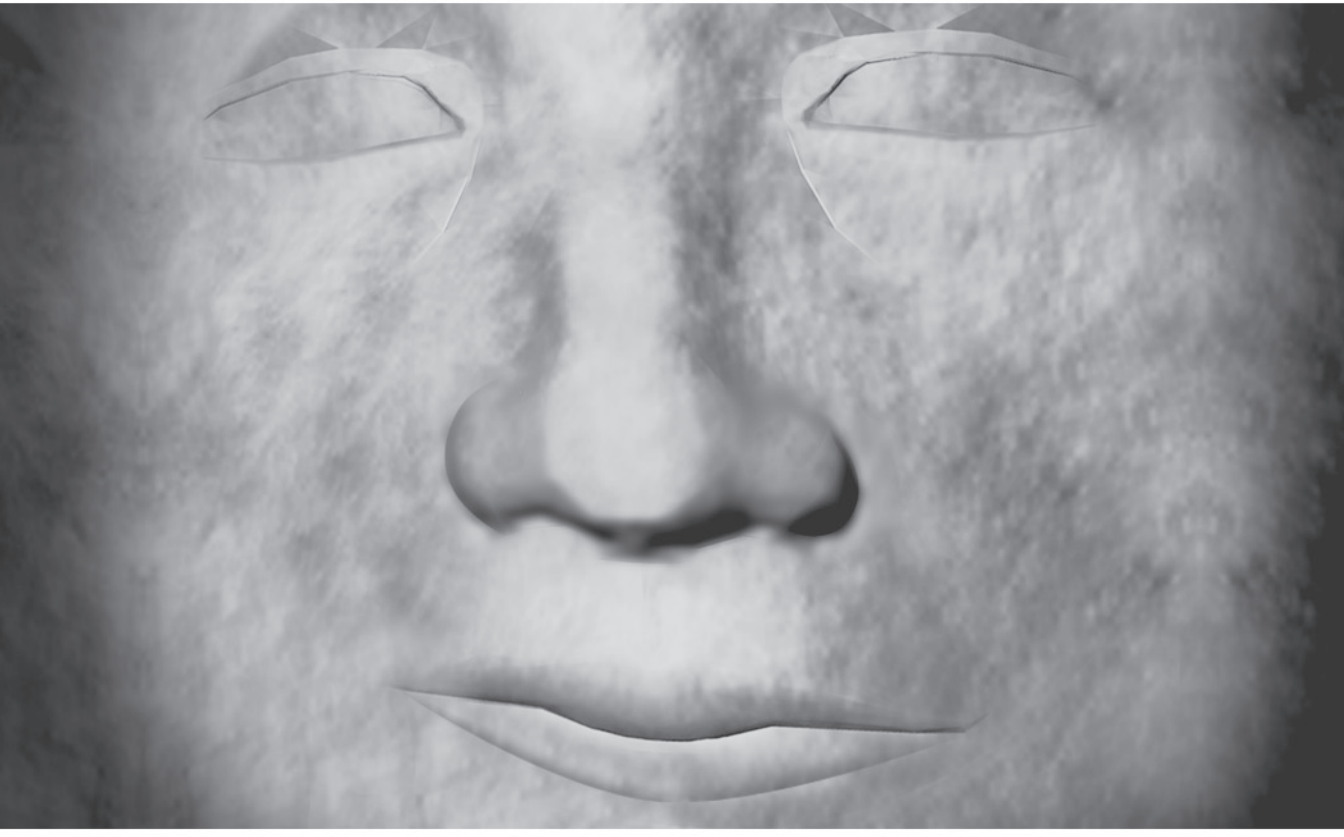
MiDAS 4.0



User Guide

MiDAS 4.0 User Manual

Table of Contents

Chapter

1

Overview

Chapter 1. Overview

Introducing MiDAS 4.0

MiDAS 4.0 is the fourth generation of Xcitex digital video and data capture control software. MiDAS 4.0 is comprised of three editions: Express, Standard, and Full. MiDAS 4.0 Express includes single camera control, frame-by-frame playback, and image processing capabilities. MiDAS 4.0 Standard includes multiple camera control, motion based video triggering, automation capabilities, measurement calipers, and manual feature tracking. MiDAS 4.0 Full adds data acquisition control, video/data synchronization, and data level based triggering to the features found in MiDAS 4.0 Standard.

New in MiDAS 4.0

MiDAS 4.0 retains the flexibility of earlier versions of the MiDAS software while significantly extending the functionality of many features and simplifying complex tasks. In addition to all the base functionality of previous versions of MiDAS, MiDAS 4.0 features:

- Data-only capture mode. Control data acquisition without having cameras attached.
- 3-D Capture Wizard. Capture calibration images and videos using two cameras, then transfer these files to ProAnalyst 3-D Professional software for motion analysis.
- Auto-recording modes.
- Project based interface.
- Smart triggering.
- Distance and velocity calipers.

Updates and Support

MiDAS 4.0 is continually upgraded and improved. You may always download the most current version of MiDAS 4.0 from the Xcitex web site at http://www.xcitex.com/html/downloads.php. We at Xcitex encourage you to visit this page frequently and update your software regularly. The MiDAS 4.0 installer software built into MiDAS 4.0 will automatically update all the files on your computer to the most current version. You can always find current technical support answers for

MiDAS 4.0 and other Xcitex products at http://www.xcitex.com/techsupport.html.

The MiDAS 4.0 Manual on Your Computer

This manual is automatically loaded onto your computer in PDF format when you install the MiDAS 4.0 software. You can access it at any time by clicking on the Windows Start button, selecting MiDAS 4.0, and then MiDAS 4.0 Manual from the menu that appears. For additional printed manuals, send an e-mail to Xcitex at <info@xcitex.com.>

Chapter

2

Installing MiDAS 4.0

Chapter 2. Installing MiDAS 4.0

Before you start using MiDAS 4.0, first check that you have received all of the components ordered. After unwrapping and checking the contents, follow the enclosed instructions for installing and setting up your hardware and software.

What's Included

Depending on the package you have purchased, you should have received the following.

All MiDAS 4.0 users should have received:

- MiDAS 4.0 Installation CD
- Example Files CD
- Security key
- Installation guide
- User guide
- License agreement
- Registration card

If you purchased a MiDAS 4.0 Data Acquisition package DA-123M, -132M, -160M, -170M, you should also have:

- A Data Acquisition Board from National Instruments
- An 8-connector BNC Breakout Box (With jumpers pre-installed with use for Midas 4.0)
- A 68-pin cable for connecting the DAQ board to the BNC Breakout Box
- BNC Female to female barrel connector.
- A 1-meter long coaxial cable with BNC connectors at each end
- A NIDAQ driver diskette from National Instruments

If you purchased a MiDAS 4.0 Data Acquisition package DA-160M, -161M, you

should also have:

- A Data Acquisition Board from National Instruments
- An 8-connector BNC Breakout Box (With jumpers pre-installed with use for Midas 4.0)
- Two BNC female to female barrel connector.
- A 16-connector BNC Extension Breakout Box
- A 100 pin Y-cable for connecting the DAQ board to the two BNC Breakout Boxes
- Two 1-meter long coaxial cable with BNC connectors at each end
- A NIDAQ driver diskette from National Instruments

Additionally, you should have the hardware and software for any camera/s that you wish to install to use with MiDAS 4.0

Install the Camera Hardware and Drivers (PCI card based)

1. Remove the cover from your computer case.

   WARNING: Prior to installing boards in your computer, disconnect the power to the computer. Make sure you are properly grounded using a wrist ground strap.

2. In an open PCI slot, install the video camera board in your computer, and attach the cable and camera head in accordance with the instructions from the manufacturer.

3. Turn on the computer and install the camera driver software in accordance with the instructions from the manufacturer.

4. Re-boot the computer when instructed to.

5. Test your camera in accordance with the instructions of the manufacturer. Make sure you can open a camera and are successfull at getting an image on the screen before continuing.

6. Repeat Steps 2-5 for each camera type to be installed in the computer.

7. Re-install the cover for your computer case, and re-insert the power cord, as well as any other cables and accesories.

Install the Camera Hardware and Drivers (USB, IEEE 1394, or ethernet based)

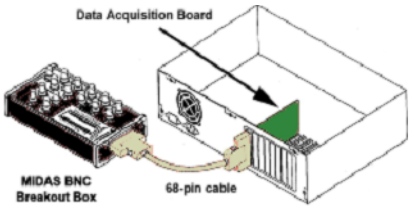
1. Turn on the computer and install the camera driver software in accordance with the instructions from the manufacturer.
2. Re-boot the computer if instructed to.
3. Once the computer has re-started you can plug in your camera.
4. Windows should locate your camera and install it.
5. For ethernet cameras, follow the manufacturer's instructions to configure the the camera's I.P. address.
6. Test your camera in accordance with the instructions of the manufacturer. Make sure you can open a camera and successfully get an image on the screen before continuing.
7. Repeat Steps 1-6 for each camera type to be installed in the computer.

Install the (optional) Data Acquisition Hardware (PCI based)

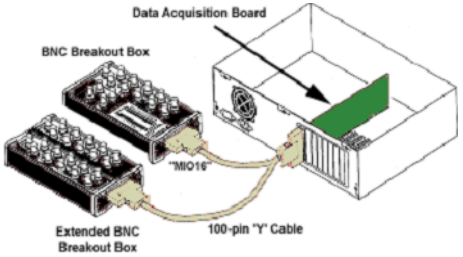
Note: If you did not purchase a MiDAS 4.0 DAQ hardware kit, you may skip this section. All MiDAS 4.0 DAQ hardware kits include a data acquisition board, a BNC Breakout Box (or multiple BNC Breakout Boxes). If you also purchased an optional MiDAS 4.0 Terminal Block, connect the BNC Breakout Box as described below, then follow the instructions listed in Chapter 7, Data Acquisition Theory.

WARNING: Prior to installing boards in your computer, disconnect the power to the computer. Make sure you are properly grounded using a wrist ground strap.

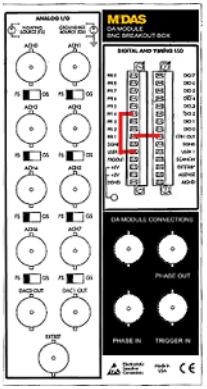
1. In an open PCI slot, install the data acquisition board.
2. If you purchased a DA-123M, or DA-170M kit, connect one end of the 68-pin shielded cable to the back panel connector of your data acquisition board. Then connect the other end of the cable to your BNC Breakout Box as shown in the following figure:



3. If you purchased a DA -171M kit, connect the large end of the -100-pin shielded "Y" cable to the back panel connector of your data acquisition board. Then connect the other end of the cable labeled "MIO16" to your MiDAS 4.0 BNC Breakout Box and the other end of the cable labeled "Extended I/O MIO64" to the Extended Breakout Box, as shown in the following figure:



4. Your MiDAS BNC Breakout Box comes pre-configured with two jumpers in place, as shown in the following figure:



Confirm that the first jumper is securely affixed to both PFI4 and User2 terminals. Confirm that the second jumper is securely affixed to both PFI1 and CTR1Out terminals.

5. Continue to **Section 6** *Install the Data Acquisition Drivers (Software)*

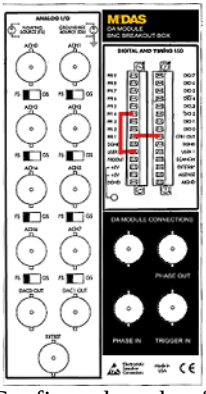
Install the (optional) Data Acquisition Hardware (PCMCIA based)

Note: If you did not purchase a MiDAS 4.0 DAQ hardware kit, you may skip this section. The following instructions are for PCMCIA-based DAQ hardware kits only. All MiDAS 4.0 DAQ hardware kits include a data acquisition board, a BNC Breakout Box (or multiple BNC Breakout Boxes). If you also purchased an optional MiDAS 4.0 Terminal Block, connect the BNC Breakout Box as described below, then follow the instructions listed in Chapter 7, Data Acquisition Theory.

1. Insert the PCMCIA card in any open PCMCIA slot in your laptop.

2. Connect one end of the 68-pin shielded cable to the back panel connector of your data acquisition board. Then connect the other end of the cable to your BNC Breakout Box.

3. Your MiDAS BNC Breakout Box comes pre-configured with two jumpers in place, as shown in the following figure:



Confirm that the first jumper is securely affixed to both PFI4 and User2 terminals. Confirm that the second jumper is securely affixed to both PFI1 and CTR1Out terminals.

4. Continue to **Section 6** *Install the Data Acquisition Drivers (Software)*

Install the Data Acquisition Drivers (Software)

Note: If you did not purchase a MiDAS 4.0 DAQ hardware kit, you may skip this section.

1. Turn on your computer.

2. Insert the "NI-DAQ" driver CD from National Instruments (Disk 1). The driver installation program should start automatically. If it does not, enter the letter of your CD-ROM drive in the Run... prompt (Start menu).

   Note: You MUST be logged in as the Windows Administrator to properly install MiDAS 4.0. Users without administrative privileges will not be able to successfully install key MiDAS drivers.

3. Click on Install NIDAQ at the first screen.

4. Follow the instructions on the screens to load the NI-PAL, MS Runtime and NIDAQ drivers for your model DAQ board.

   Note: The model DAQ board is automatically detected and determined by the software. The appropriate driver(s) will be automatically installed.

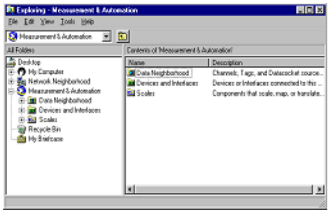
5. Re-boot the computer when instructed.

6. After the re-boot, the NIDAQ Setup Routine will continue. Follow the instructions in the program.

7. At the NIDAQ Setup screen, it is not necessary to choose any additional documentation. Check the checkbox on the screen to decline installing further documents. Click on the Next button.

8. At the Select Development Platform screen, it is again not necessary to choose any development platforms at this time - the development libraries are automatically loaded with the MiDAS 4.0 disc. Click on the Next button.

9. Select the Configure Measurement and Automation checkbox and click the Finish button. If the Measurement and Automation Explorer does not automatically appear, double click on the National Instruments Measurement and Automation icon on your desktop. The following screen will appear:



10. Click on the + sign next to the "Devices and Interfaces" folder. You should see the internal model number of your data acquisition board listed below. If you do not see the board number, the system does not recognize the existence of your hardware. You must quit, turn your computer off and re-seat the board in the PCI slot, then repeat Step 6.

11. Right click on the board number and select Test Panel. The following screen will appear:

12. Without any signal hooked up, you should see a noisy waveform (a line across the screen that varies or simply drifts up and down in time) and no error messages listed on the right side of the Test Panel. If you receive an error message, remove and reinstall the drivers starting at Step 1.

13. Remove the disk at this time. Re-boot your computer.

Install the MiDAS 4.0 Software

1. Turn on your computer.

2. Insert the CD-ROM that contains the MiDAS 4.0 software. The MiDAS 4.0 software installer should automatically start. If it does not, from the Run... prompt, type *F:/SETUP*, where "*F*" is the drive letter of your CD drive.

3. Follow the instructions on the screens to install the MiDAS 4.0 software and documentation. For more detailed information, refer to the MiDAS 4.0 Installation Guide included in the software box.

4. Continue to follow the on-screen installation procedures. When instructed by the software, remove the CD-ROM from your CD drive.

5. Re-boot your computer. Before starting MiDAS 4.0, you must first attach your MiDAS 4.0 security key and run the MiDAS 4.0 License Manager. Within the License Manager, you will enter and enable your license number. This is required before you can run MiDAS 4.0.

Run the MiDAS 4.0 License Manager

Upon purchase, the MiDAS 4.0 software comes with

- A security key (also known as a dongle)
- A 35-day license code

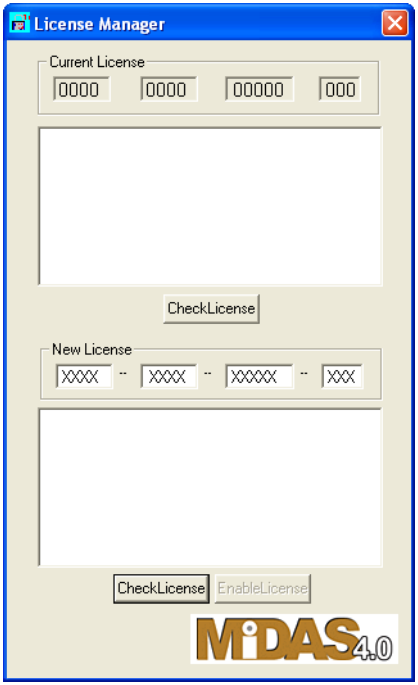
Together the security key and license key code protect the MiDAS 4.0 software from unlicensed use. The security key is a physical device that attaches to a USB port or the printer port of your computer. MiDAS 4.0 frequently seeks out the existence of the security key to confirm that you are a licensed user of MiDAS 4.0. The security key also provides a method for MiDAS 4.0 to keep track of the edition of MiDAS 4.0 that you have licensed.

You must run the MiDAS 4.0 License Manager upon installation to inform the software that you are a registered user and to enable the features for the software edition you have purchased.

1. If using a printer port (parallel port) security key, remove any printers attached to your computer.

2. Attach your MiDAS 4.0 security key to the computer's USB port or parallel port. If a parallel port security key, reconnect any printers to the security key.

3. To run the MiDAS 4.0 License Manager, MiDAS 4.0 > MiDAS 4.0 License Manager in the Programs group of the Windows Start menu.



4. Enter the 35-day license code printed on the back of your Installation CD case. If you have already registered your software, enter the permanent license code sent to you via e-mail.

5. Click on Check License. If you have entered the license code correctly, information about the security key, license code, and software will appear in the lower text box. The Enable Licensebutton will also become highlighted.

6. Click on the Enable License button.

7. You may now exit the MiDAS 4.0 License Manager.

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Chapter

3

Fundamentals

Chapter 3. Fundamentals

Understanding How MiDAS 4.0 Works

MiDAS 4.0 utilizes an organizational hierarchy based on **Projects**. A **Project** is a collection of video and/or data files. MiDAS 4.0 handles two types of projects. **Record projects** are a collection of device settings allowing you to easily duplicate previous setups. **Play projects** are a collection of previously recorded video and data files. When MiDAS 4.0 is in Record mode, it displays the controls necessary to configure and execute a recording - for example, the frame rate or acquisition frequency and resolution of the camera and data device. In Play mode, MiDAS 4.0 displays the controls necessary to play, process, and analyze recorded video and data.

MiDAS 4.0 Display Settings

The MiDAS 4.0 window colors and resolution can be changed only by modifying Windows display settings.

Note: While MiDAS 4.0 is designed to operate with a resolution as low as 1024 x 768 pixels, the optimal viewing resolutions is at least 1280 x 1024 pixels (or equivalent, depending upon aspect ratio). We recommend using the highest resolution that you are comfortable with. We also recommend a minimum color depth of 24-bit. If your color depth is not at least 16-bit, MiDAS 4.0 will give an error message.

The resolution of any video window will actively update during resizing. To resize a video window, click and drag on its border. Grab one side of the window border to change only the horizontal or vertical dimension. Grab the corner of the window to change the horizontal and vertical dimensions simultaneously. MiDAS 4.0 will always maintain the aspect ratio of the video image.

Note: If your displayed window resolution does not update in real time during resizing, you must make the following changes in your Windows settings:

1. Click on the Windows Start button.

2. Click on Control Panel.

3. Click on Display.

4. Click on the Appearance tab.

5. Click on the Effects... button. A dialog box will appear.

6. Make sure the Show Window Contents While Dragging check box is selected.

The MiDAS 4.0 Interface

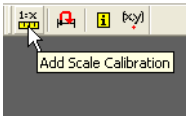
The MiDAS 4.0 interface is modeled on conventional Windows program interfaces. If you are already familiar with MiDAS 2.0 or other previous versions of MiDAS, you will recognize many of the elements in MiDAS 4.0.

Settings and tools are accessed via the menu bar at the top of the program window and the toolbar directly below the menu bar. The menu bar allows the user to control general program features and settings, while the toolbar contains buttons for commonly used MiDAS 4.0 functions.

The MiDAS 4.0 interface consists of 4 main areas: the Program Window, the Project Window(s), the Control Panel, and the Play Controls Panel.

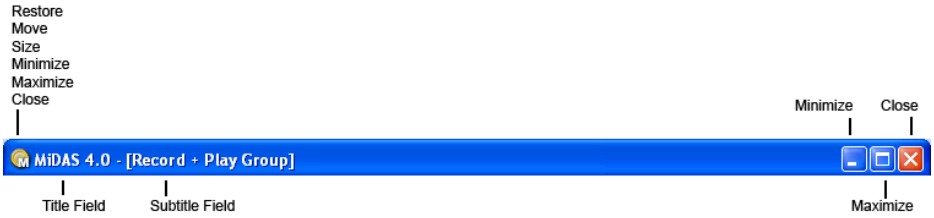
- The Program Window contains the overall MiDAS 4.0 application. Menu items in the Program Window control settings that apply across all projects and the MiDAS 4.0 application itself. The Program Window encloses the Project Window(s), the Control Panel, and the Play Controls Panel.
- The Project Window(s) contains video and/or data windows. While in Record mode, the project window displays live video and data feeds from active cameras and other devices. While in Play mode, the project window displays the recorded video and data for playback.
- The Control Panel is docked on the left of the Program Window when MiDAS 4.0 is first opened. A series of vertical tabs on the side of the control panel allow the user to configure video/data acquisition, processing, and analysis.
- The Play Controls Panel is controlled by the Toggle Play Controls button on the toolbar. This button will allow you to switch between different types and locations of the Play Controls Panel.

MiDAS 4.0 utilizes *tool tips* to help the user identify the function of buttons on the toolbar. To view a tool tip, simply place the mouse cursor over the button without clicking.



The Title Bar

All of the windows in MiDAS 4.0 use the same format for the title bar, shown below.



The Menu Bar

The MiDAS 4.0 menu bar spans the top of the program window, immediately below the title bar. The menu bar allows you to access the universal program controls and common actions such as opening cameras, opening files, and saving files. The following are the MiDAS 4.0 menu bar options:

File Edit View Tools Window Help

File

Open Play Group...
Save Play Group File As...
Open Video File...
Open Data File...
Save Video/Data File As...
Save Recorded Parameters
Save MiDAS Notes
Open Camera
Open Data Card...
Open Record Configuration...
Save Record Configuration As...
Close
Export Data To Text...
Export Data to Excel...
Print...
Print Preview
Print Setup...
Exit

Edit

Undo
Cut
Copy
Paste
Edit Record Parameteters...
Program Options...
Record Options

View

Main Toolbar

Group Layout Toolbar
Video Controls Toolbar
Video Tools Toolbar
Control Panel
Play Controls
Status Bar
Data-centric Graph
Video-centric Graph
Play Controller - Settings from Active
Play Controller - Settings from Slowest

Tools

Connection Assistant
Lens Calculator
Video Explorer
MiDAS Notes
MiDAS 2.0 Conversion Wizard
ProAnalyst 3-D Capture Wizard

Window

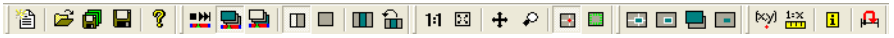
Cascade
Tile
Close All in Current Group
Close Current Group
Close All Groups

Help

Register...
Check for Updates...
About...

The Toolbar

The MiDAS 4.0 toolbar is directly below the menu bar. It provides controls for the most commonly used features of MiDAS 4.0. Toolbar buttons can be un-docked and moved anywhere on your screen. All toolbar buttons have tool tips.



Main Toolbar

The Main Toolbar consists of basic file control buttons.

New play group

Open video, data, or play group file

Save play group or record configuration

Save active playback

Help

Layout Toolbar

The Layout Toolbar consists of a variety of project environment buttons.

Play controller settings from active window

Play controller settings from slowest video source in group

Show control panel

Hide control panel

Auto arrange windows now

Toggle auto arrange windows

Video Controls Toolbar

The Video Controls toolbar contains the basic video manipulation buttons.

View actual size

Fit in window

Pan

Zoom

Show reticle

Show ruler

Video Tools Toolbar

The Video Tools toolbar consists of the zoom buttons.

Define zoom region

Set zoom region

Show zoom region

Remove zoom region

Video Measurement toolbar

The Video Measurement toolbar consists of measurement buttons.

Add measurement point

Add scale calibration

Show video information

Add go to note

The Status Bar

At the bottom of the program window is the status bar. The status bar provides size information about the active video window, in *pixels*.

Window Types

Images and data are displayed within their own window in the MiDAS 4.0 environment. Each window is self contained. The appearance of these windows is based upon your Windows theme settings.

The types of windows found within your MiDAS 4.0 projects are as follows:

Camera View Window	This window displays a live view from a camera. The camera view window is the

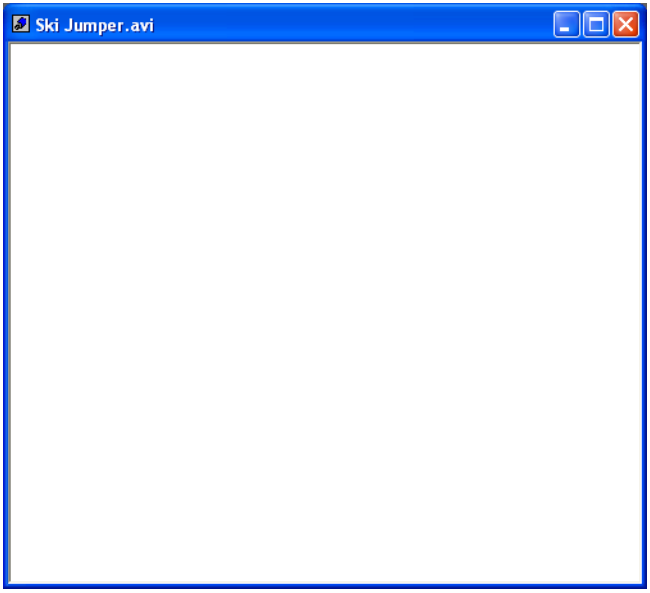
	current sensor image and is controlled by the camera. If the camera displays live images during recording, (and you have enabled this under Edit > Record Options...) the image will be visible here. Zooming, panning, and resizing are all available for the Live camera window. *NOTE: The video display window will automatically minimize to an icon when the recording is complete, and a playback window will be made active.*
Playback Window	This window displays recorded videos. You can interact with these recordings using the toolbar or the play controls in the Play Controls Panel. Multiple playback windows can be displayed and synchronized. Zooming, panning, and resizing are all available for the Playback window
Zoom Window	This is a daughter window of a Camera or Playback window. It will display a zoom view of an area defined by the user.
Data Window	This window displays a data graph. You can interact with this window independently, or you can synchronize it to the appropriate video window. It can be scaled to show you the range of data you are interested in.

The title bar will provide information on the window type. Camera view windows will show the name of the camera, and **Live** or **Recording**, plus a sequential number. Playback windows have a camera icon and show either the camera name, or, if it contains a previously recorded file, the file name and type. Data windows have a graph icon and show either the data sensor name, or, if it contains a previously saved file, the file name and type.

Working with Video Windows

There are three components to MiDAS 4.0 Camera View and Playback windows - the window frame, the actual image, and the visible region of the image.

The "Window Frame" is the outside container of the window.

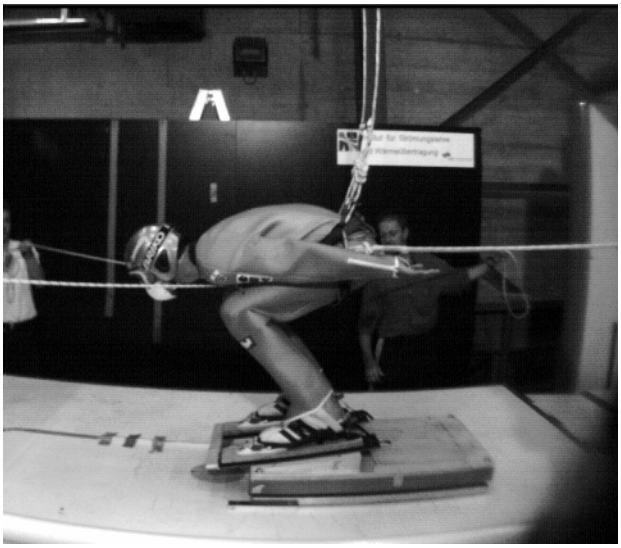


The "Actual Image Size" is the size at which the image was recorded.

The "Visible Region Size" describes the portion of the recorded image that is visible within the window frame

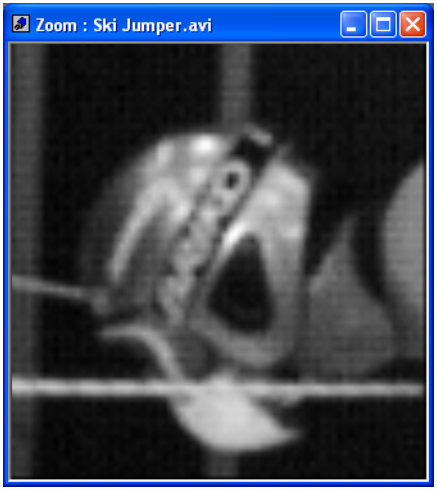
The "Zoomed Image Size" describes the on-screen dimensions of the image within the window frame.

For example, the following image of a ski jumper was recorded at 480 x 420 pixels:



The dimensions of the zoom region, the head of the player, are 76 x 80 pixels:

The zoom region is enlarged to fit a window frame of 320 x 340 pixels:



In this example, the MiDAS 4.0 status bar will report the following dimensions:

- Actual Image Size: 480 x 420
- Visible Region Size: 76 x 80

- Zoomed Image Size: 320 x 340

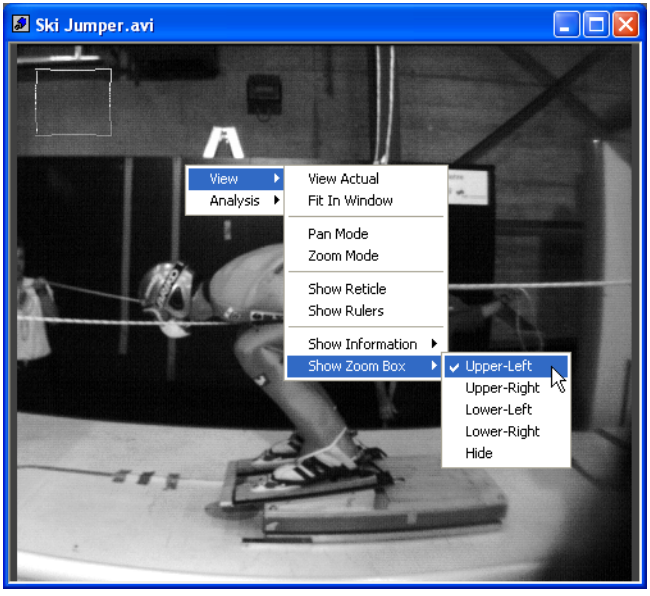
In this example, zoom region is magnified approximately 4 times (320 x 340 divided by 76 x 80 approximately equals 4) to fit in the window frame.

Magnification of the image can be achieved in any of the following ways:

- Increase the size of the window frame by clicking and dragging on the frame edges.
- Increasing the zoom of the region. This can be done by clicking on the zoom button on the toolbar or by **right-clicking** on the image and choosing Zoom in the contextual menu.

Note: A zoom ratio of 1 means that the image and the frame are the same size. A zoom ratio greater than 1 means the image is larger than the window frame, and only a portion of the image (i.e. the zoom region) is displayed within the window frame.

If only a portion of the original image is visible in the active window, i.e., the image is magnified, a small zoom map will be appear in the upper right hand corner of the image. The zoom map indicates the location and size of the visible region relative to the overall image. The zoom map position may be changed by **right-clicking** within the window and selecting Show Zoom Box in the contextual menu.

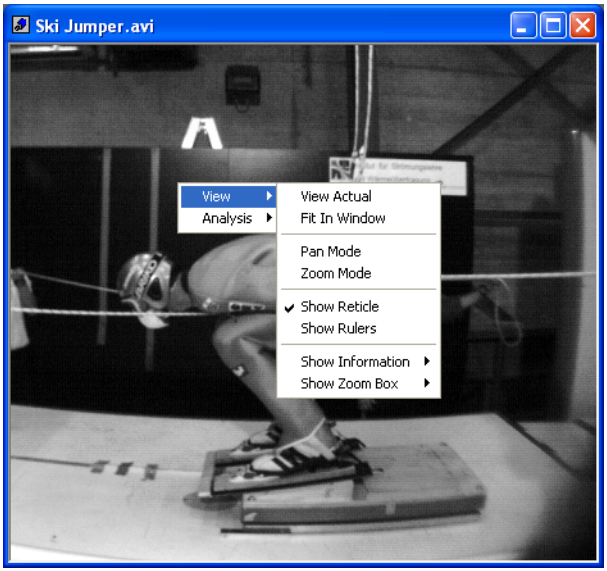


To expand the active window to the Maximum size, click on the maximize button within the window title bar . To return to its previous size, click on the restore down

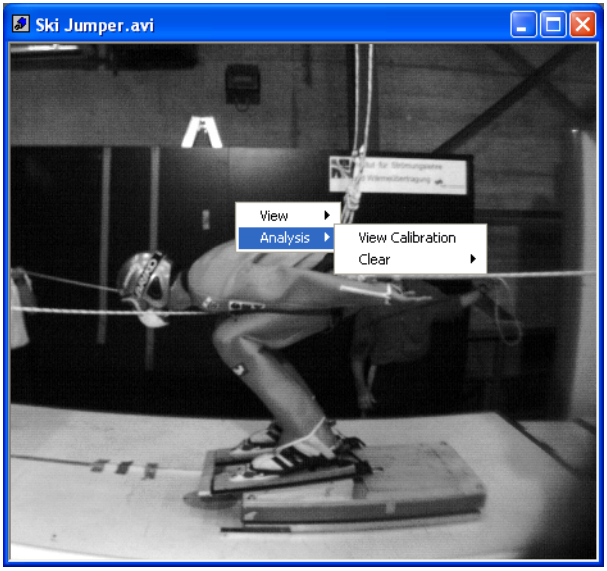
button . To minimize the window, click the minimize button .

Contextual Menus

In MiDAS 4.0, camera, play, and zoom windows share a common set of contextual menus, which are accessed by **right-clicking** within the active window. The View options are View Actual, Fit in Window, Pan Mode, Zoom Mode, Show Reticle, Show Rulers, Show Information, and Show Zoom Box.



The Analysis options are View Calibration and Clear.



Each option is described below.

View Actual	When selected, this command sets the zoom region and the window frame to be equal to the actual image size.
Fit in Window	When selected, this command fits the entire image within the window frame. This command does not change the window frame size, just the image size whithin the window frame.
Pan Mode	Pan mode allows you to use your mouse or trackball to easily pan the image. Click and hold the left mouse button and drag (or roll the trackball) to move the image to your desired position.
Zoom Mode	Zoom mode allows you to use your mouse or trackball to increase or decrease the magnification of the image. Click and drag the mouse up to zoom in or down to zoom out. Alternatively, roll the mouse scroll wheel forward to zoom in or backward to zoom out. *Note: During zooming, the geometric center of the image remains constant.*
Show Reticle	This command toggles the display of a

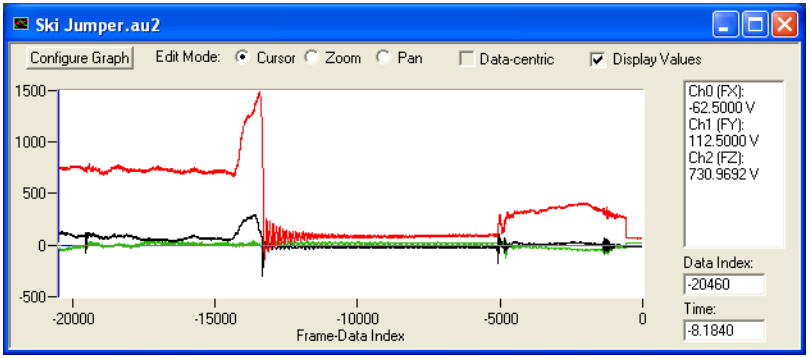
	reticle (crosshair) in the image. The reticle coordinates will be displayed in the status bar. Left-clicking within the image will reposition the reticle. *Note: You cannot reposition the reticle while in Pan Mode or Zoom Mode. Deselect Pan Mode or Zoom Mode before attempting to reposition the reticle.*
Show Rulers	This command displays rulers at the borders of the active window. The ruler units are pixels.
Show Information	This command allows you to specify where in the active window you would like to display information about that video (frame number, time, recorded rate, shutter speed, and reticle position if applicable). You can also hide this information by selecting Hide.
Show Zoom Box	This command allows you to specify where in the active window you would like the zoom box displayed. The zoom box shows you the zoom ratio - the size of the zoom region relative to the actual image size - and the position of the zoom region relative to the actual image. The status bar indicates the size of the zoom region in pixels. You can also hide the Zoom box by selecting Hide.

View Calibration	When selected, the x and y axes and two scale calibration points will be visible on the image. The calibration properties are set in the Calibration tab of the Control Panel.
Clear	Selecting Clear All Forward clears feature tracking points in subsequent frames. Feature tracking is applied using the Analysis tab of the Control Panel. The Clear action cannot be undone.

Working with Data Windows

Data windows have their own set of viewing options. At the top of the data window,

three radio buttons allow you to switch between Cursor, Zoom, and Pan modes.



The Data Playback window has a waveform display with some select features along the top. A single blue cursor shows the location of the video/data counter, in data points. Along the bottom, the time position is displayed. The features of the Data Playback window are as follows:

Edit Mode: Cursor

When the Cursor mode button is selected, the user has control of the cursor with the mouse. By clicking and dragging the cursor, both the video frames and data will advance forward or backward synchronously.

A *jump advance* feature is also provided - just click anywhere within the graph area and the cursor jumps to that position the video will jump to the corresponding frame.

Edit Mode: Zoom

When the Zoom mode button is selected, the user can change the zoom magnification of the waveform window. Simply click and drag within the graph area to select a zoom region. When the mouse is released, the zoom region is expanded to fill the graph area.

Double-click anywhere within the graph area to return to the original view.

Edit Mode: Pan

When the Pan mode button is selected, the user can click and drag on the graph area to move the graph in any direction. Double-click anywhere within the graph area to return to the original view.

Display Values

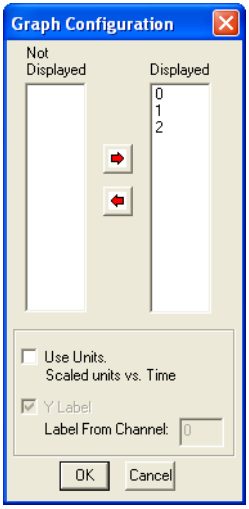
When checked, the right side of the Data Playback window will display the cursor values

	for all the active channels.
Data Index	The current data point number of the current acquisition. Note that the data index is not the same as the frame number since multiple data points can be acquired per frame of video
Time	The current time position of the cursor and the video.

To modify the appearance of the Data Window, follow these steps:

1. Open a Data Graph Window, as shown above.

2. Click on the Configure Graph button. The Graph configuration window appears:



The top half of the window is for selecting the active channels to display. To activate or deactivate any channels, use the ADD and REMOVE buttons. The Displayed channels are shown on the right side of the dialogue box. The Not Displayed channels are shown on the left side. To move, simply highlight the channel of interest and press the ADD or REMOVE buttons.

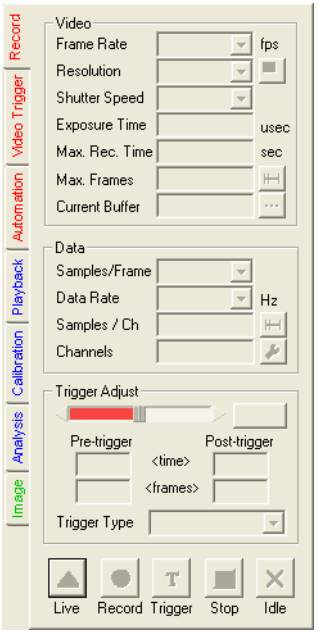
The bottom half of the window contains the following selection information:

Use Units	When this option is selected, the Y-axis (vertical axis) is displayed in the configured engineering units rather than volts.
Y Label from Channel x	When selected, this option calculates the maximum of the Y-axis label with the data

	from the selected channel (must be an active channel). If only one channel is active, or if this checkbox is unselected, the Y-axis maximum value will be calculated as the maximum of the first active channel.
OK	Saves the settings and returns to the main Data Playback window.

The Control Panel

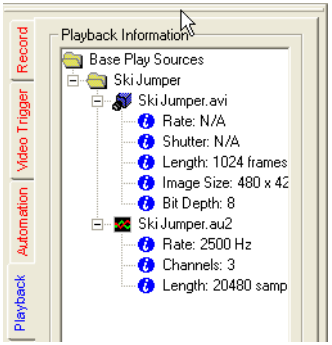
The tabs contained within the Control Panel are the primary means of interacting with MiDAS 4.0. By clicking on the various tabs on the left hand side of the control panel, such as *Playback* or *Record*, specialized controls for that particular tab are presented. The **Control Panel** tab labels are displayed in three colors. Red labels relate to recording, blue labels relate to playback and analysis, and the green label is for image processing.



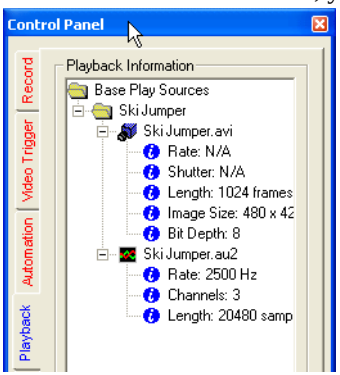
The Control Panel contents change automatically depending on the mode MiDAS 4.0 is in currently. The Record tab is visible during camera control. The Playback tab is automatically moved to the front when recording is complete.

The Control Panel is docked on the left side of the MiDAS 4.0 window by default. It can also be un-docked and repositioned anywhere on the computer screen. To un-dock

the Control Panel, double-click near the top of the docked region of the Control Panel.



To re-dock the Control Panel, you can double click the title bar of the **Control Panel**.



Alternatively, you can drag the window to the left or the right side of the Console area. If you would like to move the Control Panel near the edges of the program window without docking, press and hold the CTRL key while dragging the Control Panel window. Hide and show the Control Panel using the Hide Control Panel and Show Control Panel buttons on the toolbar.

Note: If you have dragged the Control Panel window off the lower portion of the screen and you cannot get it to reappear, it is likely that the window is hidden beneath the Windows Taskbar. In order to uncover the window, click and drag the Windows Taskbar to the right, left, or top of the screen temporarily. This should reveal the Control Panel window, which you can then drag back towards the center of the screen.

Note: The MiDAS 4.0 convention is to show those parameters that are set by the operator in white. Items in gray are not accessible.

Program Options

The following are program-wide options that will affect how you use the MiDAS 4.0 software.

Select Program Options... from the Edit menu. A dialog box will appear with three

tabs: General Settings, Camera Scanning, and Camera Connections.

Basic Interface (single Play Group window only).	When selected, this option will enable the standard MiDAS 4.0 interface. This will limit MiDAS 4.0 to opening only one record and play group at a time.
Start new Play Groups maximized.	This option is enabled by default and maximizes the size of any play or record group within the MiDAS 4.0 program window.
Automatically open similarly named files.	Enabling this option will open all image files with the same file name but different numerical appendix, e.g. `Image01.jpg`, `Image02.jpg`, `Image03.jpg`. This is used when the video has been saved as a sequence of individual image files. If you will often be opening only parts of a sequence regularly, you should turn this option off and choose the individual images using the **mouse-left-click+[shift key]**, to select the desired range.
Prompt for verification when closing from device memory.	This is a safety feature to assure that data that has just been recorded is not lost. With this enabled, if you try to close a fresh record window, MiDAS 4.0 will prompt you with a dialog box before closing the window. It is not recommended that you turn this option off.
Restore Defaults	This will revert the Program Option settings to the default values.

The Camera Scanning tab lists the most popular cameras supported by MiDAS 4.0. MiDAS 4.0 will search for the camera models that are selected. Clicking Restore Defaults will check all camera models.

The Camera Connections tab allows you to set the type of connection used by your camera.

Record Options

The following are program-wide options that will effect how MiDAS 4.0 records.

Select Record Options... from the Edit menu. A dialogue box will appear with the following options:

Live video display while recording (if supported).	This will keep the live video window from minimizing during recording, for cameras that allow this feature.
Live Data Graphing while recording.	This will allow the user to have the data display report the recorded data values during a recording. These values will update as quickly as the hardware and software drivers will allow.
Record busy dialog.	This option controls whether the recording busy dialog is displayed during recordings. This may be helpful if a live window is displayed during recording, and the "record busy" dialog box may block an important portion of the image.
(Synchronization options) First device slave	This option is utilized if the master for a capture event is to be a device not under MiDAS control. MiDAS assumes that the first device opened is the master in any record event. This selection takes the master device priority away from MiDAS and gives it to a third party device or application.
(Synchronization options) Synchronized recording	This will automatically sync all live camera windows for recording simultaneously when a recording is started.

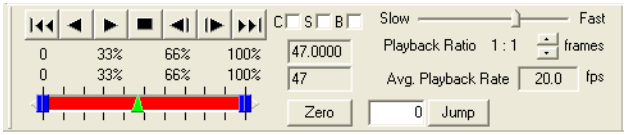
Default Live Frame Rate	This will set the refresh rate for the Live video window. The default value is set to **5** to save on processor cycles and data buss bandwidth. Available values are between **1** and **15**.
Restore Defaults	This will revert the HG setting to the default values.

System Memory Utilization	This setting will allocate a certain percentage of system memory to data from your Data Acquisition system. The available percentages are between **1%** and **10%**.
Restore Defaults	This will revert the **Data** setting to the default values.

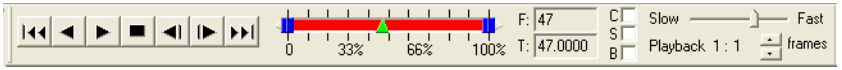
The Play Controls

There are four types of Play Controls to let you modify your workspace to your preference.

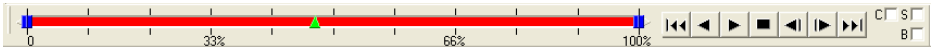
1. Standard play bar.



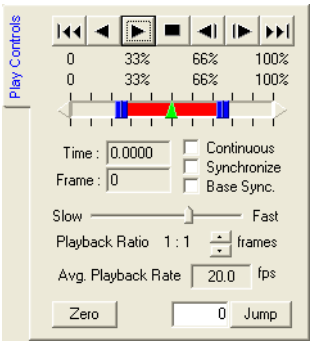
2. Thin, or abridged play bar.



3. Long Play Bar used for greater slider resolution.



4. Play Control panel, docked under the control panel.



You can switch between the four panels by clicking on the Play Controls icon on the toolbar . Play Controls include the following functions:

Play Controls	Jump to first frame
	Play backward
	Play forward
	Stop
	Step back one frame
	Step forward one frame

	 Jump to last frame  The slide bar allows you to quickly move to a specific part of the video.
Frame and Time	The frame number and time stamp relative to the trigger event are displayed next to the play controls.
Synchronization Options	The **C** checkbox selects a continuous playback mode. When this option is selected, the video will play in a loop, going back to the beginning of the video when it reaches the last frame. The **S** checkbox selects synchronized playback. This option allows for the synchronization of the playback of multiple video files. When synchonized, two or more videos and data sets will play at the same frame rate. The **B** checkbox (base synchronization) will be automatically checked when opening a play group that utilizes it. Base Synchronization is the inherent synchronization of a video and data set that was recorded together originally. It is normal to keep this synchronization in place during playback.
Playback Rate	 Set the playback rate by clicking and dragging the slider post towards the right or left. The actual playback rate is determined by many factors, including the number of synchornized videos, the video RAM, and the speed of the computer processor. The average playback rate may be displayed below the playback rate slider in frames per second (fps).
Playback Ratio	The playback ratio setting allows you to select the ratio of frames displayed to actual frames. A ratio of 1:*n* plays every *n* frames and increases the playback rate. Adjust the value of n by clicking on the up and down arrow buttons.

Jump	Enter a frame number in the text field and click the Jump button to go to that frame.
Zero	Click the Zero button to set the current video frame and its corresponding data point as the zero reference. Video frames and data points prior to the zero reference will numbered with negative values. Video frames and data points after the zero reference will be numbered with positive values.

Chapter

4

Recording Projects

Chapter 4. Recording Projects

This section describes the basic features used in MiDAS 4.0 for recording video. The term *video* in this section is interchangeably defined as either 1. a single file that contains all the frames, or 2. a sequence of image files, numbered sequentially for playback in the correct order. The most common video format is `.AVI`. The most common formats for image sequences are `.BMP` or `.JPG`.

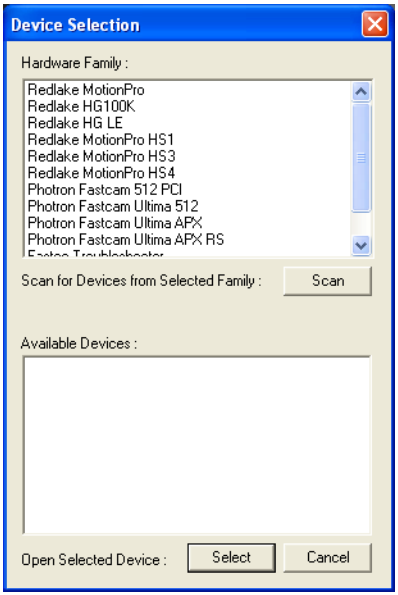
Acquiring video is the principal function of MiDAS 4.0. MiDAS 4.0 controls video cameras through their standard communication protocol, configuring video acquisition. MiDAS 4.0 allows you to control video acquisition using its own software triggers, external hardware triggers or the automation modes explained in Chapter 6, *Automation*. In addition, MiDAS 4.0 can capture video synchronized with external data as explained in other sections of this manual. This section describes the basics of video acquisition and instructions for acquiring video only.

Opening and Configuring Cameras

Begin by opening a new Record project if you do not already have one open, either by selecting New Group from the File menu or by clicking on the New Play Group button  on the toolbar. Note that you can only have one Record project open at a time.

Connect your camera(s) per the instructions in Chapter 2, *Installing MiDAS 4.0*. If you have multiple cameras in your system, connect the hardware as depicted in the MiDAS 4.0 Connection Assistant.

Go to Open Camera... in the File menu. A dialog box will appear, prompting you to select the hardware family of your camera.



This list is populated based on the selections you make in the Camera Scanning tab in Program Options..., selected from the Edit menu. You can reduce the list to the family of cameras you normally work with. Select the appropriate family and click on Scan. If your camera is properly connected and configured, it will appear in the Available Devices field.

Select the desired camera from the **Available Devices** field and click on Select to open the camera. Repeat these steps for each camera you wish to open. Open the camera that you wish to be the master first.

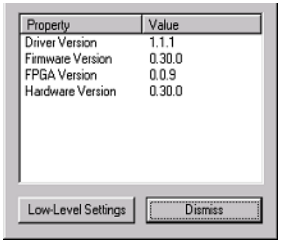
Note: You may change the name of the camera to aid in differentiation when you are using multiple cameras. For example, name one camera "Bottom View" and one camera "Top View." To change the names once the camera is opened, right-click on the video image and select Change Camera Name.

Camera Information

MiDAS 4.0 can also display pertinent information about a specific camera, as retrieved from the firmware and camera hardware. To access the information about the camera, **right-click** on the camera image and select Camera Information. The camera manufacturer determines the specific information in the **Device Information** window. This information is not editable. Possible information in this window might include:

- Camera serial number
- Camera model number
- Firmware revision level

- Camera address
- Maximum frame rate and resolution
- Security code
- FPGA revision level
- Hardware serialization
- Maximum frame rate allowed



Configuring Open Cameras

To configure your camera, click on the **Record** tab in the control panel. On this tab you will see controls for your camera **frame rate**, **resolution**, and **shutter speed**. Based on these user-defined settings, MiDAS 4.0 automatically calculates and displays the **Exposure time**, **maximum recording time**, and **Max. Frames.** Although MiDAS 4.0 automatically calculates the maximum number of frames to record, you can limit this to be any number of frames less than the maximum amount using the button .

The default **frame rate** is 60 frames per second. Based on the frame rate chosen, MiDAS 4.0 will change the resolution to the maximum available. You can then choose the resolution you desire from the drop-down menu of available resolutions. The drop-down menu will be limited to only those resolutions that are available. Lower resolutions will result allow longer recording times and more video frames. Frame rate is typically the primary consideration, and resolution is adjusted accordingly. If resolution is the more important factor in your project, some experimentation will be required to find the combination of resolution and frame rate that meets your needs.

The **shutter speed** is the amount of time that the electronic shutter of the camera remains *open* during each frame. It is important to note that the electronic shutter is not a physical shutter, but simply the amount of time that the array is excited and collecting information. Higher shutter speeds mean shorter exposure times (displayed below the shutter speed), which reduces blur within each frame at the expense of light-collecting ability. The default shutter speed is set to 1x. Shutter speeds are the inverse of the frame rate, times the exposure time. Exposure times are displayed in

microseconds (10^{-6} seconds).

Some cameras allow the user to set custom exposure times. To set an exposure time, select User... from the shutter speed drop-down menu. Then type in the exposure time, in microseconds, into the dialogue box that appears. Alternatively you may use the up/down arrows to adjust the exposure time.

For cameras that support the variable setting of recording time and number of frames, the button to the right of the Max Frames setting will be enabled. Click on this button to bring up the Frames to Record dialogue box. Use the slider bar or type in the number of frames to record. Click OK to continue. To reset to the maximum number of frames permissible by your camera and MiDAS 4.0, drag the slider bar to the far right.

Record Tab

Frame Rate	The frame rate drop-down menu displays the available video frame rates. The available rates are determined by the camera hardware. The default is 60 frames per second (fps).
Resolution	The available resolution settings for the camera. For each frame rate chosen, there are certain resolutions that are available. You can choose the desired resolution from the list shown. Note that lower resolutions typically result in longer recording times, so more frames are captured.
Shutter Speed / Exposure Time	The **shutter speed** is the amount of time that the electronic shutter of the camera remains *open* during each frame. It is important to note that the electronic shutter is not a physical shutter, but simply the amount of time that the array is excited and collecting information. Higher shutter speeds mean shorter exposure times (displayed below the shutter speed), which reduces blur within each frame at the expense of light-collecting ability. The default shutter speed is set to 1x. Shutter speeds are the inverse of the frame rate, times the exposure time. Exposure times are displayed in microseconds (10^{-6} seconds). Select the shutter speed from the drop-down box. The corresponding

	exposure time will be displayed in the gray box below the selected shutter speed. Some cameras allow the user to set custom exposure times. To set an exposure time, select User... from the shutter speed drop-down menu. Then type in the exposure time, in microseconds, into the dialogue box that appears, alternatively you may use the up/down arrows to adjust the exposure time.
Max Rec Time	The maximum amount of time that can be recorded, in seconds.
Max Frames	The maximum number of frames that will be acquired.

Samples/Frame	The Samples/Frame drop-down menu allows you to choose the number of data samples that will be acquired per frame of video.
Data Rate	This allows you to adjust the rate at which data is collected.
Samples / Ch	The maximum number of data points that will be acquired.
Channels	Opens a dialog box that will allow you to configure your data channels.

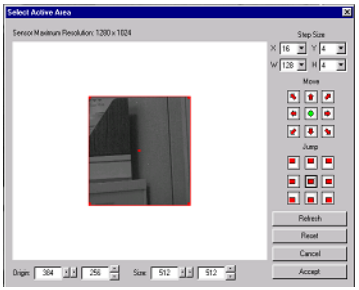
Trigger Adjust	The **Trigger adjust** allows you to determine how much pre and post trigger event will be recorded. The default is 100%, this means that the trigger event should happen at the end of the event of interest. A setting of 0% means that the trigger event should happen at the begging of the sequence of events.
Pre-Trigger Time	The amount of record time to be acquired prior to the trigger input.
Post-Trigger Time	The amount of record time to be acquired after the trigger input.
Pre-Trigger Frames	The number of frames to be acquired prior to the trigger input.
Post-Trigger Frames	The number of frames to be acquired after the trigger input.

Trigger Type	The Trigger Type box is used to instruct MiDAS 4.0 as to which type of external and internal (software button) triggers to accept. Select Rising Edge if your event trigger generates a positive going pulse. Select Falling Edge if your event trigger generates a negative going pulse. Select Rising or Falling Edge if your trigger latches or is a fast pulse. Note: Select FALLING EDGE when using MiDAS 4.0 Motion Trigger.

LIVE button	The LIVE button puts the camera into live video mode. While in this mode, video is streamed directly to the display and refreshed at approximately 5 frames/second, or as configured.
RECORD button	The RECORD button puts the camera board into record mode. MiDAS 4.0 displays a flashing box with the words *MiDAS 4.0 RECORDING* to notify the operator that MiDAS 4.0 is recording.
TRIGGER button	The Trigger button sends a software trigger signal. This button is only available once the recording has started.
STOP button	This button stops the recording and returns the maximum number of frames available before the stop button was pressed. MiDAS 4.0 then goes into the Play mode.
IDLE button	This button stops the recording without returning any recorded frames, and without returning the live window, or switching MiDAS 4.0 to the play mode.

Setting the Camera Active Area

For cameras that support the variable placement and sizing of the active image area, the button to the right of the resolution setting will be enabled. This feature allows you to crop the image area to limit the recording to an area of interest. To adjust the active area click on the Set Active Area button  to bring up the Set Active Area dialog window.



There are a few ways to modify the active area directly using the mouse controls in the preview area. You will see a temporary still frame of the active camera surrounded by a red border. This red border has one box in each corner, and one box in the center of the active area. You can adjust the active area using these red boxes. To adjust the size and aspect ratio, click on any of the red corner boxes, which will allow you to re-size the two adjoining sides. The opposite corner will stay anchored. Once you have adjusted the size and aspect ratio, you can pan the image by clicking and dragging the center red box. Moving the centroid will not affect the size or aspect ratio.

You can also adjust the active area utilizing the controls to the right and below the preview area.

Step Size — The settings here will adjust how much the inputs of the other controls will move the active area. The X and Y coordinates will adjust the resolution, in pixels, that the centroid of the active area will move, with each step adjustment. The W and H effect the step size of the Width and Height steps respectively. The integer number is fixed based upon the camera firmware. You can only select those options available in the drop-down menu.

Move — The Move buttons will shift the entire active area, without affecting its size, in the direction of the arrow. When you click on a Move arrow, the red border will shift, allowing you to preview your adjustment geometry. Once you have it positioned where you desire, click the green button in the center of the move array to confirm, and the active area will adjust to the selected area.

Jump — The Jump buttons will shift the active area as a whole to the position represented in the button. The center button will automatically shift the active area to the center of the pixel array.

Origin and Size — Located below the preview area are 4 text boxes, two for the X and Y coordinates of the center of the active area, and two for the width and height dimensions. You can adjust these values using the arrows to the right of the text boxes. They

	will increase or decrease in increments set in the step size controls. You can also edit these numbers directly. Click inside of the box and type the desired coordinate or dimension. To commit these changes, you will need to click your mouse into one of the other three boxes.
Refresh	The image within the preview area is not a dynamic live window, but a still frame captured when the active area button was clicked. As you adjust the active area, this will not refresh. To show the live image corresponding to the active area you have selected, click on the refresh button.
Reset	This will undo the last active area adjustment you made.
Cancel	This will close the **Set Active Area** window, and you will loose any adjustments you have made.
Accept	This will apply the changes you have made to the active area and close the **Set Active Area** dialog box.

Note: When moving the active area away from the center of your camera's field of view, you may be required to use higher performance and larger format lenses to get the needed image quality.

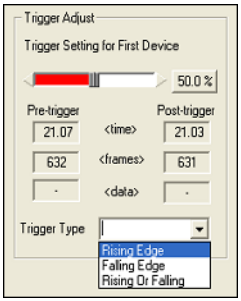
Trigger Settings

Once you have finished configuring your camera, you will need to move on to the trigger settings found on the **Record** tab on the control panel. In the following sections, we will go over the trigger settings, trigger types and recording modes available in MiDAS 4.0.

The Trigger Adjust Setting

The Trigger Adjust setting manages in what way that your video and data will be collected. You should design your triggering event in such a way that it will be activated reliably, and be indexed to the action in the same way every time. If you review the *Circular buffer* concept you can understand why it is so important to properly design and configure your triggering plan. The camera will be constantly writing to the buffer from the time that recording begins, using the principal of first in first out. You have a finite amount of frames to utilize, so to get the data you require, you must make sure that you trigger during the period of interest.

The number reported in the button to the right of the slider bar is the pre-trigger percentage of the total acquisition. The reporting boxes below will tell you how much time, and how many frames will be collected pre and post trigger.



Trigger Types

In addition to the internal (software) trigger generated by clicking on the Trigger button in the **Record Tab**, MiDAS 4.0 accepts three different types of basic hardware triggers, also known as external event triggers. The types of triggers, the input voltage ranges, the triggering thresholds, and the connection types are determined by your camera architecture. In addition, many cameras allow a contact closure to be interpreted as a trigger event. Consult your camera manual to determine which trigger types and input types are available.

If your camera does not support a certain trigger type, that option is grayed on the menu.

You may specify the type of trigger by selecting one of the following options from the drop-down list in the Record tab on the control panel:

Rising Edge	Select Rising Edge if your event trigger generates a positive-going pulse, or if your camera hardware interprets a contact closure as a trigger event.
Falling Edge	Select Falling Edge if your event trigger generates a negative-going pulse.
Rising or Falling	Select Rising or Falling if you wish to trigger upon either type. If you have a latching trigger, a flip-flop or logic device that sends out a pulse, use this option.

Note: Select Falling Edge when using the MiDAS Motion Trigger.

Connecting an External Event Trigger

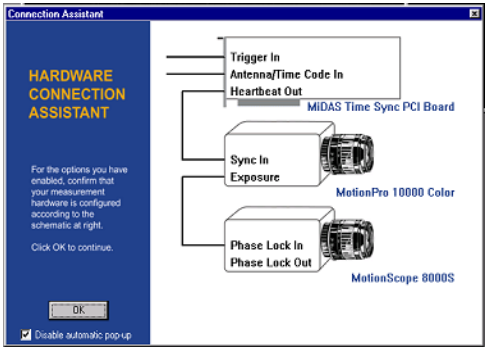
To trigger MiDAS 4.0 using an external trigger pulse from a sensor or machine output, you must first connect that sensor to a physical MiDAS 4.0 component. You must always connect the event trigger to the first component on the synchronization chain.

The location of the master component depends on what combination of MiDAS 4.0

modules you have installed and determines where you should connect your external trigger.

*Note: When chaining multiple cameras together, make sure to connect the external trigger to the **Trigger In** connector on the first camera in the chain.*

The easiest method of determining where to connect your external trigger is to use the MiDAS 4.0 Connection Assistant. The Connection Assistant, in addition to helping you confirm the cabling and interconnection between multiple cameras, data acquisition systems and external timing boards, also explains where to connect the external trigger input.



The MiDAS 4.0 Hardware Connection Assistant can be opened from the Tools menu.

Depending on what hardware is installed and enabled, the Connection Assistant will show the interconnection diagram.

Note: Consult with your camera manufacturer to find the input trigger location and labeling. Camera manufacturers often change label conventions.

WARNING: Do not connect your event trigger to more than one location. Doing so will confuse the clocks and could effect your measurement. Connect the event trigger to one location only.

Controlling the Recording Process

The final step in making a recording, after you have configured your device and trigger settings, and entered into recording mode is to trigger the recording.

While MiDAS 4.0 is in Record mode, the Record Tab is your primary means of controlling the recording process. On the Record Tab you will find the following buttons:

Live — sets the camera view window to a live display of the images in the camera buffer. The camera view window displays frames at a default rate

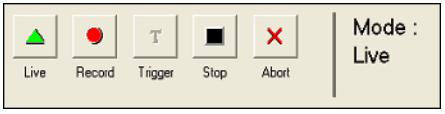
of 5 frames per second. (This default can be changed under the HG tab in the Edit -> Record Options menu.)

Record — This button puts the camera into recording mode. While recording, video (and data, if applicable) is being written to the buffer. If live video and data acquisition while recording are supported and enabled, the camera pane and data pane will continue to display live images. (These options may be enabled in the Record tab from the Edit -> Record Options menu).

Trigger — This button sends a software trigger signal (if being used) to MiDAS 4.0. The Trigger button is only available once the recording has started. In other words, you must click the Record button before the Trigger button.

Stop — This button stops the recording. See Chapter 8, *Event Triggering* for an explanation of the Stop command.

Idle — This button stops the recording without capturing video or data from the buffer and without switching MiDAS into Play mode.



Once you have clicked on the Trigger button and MiDAS 4.0 has carried out the recording process according to the camera and trigger settings, the program will automatically switch into Play mode.

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Chapter

5

Video Trigger

Chapter 5. Video Trigger

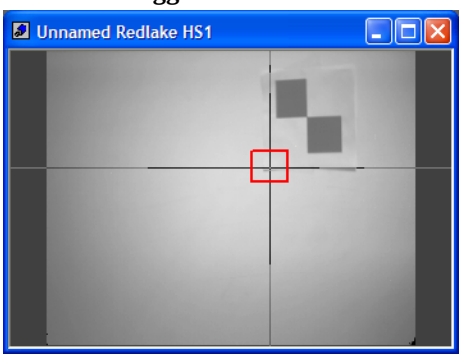
The MiDAS 4.0 video trigger offers the user the ability to trigger recordings from action within the video frame. This allows you to trigger video and data when the action has actually entered the video frame. Movement is sensed by a change of pixel intensity within a user selected region of the video frame. The video trigger does not control the cicular buffer. The Trigger Adjust settings in the Record tab will still control the percentage of pre and post video/data capture. The Video Trigger only identifies the trigger event.

Configuring the Video Trigger

To configure the video trigger you must have a live camera window open. Once you have opened a camera as described in Chapter 4, *Recording Projects* switch to the Video Trigger tab. You can then select a region for the video trigger, then set the thresholds.

1. Click on the Define Region button within the Video Trigger tab.

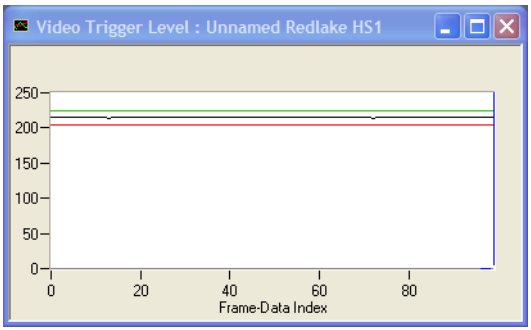
2. The reticle will be enabled. Use this to choose the region that you wish to use for the **Video Trigger**.



3. Once you have outlined the area you want,click on the Set Region button.

4. Once you have selected a Region, an intensity graph will open. Based upon the settings currently chosen it will sample the intensity of the specified amount of frames in the Training Count field.

5. Once the number of frames in the Training Count field are sampled MiDAS 4.0 will calculate the average intensity, and determine and display two threshold levels based on the Rising Level and Falling Level settings.

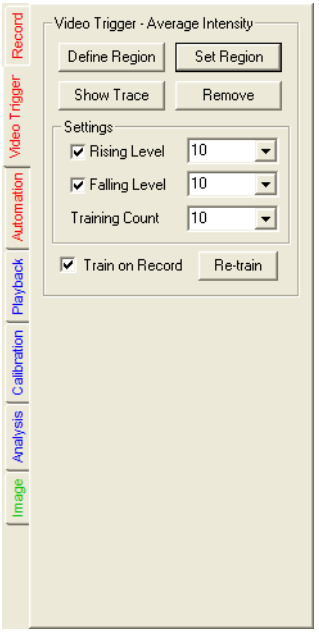


The red and green threshold levels display the pixel intensity values that will initiate a trigger. Once the camera is put into record mode, it will monitor the region you have selected. When the intensity levels exceed the threshold values you have chosen to use in the graph, MiDAS 4.0 will send a trigger pulse. You can adjust the threshold levels with the Rising Level and Falling Level drop down selections.

It is important to note that the average baseline of the Video Trigger can be any level of pixel intensity from 0 to 255. Since the trigger thresholds are relative to the baseline, it is possible that you could achieve Trigger threshold levels that are less than 0 or greater than 255. Tthe camera cannot generate values of this level. Therefore any trigger levels that are less than 0 or greater than 255 will not work. If your baseline is closest to 255 (white) you should concentrate on the Falling Level threshold. If your baseline averages are closer to 0 (black) you should concentrate on Rising level threshold.

Adjusting the Video Trigger

The average baseline can be noisy depending on local lighting conditions. If there is a noisy signal, the default threshold levels of +10 and -10 pixels may not work for your application. The MiDAS 4.0 Video Trigger allows for adjustment if these thresholds. In addition it allows for you to use the first frames in record mode as the training period for the Video Trigger.



The first selection under Settings controls the Rising Level trigger. There is a checkbox that enables the Rising Level trigger. Use this if you expect the change to be towards more white levels, i.e., approaching 255. If you do not want to trigger on higher white values, un-check this box. The drop down box allows you to set the threshold that will activate the trigger. This number is in levels of pixel intensity. There are preset values, but you can also choose User which will allow you to input the number you require.

The second Checkbox controls the Falling Level thresholds. It works similarly to the Rising Level threshold controls, but in the change to Black (0) direction of the video.

The final setting is the Training Count. This is the number of frames sampled to establish the baseline average that the threshold levels are referenced to. If the light levels in the region you wish to use as a trigger are noisy, you will want to expand the number of frames used for training.

Some cameras will have changes in the image when switching to record mode. For this reason MiDAS 4.0 has the ability to establish the training period from when the Camera enters record mode. This is enabled by checking the box labeled Train on Record. When enabled it will sample the number of frames in the Training Count field, establish an average for the baseline, and then apply the thresholds as you have configured them in the Rising Level and Falling level fields.

As you make changes you can re-establish the graph baseline by clicking on the Re-train button.

Once the pixel intensity in the region you have established as the video trigger exceeds

the threshold values, MiDAS 4.0 will send a trigger as configured in the Trigger Adjust in the Record Tab.

Chapter

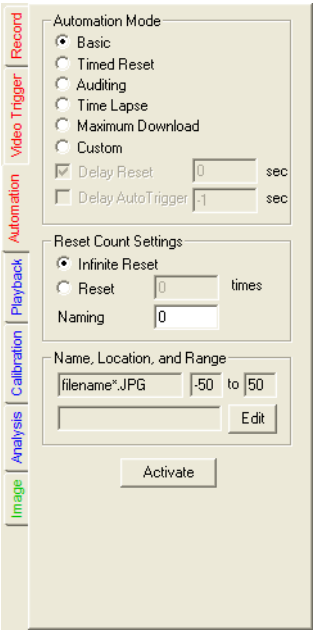
6

Automation

Chapter 6. Automation

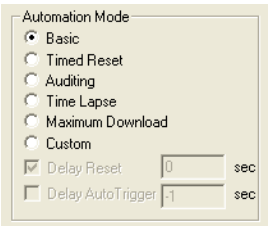
Overview

The MiDAS 4.0 Automation feature allows for the unsupervised, automated collection of video and data. MiDAS 4.0 offers a variety of Automation modes to satisfy your requirements for automated data collection. With the exception of the Time Lapse feature, all Automation modes collect video and data as configured in the Record tab.



Automation Modes

Each automation mode has different methods of triggering and collecting recordings. Below is a detailed description of each automation mode.



Basic	Basic mode is a Record-Download-Reset

	cycle. MiDAS 4.0 will enter Record mode and wait to receive a trigger. Once a trigger is received, it will download the recording as configured in the Record tab. Once the recording is saved, MiDAS 4.0 will return to Record mode. This process will continue until you exit Automation mode or until the Reset Count is reached.
Timed Reset	Time Reset mode is a Record-Download-Delay-Reset cycle. MiDAS 4.0 will enter Record mode and wait to receive a trigger. Once a trigger is received, it will download the recording as configured in the Record tab. Once the recording is saved, MiDAS 4.0 will enter Idle mode for the amount of time specified in the Delay Reset field. MiDAS 4.0 will then return to Record mode. This process will continue until you exit Automation mode or until the Reset Count is reached.
Auditing	Auditing mode is a Record-Download-Delay-Reset-Delay cycle. MiDAS 4.0 will enter Record mode and wait to receive an AutoTrigger. The AutoTrigger will occur at a time interval specified by the user in the Delay AutoTrigger field. Once a trigger is received, it will download the recording as configured in the Record tab. Once the recording is saved, MiDAS 4.0 will enter Idle mode for the amount of time specified in the Delay Reset field. MiDAS 4.0 will then return to Record mode. This process will continue until you exit Automation mode or until the Reset Count is reached.
Time Lapse	Time Lapse mode is a Record-Download cycle. MiDAS 4.0 will enter Record mode and wait to receive a trigger. Once a trigger is received, it will download the recording as configured in the Record tab. Once the recording is saved, MiDAS 4.0 will enter Idle mode for the amount of time specified in the Delay Reset field. MiDAS 4.0 will then return to Record mode. This process will continue until you exit Automation mode or until the

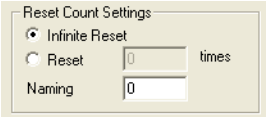
	Reset Count is reached. The downloaded recordings are stiched together to form one larger video.
Maximum Download	Maximum Download is a Record-Download cycle. MiDAS 4.0 will enter Record mode and wait to receive a trigger. Once a trigger is received, it will download the recording as configured in the Record tab. Once the recording is saved, MiDAS 4.0 will return to Record mode. This process will continue until your computer runs out of memory or until the Reset Count is reached.
Custom	The Custom option will enable all fields and allow you to configure the recording process as desired.

Below is a quick reference document to assist in configuring Automation. For recording parameters refer to Chapter 4, *Recording Projects*.

	TTL Trigger	Delay Reset	Delay Auto Trigger	Number of Frames captured
Basic	X	0	N/A	As configured in Record Tab.
Timed Reset	X	# of seconds in the "delay reset" field	N/A	As configured in Record Tab.
Auditing	X*	N/A	# of seconds in the "delay reset" field	As configured in Record Tab.
Time Lapse	X	N/A	# of seconds in the "delay reset" field	1 Frame
Maximum Download	X*	N/A	As soon as pre-trigger is filled.	As configured in Record Tab.
Custom	X	# of seconds in the "delay reset" field	# of seconds in the "delay Auto Trigger" field	As configured in Record Tab.

Reset Count Settings

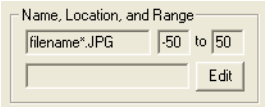
The Reset Count Settings control the number of times that the recording cycles will repeat in the selected Automation mode.



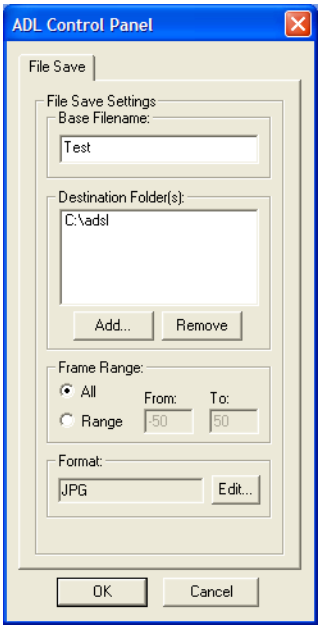
Infinite Reset	Selecting Infinite Reset enables the automation mode to continue indefinitely until the user manually stops the recording.
Reset	When the Reset selection is enabled, you will be able to input an integer into the accompanying field to specify the number of recordings.
Naming	Utilising this field will allow you to alter the number appended to each file name. For example, if you enter "25" in this field, the first saved file will be named `filename25`. The number is incremented for each consecutively saved file.

Name, Location, and Range

The Name, Location, and Range section is utilized to define the naming convention and location for downloaded files.



The Name, Location, and Range section simply reports the filename and extension being used, as well as the frame range to be saved and the final location of the downloaded files. To change these settings, click the Edit button, which will open an additional dialog box where the settings can be changed.



Base Filename

This is the leading potion of the filename that will be used for every sequence saved. A number is appended to the **Base Filename** when a file is saved. The starting number is defined in the Naming field under Reset Count Settings. The number is incremented for each consecutively saved file.

Destination Folder(s)

This will allow you to choose the destination where recordings will be saved. You can populate this field with multiple locations. Clicking on Add will open a file browsing window. Once a destination is selected, it will be placed within Destination Folder(s) field. Files downloaded in Automation mode will be saved to the first location in the list until the drive is full, or until the size limit for the folder has been reached. Files will then be saved in the next location listed.

Frame Range

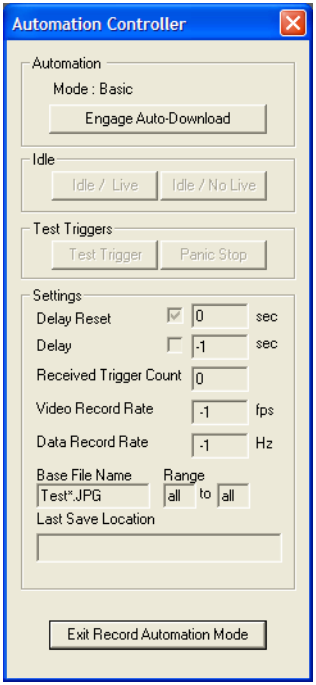
This allows you to select what range of frames captured will be saved to the video and/or data file. Checking the All box will save the complete set of frames. When the Range box is checked you will be able to select the range of files to be saved. Note that negative frame numbers occur before the trigger, identified as Frame 0, and positive numbers occur after the trigger.

Format

The Format section determines which type of file videos will be saved as. To change click on the Edit... button, a separate dialog will open. The choices you have are either `.avi`, or image sequences `.jpg`, `.bmp`, `.tif`. Once selected, click on OK to save your changes, or Cancel to leave the dialog without making any changes.

Automation Controller

Once you have configured the automation settings and your hardware is in place, you can activate the Automation Mode. Click the Activate button at the bottom of the Automation tab. This will open the Automation Controller dialog box.



This controller will allow you to engage and stop the automation mode.

Automation

This section will display which mode of Automation you are in, and contains the Engage Auto-Download button. Once engaged, Automation will start to record based upon how you have configured Automation. The Engage Auto-Download Button will revert to the Disengage Auto-Download button . Use this to stop the automated collection of recordings.

Idle	The Idle section includes two buttons, Idle / Live and Idle / No Live. This will pause the Automation mode without exiting. Idle / Live will pause the recording and will allow you to view a live camera window. Idle / No Live will pause without displaying a live camera window. To re-engage Automation, click on the Disengage Auto-Download button, and then Engage Auto-Download.
Test Triggers	Here we have two buttons in this section for manually triggering or stopping the current recording. The Test Trigger button will send a trigger pulse to MiDAS 4.0 and the camera, and a recording based upon your trigger configuration will be captured. This recording will also be saved per your configuration. The Panic Stop Button will act as a trigger with a 100% pre-trigger. It will trigger and stop recording immediately, saving all previously captured video and data, then return to Record Mode. To exit Automation and Record modes, click the Disengage Auto-Download button.
Settings	This is simply a reporting window that displays all of the settings as you have configured them. At the bottom is the Last Save Location field, which will display the last save location utilized.

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Chapter

7

Data Acquisition Theory

Chapter 7. Data Acquisition Theory

Overview

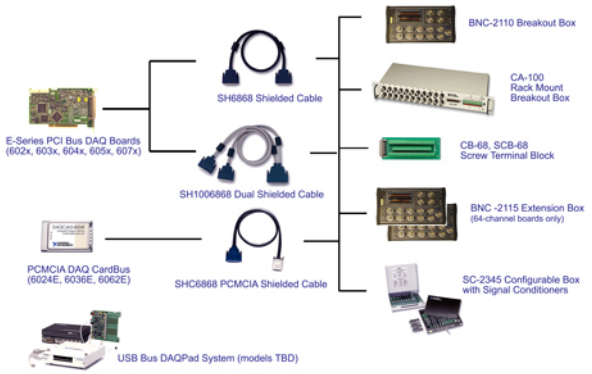
If you have purchased MiDAS 4.0 Full Edition, you can capture data from a variety of sensors, including accelerometers, strain sensors, microphones, etc. and have them integrated with your video into a MiDAS 4.0 project. MiDAS 4.0 will accept up to sixty-four (64) analog inputs. You can also use these as triggering sources for your video capture needs.

There are eight available high-speed Data Acquisition kits for MiDAS 4.0. The specifications of these kits are as follows:

Part Number	Differential Analog Inputs	Single Ended Analog Inputs	Total Sample Rate (kS/s)	Included Hardware
DA-123M	8	16	200	BNC Breakout Box / PCI card
DA-124M	8	16	200	BNC Breakout Box / PCMCIA card
DA-162M	8	16	500	BNC Breakout Box / PCMCIA card
DA-170M	8	16	1,250	BNC Breakout Box / PCI card
DA-171M	16	64	1,250	BNC Breakout Box & BNC Extended Breakout Box / PCI card

MiDAS 4.0 Data Acquisition models DA-123M, -170M and -171M are all configured for PCI bus architecture with 12-bit resolution. Output lines and digital input lines are currently not used by MiDAS 4.0 standard software but are available for use with specialty software and with the DAQ boards independent of MiDAS 4.0.

All MiDAS 4.0 data acquisition kits are supplied with a data acquisition board manufactured by National Instruments, a cable and a breakout box. The supported configurations of data acquisition hardware are shown in the following diagram:



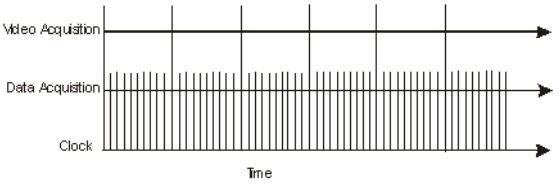
Installation instructions are provided in Chapter 2, *Installing MiDAS 4.0*.

How MiDAS 4.0 Data Acquisition Works

The Master Clock

The master clock used by the MiDAS 4.0 data acquisition system comes from the data acquisition board installed in the computer. The data acquisition board sends pulses to both the data acquisition engine and the video acquisition engine of MiDAS 4.0 with precise timing. Each timing pulse causes the acquisition of the corresponding signal and the subsequent storage of the data or video. The MiDAS 4.0 data acquisition board and the camera board are connected via a synchronization cable - a BNC coaxial cable from the Phase Out connection on the BNC breakout box to the Phase In connection on the camera board. The camera operates as a slave device to the MiDAS 4.0 system - that is, a frame is acquired when a pulse is received across the phase in line. Similarly, the MiDAS 4.0 data acquisition engine is a slave device to the system: data is acquired only when the software instructs the engine to sample each enabled analog input channel.

The ability to have synchronized yet different clock rates, and thus a different acquisition frequency for video and data is the basis for the MiDAS 4.0 Waveform per Frame™ technology. If, for example, the operator chooses to acquire 10 data points per single frame, the pulse sequence includes one pulse to the video camera for every 10 data pulses, as follows:



Multiplexed Data Acquisition

If multiple analog channels are selected, the various inputs are multiplexed - sampled sequentially through a single analog input. The input is switched between the enabled channels. The switching time between acquisition is dependent on the type of data acquisition card you are using. If your data acquisition hardware can acquire 200,000 samples per second (e.g. model DA-123M), and if you enable two (2) analog input channels, then each channel can acquire 100,000 samples/second. If four (4) channels are enabled, then each channel can acquire 50,000 samples/second. If eight (8) channels are enabled, then each channel can acquire 25,000 samples/second.

Therefore, if in the above example, the operator chooses to acquire 10 data points per frame and enables 8 analog channels, the pulse sequence includes one pulse to the video camera, and 10 slightly offset data pulses to each data channel.

Camera images are streamed directly to the local memory on the camera board. Data is streamed directly to the computer RAM.

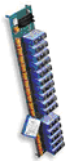
BNC Breakout Box vs. Terminal Block vs. 5B+ Rack

Most MiDAS 4.0 data acquisition kits include a standard BNC breakout box. If you purchased an extended analog model (DA-171M), you also received an additional BNC extension breakout box.

MiDAS 4.0 is also capable of working with a 5B+ rack system.The 5B+ rack is a common hardware interface from Analog Devices Inc, that allows for individual signal conditioner hardwares. MiDAS 4.0 accepts standard outputs from 5B+ signal conditioner hardwares.

Some high-end and laboratory applications necessitate replacing the BNC breakout boxes with optional screw terminal blocks. It is recommended that you be very familiar with data acquisition fundamentals and with your sensor performance if you are to use terminal blocks. Terminal blocks are typically used for a large number of sensor inputs (MiDAS 4.0 can support 64 sensor inputs) and for large numbers of single-ended sensors that bring only one wire back to the data acquisition hardware.

The following table helps describe the advantages of each type of connection hardware. If you have questions for a particular application, contact Xcitex engineers for assistance.

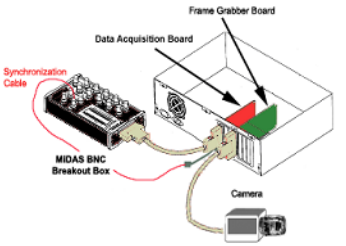
			
	BNC breakout box(es)	**Terminal block(s)**	**5B+ rack**
Maximum number of analog inputs kits: DA-123M, DA-124M, DA-162M, DA-170M	8 any type	16 Single Ended or 8 Differential	16 any type
Maximum number of analog inputs kits: DA-171M	8 any type	32 any type	Not Available
Maximum number of extended inputs kits: DA-171M	24 any type	32 any type	Not Available
Cable type	Shielded	Shielded	Ribbon
Switching	Internal	None	Internal
Connection types	BNC jacks	Screw terminals	Plug ins
Internal isolation/shielding	Yes	No	No
Built-in bias resistors for floating sources	Yes	No	Yes
Accepts signal conditioner hardwares	No	No	Yes
Powers strain gauge sensors directly	No	No	Yes
Accepts Voltages greater than +/-10V	No	No	Yes (with SC)
Accepts single-ended signal inputs	Yes	Yes	Yes
Accepts differential signal inputs	Yes	Yes	No

BNC pigtail required for sync cable	No	Yes	No
BNC pigtail required for ext. trigger	No	Yes	No

Connecting Your Data Acquisition Hardware

Please refer to Chapter 2, *Installing MiDAS 4.0* to install the software and hardware for the data acquisition hardware.

If you are using a BNC breakout box, connect your synchronization cable(s) between the breakout box and the camera. The system should resemble the following diagram:

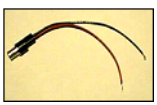


Note: It is advisable to first install MiDAS 4.0 with the standard BNC breakout box(es) supplied with your shipment. Once you have tested and learned how to use MiDAS 4.0 with the standard hardware, change over to the optional 5B+ rack or terminal block as required by your application.

Note: MiDAS 4.0 no longer supports MiDAS 1.X style breakout boxes.

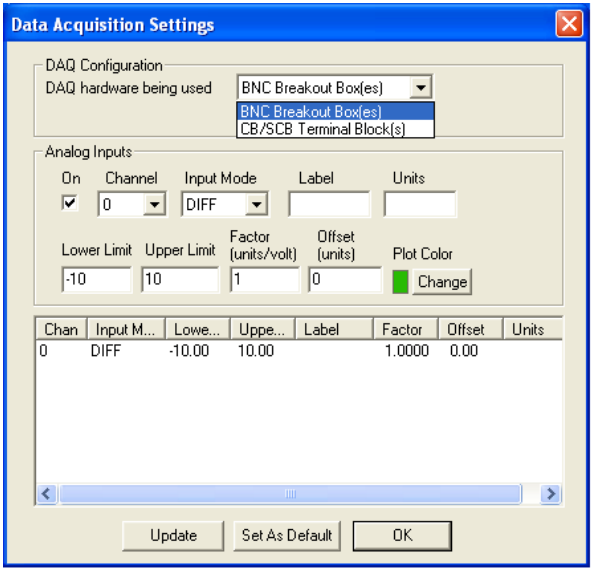
If you are using Terminal Block(s), simply disconnect the standard BNC Breakout Boxes and replace them with the optional Terminal Blocks. On the primary Terminal Block (the one connected to the cable labeled "MIO-16"), you must also:

- Connect (with a wire) terminal 10 to terminal 40
- You must also create the Sync Out synchronization cable. Using a BNC pigtail as such as shown:



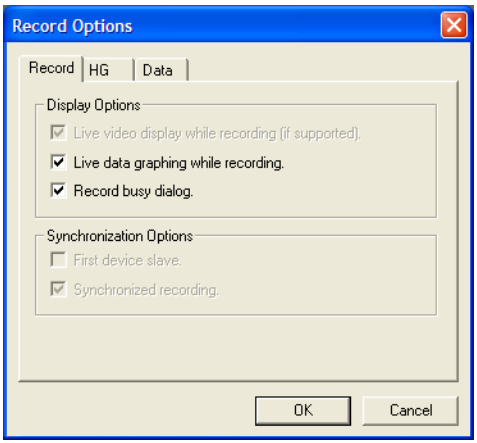
- Connect the red (center post) wire to terminal 2
- Connect the black (outside ground) wire to terminal 35
- Label this pigtail "Sync Out." From this connector, run the BNC sync cable to the camera "Sync-In" connector as shown in the above diagram

- You must also create a BNC connector to accept the external event trigger. Using a BNC pigtail as shown in the figure above.
  - Connect the red (center post) wire to terminal 41
  - Connect the black (outside ground) wire to terminal 3
  - Label this pigtail "Trigger In."
  - When you configure your sensors make sure you select CB/SCB Terminal Block(s)



If you are using a MiDAS 5B+ rack, simply connect the 5B+ ribbon cable and the 5B+ rack directly to the data acquisition board as instructed in Chapter 2, *Installing MiDAS 4.0* of this manual. No jumpers are required for 5B+ hardware. The sync cable and the external trigger connect directly to the extension bracket on the 5B+ rack.

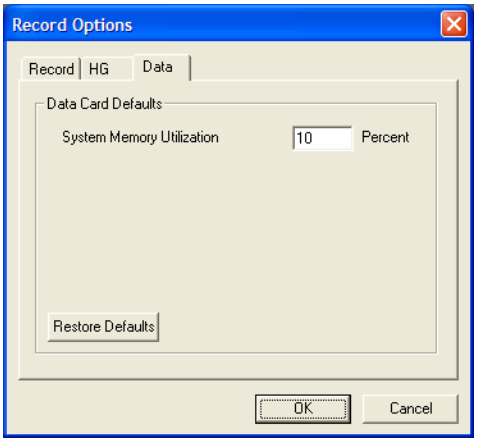
MiDAS 4.0 software typically recognizes that your system is set up to acquire synchronized data. You can enable or disable data acquisition by selecting or de-selecting the "Synchronized Recording" checkbox in the RECORD OPTIONS window under the EDIT menu. See Chapter 3, *Fundamentals* for more information about the RECORD OPTIONS window.



Note that the process of updating a live data graph is very processor intensive and can require all of the processor power available from the computer, leaving no computation ability for other MiDAS 4.0 functions. For example, you may not be able to stop the recording or re-size a window, If your computer has a slower processor, uncheck the Live data graphing while recording checkbox in the RECORD OPTIONS window under the EDIT menu. If you do not do this, the system may be slow to respond, and there may be other unfavorable effects.

Note: Enable the Live data graphing while recording feature only if you have sufficient CPU power. To determine if your computer has enough power, enable the CPU monitor from the Performance tab of the Windows Task Manager during a test recording and note the amount of CPU usage during a recording. Optimally, the CPU usage should be <40%.

Under the Data tab of the RECORD OPTIONS you can control how much of system memory is used to store sensor data. With systems with large amounts of RAM memory it is often beneficial to reduce this from the default from 10 percent. Otherwise the amount of sensor data can be so large as to be difficult to manage.



Data Acquisition Basics

MiDAS 4.0 data acquisition kits have been designed to work with a large number of different types of transducers.These sensors convert force, rate of flow, pressure, temperature, etc. into a voltage that is proportional to the physical parameters being monitored. Typical sensors include:

- Accelerometers
- Microphones
- Strain Gauges
- Flow Sensors
- Pressure Sensors
- Thermistors
- Hydrophones
- Dynamometers
- Speedometers
- Tachometers

Often, signals from these sensors must be amplified, filtered, biased, converted from current to voltage, or other similar processes. Therefore, each sensor type typically uses a signal conditioner, designed for the type of sensor, to produce signals recognized by the MiDAS 4.0 data acquisition hardware. MiDAS 4.0 utilizes varying

voltage for its data recording needs; therefore any signal conditioner that outputs a voltage can be utilized.

Understanding What MiDAS 4.0 Data Acquisition Measures

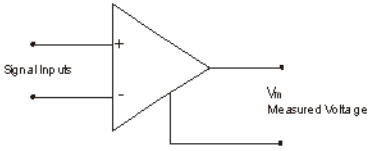
In the next few sections, you will be introduced to the variety of sensor types most commonly used with MiDAS 4.0. However, it is first important to understand what the various data acquisition kits measure.

Your MiDAS 4.0 data acquisition board has an on-board instrumentation amplifier. Sensors are connected to the DAQ hardware (breakout box or terminal block), which in turn passes these signals to this amplifier via the cable and board connector. Therefore, when you connect your sensor to the MiDAS 4.0 hardware, you are essentially connecting directly to the computer board circuitry.

MiDAS 4.0 measures the difference between the output of the instrumentation amplifier and another reference voltage. Based on the information you give MiDAS 4.0 when setting up your test, the software measures the difference between the amplifier output and a ground, either the computer ground, the local ground at your sensor or signal conditioner, or a floating ground source.

An instrumentation amplifier is a differential amplifier, It outputs the difference between two inputs. Therefore two leads from a sensor can be connected to the amplifier, the amplifier will then compare the inputs and reference them to the chosen ground.

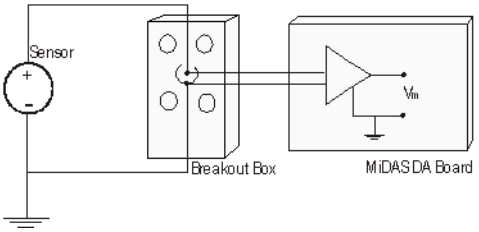
The differential instrumentation amplifier on the MiDAS 4.0 data acquisition board is depicted as follows:



The signal inputs are connected to the sensor or to the transducer via the end connector on the board or via the BNC breakout box provided with all MiDAS 4.0 data acquisition systems.

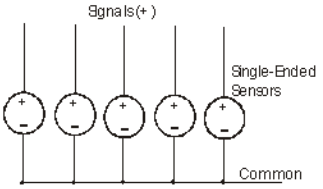
Understanding Different Types of Sensors

Sensors have different characteristics that must be considered when connecting to MiDAS 4.0 or any data acquisition system.



Some sensors have two output wires and produce a signal that is the difference between the positive (+, or signal) lead and the negative (-) lead. These are known as "differential" sensors.

Some sensors have one signal wire and one common wire. These sensors are generally named "single-ended" sensors. Typically, the common wires for an entire group of single-ended sensors are all tied together. These are very common in larger test facilities that use many sensors (crash testing, structural testing, etc.)



If the common wire from a sensor is physically connected to the data acquisition hardware, the system is called "referenced" - that is, the sensor common is electrically connected to the data acquisition board common. On the other hand, if the common wire from a sensor is connected to a common building or earth ground (and perhaps not physically connected to the data acquisition (hardware), the system is considered to be "non-referenced."

Sensors may also be configured as combinations of these types, such as referenced single-ended, non-referenced single-ended, or differential.

MiDAS 4.0 is designed to work with all of these sensor designs. The operator must simply instruct MiDAS 4.0 as to which sensor type is being connected, and the software automatically makes the proper adjustments and switch settings. For example, if you are using a Referenced Single Ended sensor, MiDAS 4.0 knows to reference the signal to the common ground of the system (e.g. computer or building) and makes the appropriate internal switch changes. Likewise, if you are using differential sensors, MiDAS 4.0 knows which terminals to assign to the sensor and makes the appropriate switch changes to measure the difference between positive and negative leads.

Differential sensors are always recommended for better signal integrity. Single-ended sensors are recommended only under controlled conditions. If your signal environment is the least bit noisy, your cable lengths exceed 3 meters (10 ft) or your signal level is less than 1V P-P, then it is highly recommended that you use Differential sensor types with two leads.

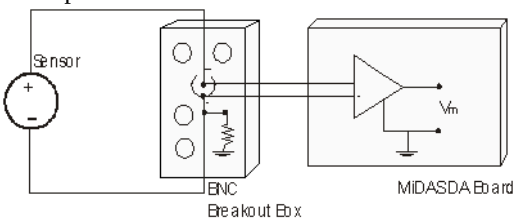
In the following sections, each type of sensor is summarized and depicted with a basic schematic.

Differential Grounded Sensors

In this configuration, the Differential sensor has two leads-one positive (+) and one negative (-). The negative lead of the sensor is also tied to earth or building ground and is therefore already connected to a common ground point with respect to the board (assuming that the computer is plugged into the same power system).

If you have a differential grounded sensor and you are using either a BNC breakout box or a terminal block, wire the sensor positive and negative leads directly to the DAQ hardware, as shown in the following diagram.

Most commercial data acquisition systems are designed in a differential grounded configuration, especially if significant signal conditioning is required. In this configuration, the little rocker switch under the BNC jack should be placed in the "GS" position.

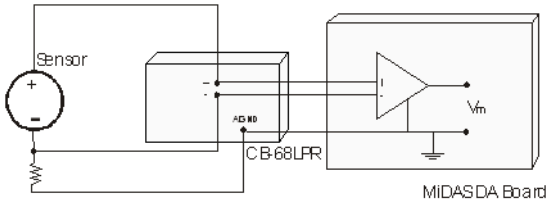


Differential Floating Sensors

In this configuration, the differential sensor has two leads-one positive (+) and one negative (-) where the negative lead of the sensor is NOT tied to earth or building ground and is therefore "floating" with respect to the amplifier. Therefore, to reduce the effects of signal drift relative to the board ground, you must tie the ground reference of the floating signal to your board's analog input ground through a bias resistor.

If you are using a BNC breakout box, a built-in 5kW bias resistor (and 0.1 mF capacitor filter) is automatically engaged when the rocker switch below the BNC jack is set to "FS".

If you are using a terminal block, you must add the bias resistor yourself. For sources with low impedance, no bias resistor is needed and you may simply connect the negative lead to AIGND as well as the assigned screw terminal for the negative side of the amplifier. For sources with high impedance, however, you must put a bias resistor in-line to de-couple the noise from the amplifier. Place a bias resistor of minimum 100x the equivalent source impedance between the negative terminal and the AIGND pin as shown in the following diagram:



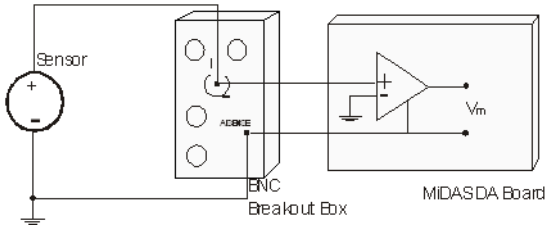
Some commercial data acquisition systems require an in-line resistor due to larger source impedance. Check the manual provided with your sensor for their recommendation. In this configuration, the rocker switch under the BNC jack should be placed in the "FS" position.

Single-Ended Grounded Sensors (Non-Referenced or NRSE)

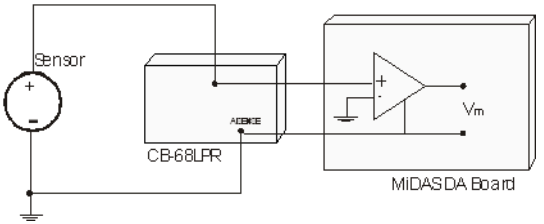
Single-ended sensors have one wire that carries the signal (+) and one common wire. Typically, single ended sensors are used in specialized applications such as crash testing where many additional sensors are required and the test environment is highly controlled. If you are using single-ended sensors, you may tie the common wires of the sensors together.

On a grounded single-ended sensor, the common lead of the sensor is also tied to earth or building ground and as such is already connected to a common ground point with respect to the board (assuming that the computer is plugged into the same power circuit). However, since the differential amplifier needs both a positive (+) and negative (-) input, the common lead must be tied to a point on the DAQ hardware called the **AISENSE** - an internal ground sensing point. When using single-ended grounded sensors, the common lead gets tied to **AISENSE** at the BNC breakout box or the terminal block hardware. All other connections and switches are handled automatically by the MiDAS 4.0 software.

If you are using a BNC breakout box, the positive signal lead is connected to the center post of the BNC jack and the common lead(s) must be wired to the **AISENSE** terminal screw on the breakout box, as depicted in the following diagram:



If you are using a terminal block, the connections are identical. The positive signal lead from the sensor gets connected to the appropriate screw terminal and the common lead(s) must be wired to the **AISENSE** terminal as depicted in the following diagram:



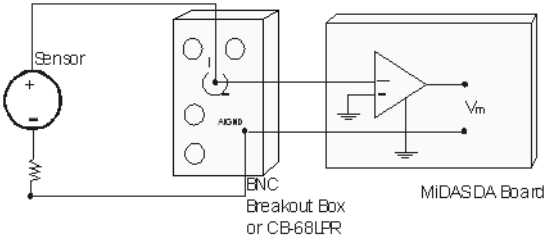
In the NRSE (single-ended grounded) mode, the MiDAS 4.0 software measures the difference between the output of the amplifier and **AISENSE**, The switch on the BNC breakout box is not used.

Single-Ended Floating Sensors (Referenced or RSE)

Single-ended sensors have one wire that carries the signal (+) and one common wire. Typically, single ended sensors are used in specialized applications such as crash testing where many additional sensors are required and the test environment is highly controlled. If you are using single ended sensors, you may tie the common wires of the sensors together.

On a floating single-ended sensor, the common lead of the sensor is not tied to earth or building ground and as such is floating relative to the ground of the amplifier. Therefore, to reduce the effects of signal drift relative to the board ground, you must *reference* the floating signal to the amplifier analog input ground through a bias resistor.

You must add the bias resistor yourself, even if you are using the BNC breakout box (single-ended sensors do not use the negative lead of the BNC jack). For sources with low impedance, no bias resistor is needed and you may simply connect the common lead(s) to AIGND directly. For sources with high impedance, however, you must put a bias resistor in-line to de-couple the noise from the amplifier. Place a bias resistor of minimum 100x the equivalent source impedance between the negative terminal (common) of the sensor and the AIGND pin of either the BNC breakout box or the terminal block (whichever you are using) as shown in the following diagram:



Note that this resistor must be placed regardless of whether you use the BNC breakout box or the terminal block. In the RSE (single-ended floating) mode, MiDAS 4.0 measures the difference between the output of the amplifier and AIGND. The switch

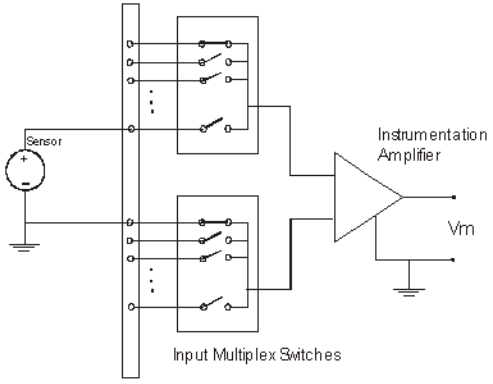
on the BNC breakout box is not used.

How Multiplexing Works

MiDAS 4.0 data acquisition kits gather their signals through multiplexing, the common technique for sampling multiple channels with one acquisition device. The incoming signals are wired to a multiplexer switch (mux) that rapidly, switches the inputs to the instrumentation amplifier. The MiDAS 4.0 software automatically configures the data acquisition hardware to enable this switching and keeps track of which channel is configured on which connector.

When a single acquisition device deals with a multiplexed input, the incoming signals are staggered. For example, first channel 0 is sampled, then channel 1, then channel 2, etc. The increment of time between samples is inversely proportional to the number of channels and the total sample rate, but is typically a few microseconds.

Therefore, if multiple channels are selected, the true diagrams presented in the previous section would also include the front multiplex switch, as follows (example of differential grounded source):



Note: This is a schematic for demonstration purposes. The switches are not mechanical, but high-speed semiconductor switches.

Choosing the Data Sample Rate

Since the inputs are switched via the multiplexer described above, the total data sample rate is the product of the number of channels times the sample rate per channel. For example, if you have 4 channels active and wish to acquire 10,000 samples per second per channel, the total sample rate is 4 x 10,000 = 40,000 samples/second. Likewise, if your data acquisition board is rated for 200,000 samples per second maximum rate and you have 8 channels active, the maximum rate per channel is 200,000/8 = 12,500 samples/second.

One important consideration when selecting the data rate is the processor usage.

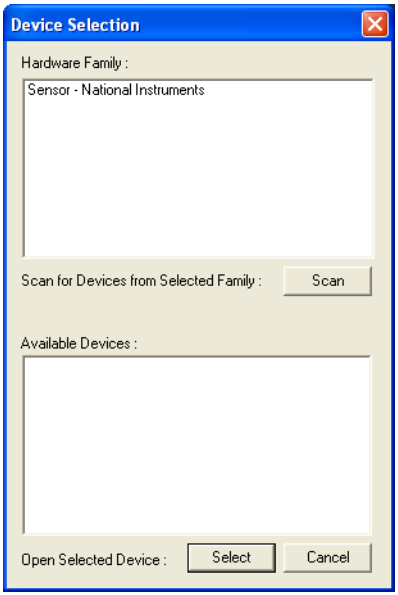
MiDAS 4.0 draws each data point on the screen plus the cursor position for each graph. With many thousands of data points and multiple channels, the processor power required just to draw continuously will slow the system performance.

Opening and Configuring Data Card(s)

Begin by opening a new Record project if you do not already have one open, either by selecting New Group from the File menu or by clicking on the New Play Group icon in the program window toolbar. It's important to note that you can only have one **Record Group** open at a time.

Connect your data acquisition hardware per the instructions in Chapter 2, *Installing MiDAS 4.0*. If you have multiple data cards in your system, interconnect the hardware as depicted in the MiDAS 4.0 Connection Assistant.

Under File... Click on Open Data Card.... A dialogue box will appear prompting you to select the hardware family of your data acquisition card.

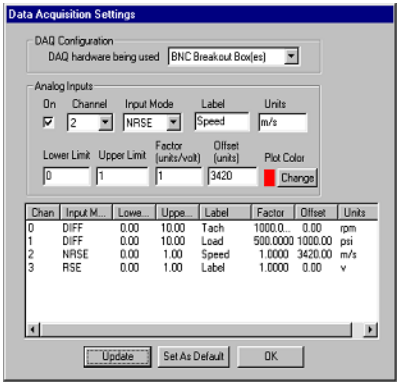


Select the appropriate family and click on Scan. If your hardware is properly connected and configured, it will appear in the Available Devices field.

Select the desired camera from the **Available devices** field and click on Select to open the Data acquisition card. Repeat these steps for each card you wish to open.

Connecting Sensors to the BNC Breakout Box

1. Click on the wrench button located next to channels next to the Data section in the Recording tab. The DATA ACQUISITION SETTINGS dialog box will open.



2. Select BNC BREAKOUT BOX(ES) in the DAQ Configuration window.

3. Select the appropriate channel (e.g. "Channel 0") from the drag-down box. If that channel is available, click the ON checkbox. If that channel is unavailable, go to the next highest channel until you find an available channel. Always start with Channel 0.

4. Determine the type of sensor that you are using (see the instruction manual that came with your sensor for more details).

5. Determine the parameters of the sensor (gain, offset, voltage range, calibration). Make sure you factor in the signal conditioning amplification, if appropriate.

6. Configure MiDAS 4.0 with the specific information about the sensor and (if applicable) signal conditioner. Set the information about each sensor on which you are acquiring data. The following chart shows the options for configuring a sensor. Enter all the information requested.

DAQ hardware being used	The options are BNC Breakout Box(es) or Terminal Block. If you are using the supplied BNC Breakout Boxes, select BNC BREAKOUT BOX(ES) See above.
Channel	MiDAS 4.0 automatically determines and displays which channels are available based on which DAQ hardware you have installed and which type of sensors you have already configured. Start with the next sequentially

	available channel and check the box to enable that channel.
Input Mode	The three options here are DIFF, RSE and NRSE. See the above description to determine which type of sensor you are using. If you do not know which type of sensor you have, and the sensor was provided with a BNC connector, try DIFF mode.
Label	Provides a short (4 character) label for the analog input channel. This label is printed on the melded AVI file. We recommend using lower case letters only.
Units	A short (3 character) field for placing units in the graphs. We recommend using lower case letters only.
Lower Limit	The lower limit, in volts, that you expect to see from your sensor. MiDAS 4.0 magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the lower limit in this field will appear as clipped or under-saturated. A small amount of over scan has been automatically provided. Typical "bi-polar" sensors have an input range of -10V to +10V Typical *uni-polar* sources have an input range of 0V to +10V.
Upper Limit	The upper limit, in volts, that you expect to see from your sensor. MiDAS 4.0 magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the upper limit in this field will appear as clipped or saturated. A small amount of over scan has been automatically provided. Typical "bi-polar" sensors have an input range of -10V to +10V Typical *uni-polar* sources have an input range of 0V to +10V.
Factor	The scale factor to be applied by MiDAS 4.0 to convert the input volts to a meaningful number, in engineering units. This number is applied immediately after the input voltage is registered.

Offset	The offset to be applied by MiDAS 4.0 to account for drifts or offsets in the input, in units. This offset is applied after the scale factor multiplication.
PLOT COLOR button	The color of the line to be used in multiple-line graphs. Select this button to bring up the color palette.
UPDATE button	When clicked, this button causes the table to be updated with the new information.
SET AS DEFAULT button	When clicked, this button causes the current data configuration to be saved as the default for all future measurements. When the MiDAS 4.0 data acquisition section is opened subsequently, the default configuration will be present.
OK button	Exits the screen without further data saving.

7. Click on the UPDATE button.

8. Physically connect your sensor to the BNC Breakout Box(es).

   - Terminate your sensor with a BNC plug connector. Connect the positive signal channel (+) from your sensor to the center post of the BNC.

     - If you are using a differential sensor, connect the negative to the outside of the BNC. Note that most differential sensors will already have BNC terminations.

     - If your sensor is a single-ended grounded (NRSE) sensor, connect the common wire from the sensor system to the screw terminal labeled AISENSE on the BNC Breakout Box.

     - If your sensor is single-ended floating (RSE) sensor, connect the common wire from the sensor system to the screw terminal labeled AIGND on the BNC Breakout Box with a bias resistor, as described in the above section.

   - Connect the BNC connector to the corresponding BNC input on the BNC Breakout Box and the BNC Extended Breakout Box. MiDAS 4.0 will automatically enable the correct channels for you depending on which data acquisition hardware is installed. Data acquisition models DA-123M, DA-162M and DA-170M, all enable 8 channels. Data acquisition models DA -171 enables 32 channels.

     When using the MiDAS 4.0 BNC Breakout Box(es), connect your sensors as

shown in the following chart:

MiDAS Channel (as selected in Settings Window)	Connect Sensor to BNC labeled...
0	ACH 0
1	ACH 1
2	ACH 2
3	ACH 3
4	ACH 4
5	ACH 5
6	ACH 6
7	ACH 7
16	CH 16
17	CH 17
18	CH 18
19	CH 19
20	CH 20
21	CH 21
22	CH 22
23	CH 23
32	CH 32
33	CH 33
34	CH 34
35	CH 35
36	CH 36
37	CH 37
38	CH 38
39	CH 39
48	CH 48
49	CH 49
50	CH 50
51	CH 51
52	CH 52
53	CH 53
54	CH 54

55	CH 55

9. Flip the little rocker switch on the bottom of the BNC input as follows:

   If your sensor is differential and grounded, set the switch to "GS"

   If your sensor is differential and floating, set the switch to "FS"

   If your sensor is single-ended, set the switch to "FS"

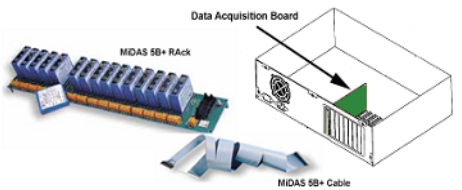
10. Repeat steps 3-9 for each sensor that you wish to hook up to MiDAS 4.0 data acquisition .

11. When done hooking up all your sensors, click on the OK button.

Note: Consult with your sensor manufacturer for specific details regarding your sensor(s). MiDAS 4.0 BNC Breakout Boxes accept -10V to 10V signals (the standard in the data acquisition industry). If your sensors put out more than this voltage, you should place a voltage divider in line between the sensor and the BNC Breakout Box, or consider using the MiDAS 5B+ Rack with voltage divider hardwares.

Connecting Sensors to the MiDAS 4.0 5B+ Rack

The MiDAS 4.0 DA-123B hardware includes a 16-channel 5B+ Rack and special cable. The MiDAS 4.0 5B+ rack is a derivative of the series of "5B" hardware manufactured by Analog Devices and sold through numerous worldwide distributors. The 5B+ hardware has a distinct advantage over the standard BNC breakout box in that it directly accepts a complete line of signal conditioner hardwares for modifying signals from sensors. The MiDAS 4.0 5B+ rack is depicted in the following diagram, completely populated with 16 signal conditioner hardwares:



A list of the available 5B+ signal conditioner hardwares is as follows:

Frequency Measurement hardwares

Frequency hardwares convert input frequency from encoders, gauges, tachometers to output voltage (0-5VDC).

Input Range	Output Range	Bandwidth	Part Number
0-5kHz	0-5V	10Hz	M5B-FI45-04
0-10kHz	0-5V	10Hz	M5B-FI45-05
0-25kHz	0-5V	190Hz	M5B-FI46-01
0-50kHz	0-5V	190Hz	M5B-FI46-02
0-100kHz	0-5V	190Hz	M5B-FI46-03
0-250kHz	0-5V	190Hz	M5B-FI46-04

Voltage Measurement hardwares

Voltage hardwares amplify or reduce DC input voltages to ±5VDC for MiDAS input.

Input Range	Output Range	Bandwidth	Part Number
±10mV	±5V	10kHz	M5B-VI40-01
±50mV	±5V	10kHz	M5B-VI40-02
±100mV	±5V	10kHz	M5B-VI40-03
±1V	±5V	10kHz	M5B-VI41-01
±5V	±5V	10kHz	M5B-VI41-02
±10V	±5V	10kHz	M5B-VI41-03
±20V	±5V	10kHz	M5B-VI41-07
±40V	±5V	10kHz	M5B-VI41-08

Current Measurement hardwares

Current hardwares convert sensor output currents to output voltage (0-5V).

Input Range	Output Range	Bandwidth	Part Number
0-20mA	0-5V	4Hz	M5B-CI32-02

5B Strain Measurement hardwares

Strain Gauge hardwares both provide bias "excitation" voltage to the sensors and convert isolated strain gauge inputs to output voltage (0-5V).

Input Range	Output Range	Sensitivity	Bandwidth	Part Number
±30 mV @ 10 V Excitation	±5V	Full bridge300-10kO	10 kHz	M5B-SG38-02
±30 mV @ 10 V Excitation	±5V	Half bridge300-10kO	10 kHz	M5B-SG38-04
±20 mV @ 10 V Excitation	±5V	Full bridge300-10kO	10 kHz	M5B-SG38-05

5B Temperature Measurement hardwares

Temperature hardwares provide power to thermocouples and convert temperature from a thermocouple with cold-junction compensation (CJC) to voltage (0-5DC).

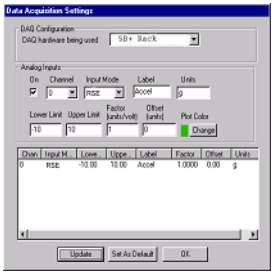
Type / Input Range	Output Range	Accuracy	Part Number
J type/0-760°C	0-5V	±.05%	M5B-TI37-J1
K type/-100-1350°C	0-5V	±.05%	M5B-TI37-K1
T type/-100-400°C	0-5V	±.05%	M5B-TI37-T1
E type/0-900°C	0-5V	±.05%	M5B-TI37-E1
R type/0-1750°C	0-5V	±.05%	M5B-TI37-R1
S type/0-1750°C	0-5V	±.05%	M5B-TI37-S1
B type/0-1800°C	0-5V	±.05%	M5B-TI37-B1
C type/-100-1300°C	0-5V	±.05%	M5B-TI37-C2

To connect sensors to your MiDAS 4.0 DA-123B hardware:

1. Connect your MiDAS 4.0 data acquisition hardware per the instructions in Chapter 2, *Installing MiDAS 4.0*.

2. Replace the BNC breakout box and shielded cable with the 5B+ rack and ribbon cable.

3. Click on the wrench button  located next to channels next to theData section in the Recording tab. The DATA ACQUISITION SETTINGS dialog box will open.



4. First, you must tell MiDAS 4.0 which type of DAQ hardware you are using. Select 5B+ RACK in the DAQ Configuration window.

5. Determine the type of sensor that you are using (see the instruction manual that came with your sensor for more details).

6. Starting with Channel 0, select a channel.

7. Click the ON checkbox next to the channel you selected.

8. Configure MiDAS 4.0 with the specific information about the sensor. Note that all 5B+ signal conditioner hardwares are reference single ended (e.g. RSE).

9. Set the information about each channel on which you are acquiring analog data per the following instructions. Use the information coming out of the 5B+ hardwares (typically +/-5V or 10V range). Set the scale factor as the product of the sensor and the signal conditioner amplification.

DAQ hardware being used	The options are BNC Breakout Box(es) or Terminal Block. If you are using the supplied BNC Breakout Boxes, select BNC BREAKOUT BOX(ES) See above.
Channel	MiDAS 4.0 automatically determines and displays which channels are available based on which hardware you have purchased which type of DAQ hardware you have chosen and which type of sensors you have already configured. Starting with the next sequentially available channel (start with Channel 0) and check the box to enable that channel.
Input Mode	The three options here are DIFF, RSE and NRSE. See the above description to determine which type of sensor you are using. If you do not know which type of sensor you have, and the sensor was provided with a BNC connector, try DIFF

	mode.
Label	Provides a short (4 character) label for the analog input channel. This label is printed on the melded AVI file. We recommend using lower case letters only.
Units	A short (3 character) field for placing units in the graphs. We recommend using lower case letters only.
Lower Limit	The lower limit, in volts, that you expect to see from your sensor. MiDAS 4.0 magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the lower limit in this field will appear as clipped or under-saturated. A small amount of over scan has been automatically provided. Typical *bi-polar* sensors have an input range of -10V to +10V. Typical *uni-polar* sources have an input range of 0V to +10V.
Upper Limit	The upper limit, in volts, that you expect to see from your sensor. MiDAS 4.0 magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the upper limit in this field will appear as clipped or saturated. A small amount of over scan has been automatically provided. Typical bi-polar sensors have an input range of -10V to +10V. Typical *uni-polar* sources have an input range of 0V to +10V.
Factor	The scale factor to be applied by MiDAS 4.0 to convert the input volts to a meaningful number, in engineering units. This number is applied immediately after the input voltage is registered.
Offset	The offset to be applied by MiDAS 4.0 to account for drifts or offsets in the input, in units. This offset is applied after the scale factor multiplication.
PLOT COLOR button	The color of the line to be used in multiple-line graphs. Select this button to bring up the color palette.

UPDATE button	When clicked, this button causes the table to be updated with the new information.
SET AS DEFAULT button	When clicked, this button causes the current data configuration to be saved as the default for all future measurements. When the MiDAS 4.0 data acquisition hardware is opened subsequently, the default configuration will be present.
OK button	Exits the screen without further data saving.

10. Click on the UPDATE button.

11. Insert your 5B signal conditioner hardwares into the 5B+ rack. Make any adjustments to the hardwares (settings, voltage jumpers, etc.) at this time.

12. Connect your sensor directly to the 5B signal conditioner hardwares.

13. Repeat steps 5-12 for each sensor you attach (up to 16).

14. Power up the 5B+ Rack with the power supply.

15. Adjust your offset values as necessary.

    Note: Consult both your sensor manufacturer and/or the instructions that came with your 5B signal conditioner hardwares for instructions on connecting your sensors to the signal conditioner hardwares. Some sensors require 3 wires, some require 2, and some require reverse bias. Most 5B hardwares accept both differential and single ended sensor inputs.

16. Configure your channels. When using the MiDAS 4.0 5B+ rack, connect your sensors as shown in the following chart:

MiDAS Pro Channel (as selected in Settings Window)	Connect Sensor to 5B Rack Position
0	1
1	2
2	3
3	4
4	5
5	6
6	7
7	8
8	9

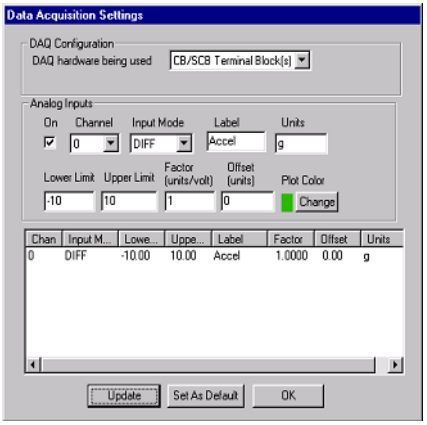
9	10
10	11
11	12
12	13
13	14
14	15
15	16

Note: Factor in any scaling or amplification caused by the 5B signal conditioner when setting channel information. For example, if the signal conditioner is a 2x voltage divider, the MiDAS 4.0 scale factor must be multiplied by 2x for accurate acquisition.

Connecting Sensors to the Terminal Blocks

1. Replace the BNC breakout box and the BNC extended breakout box if you have an extended analog hardware with terminal blocks.

2. Click on the wrench button located next to channels next to theData section in the Recording tab. The DATA ACQUISITION SETTINGS dialog box will open.



3. Select CB/SCB TERMINAL BLOCK(S) in the DAQ Configuration window.

4. Select the appropriate channel (e.g. "Channel 0") from the drag-down box. If that channel is available, click the ON checkbox. Start with Channel 0 always. If

Channel 0 is not available (already in use), then use Channel 1. If Channel 1 is already in use, then use Channel 2, and so on, until you find an available channel. Increment upwards as you proceed. MiDAS 4.0 automatically detects available channels. You cannot override this setting.

5. Determine the type of sensor that you are using (see the instruction manual that came with your sensor for more details).

6. Determine the parameters of the sensor (gain, offset, voltage range, calibration). Make sure you factor in the signal conditioning amplification, if appropriate.

7. Configure MiDAS 4.0 with the specific information about the sensor and (if applicable) signal conditioner. Set the information about each sensor on which you are acquiring data. The following chart shows the options for configuring a sensor. Enter all the information requested.

DAQ hardware being used	The options are BNC Breakout Box(es) or Terminal Block. If you are using the supplied BNC Breakout Boxes, select BNC BREAKOUT BOX(ES) See above.
Channel	MiDAS 4.0 automatically determines and displays which channels are available based on which hardware you have purchased which type of DAQ hardware you have chosen and which type of sensors you have already configured. Starting with the next sequentially available channel (start with Channel 0) and check the box to enable that channel.
Input Mode	The three options here are DIFF, RSE and NRSE. See the above description to determine which type of sensor you are using. If you do not know which type of sensor you have, and the sensor was provided with a BNC connector, try DIFF mode.
Label	Provides a short (4 character) label for the analog input channel. This label is printed on the melded AVI file. We recommend using lower case letters only.
Units	A short (3 character) field for placing units in the graphs. We recommend using lower case letters only.
Lower Limit	The lower limit, in volts, that you expect to

	see from your sensor. MiDAS 4.0 magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the lower limit in this field will appear as clipped or under-saturated. A small amount of over scan has been automatically provided. Typical *bi-polar* sensors have an input range of -10V to +10V. Typical *uni-polar* sources have an input range of 0V to +10V.
Upper Limit	The upper limit, in volts, that you expect to see from your sensor. MiDAS 4.0 magnifies the dynamic range of the input from Lower Limit to Upper Limit. Voltages that exceed the upper limit in this field will appear as clipped or saturated. A small amount of over scan has been automatically provided. Typical *bi-polar* sensors have an input range of -10V to +10V. Typical *uni-polar* sources have an input range of 0V to +10V.
Factor	The scale factor to be applied by MiDAS 4.0 to convert the input volts to a meaningful number, in engineering units. This number is applied immediately after the input voltage is registered.
Offset	The offset to be applied by MiDAS 4.0 to account for drifts or offsets in the input, in units. This offset is applied after the scale factor multiplication.
PLOT COLOR button	The color of the line to be used in multiple-line graphs. Select this button to bring up the color palette.
UPDATE button	When clicked, this button causes the table to be updated with the new information.
SET AS DEFAULT button	When clicked, this button causes the current data configuration to be saved as the default for all future measurements. When the MiDAS 4.0 data acquisition hardware is opened subsequently, the default configuration will be present.
OK button	Exits the screen without further data saving.

8. Click on the UPDATE button.

9. Physically connect your sensor to the CB-68LP Terminal Block(s)

   Note: MiDAS 4.0 can accommodate both differential and single ended inputs. Mix and match them as required by your application.

   If your sensor is differential, grounded or differential, floating:

   - Connect the signal (+) lead and the negative (-) lead from your sensor to the screw terminals on the Terminal Block corresponding to the selected MiDAS channel you selected in Step 3 above. Use the following two charts to determine which terminals to use.

     Note: For example, if you selected Channel 5 in Step 3 above, then you connect the positive lead to terminal (pin) # 60 and the negative lead to terminal (pin) #26.

     If you have MiDAS 4.0 data acquisition models DA-123M, -124M, -162M, -160M, DA-170M, you can connect up to 8 Differential Input Sensors into the Terminal Block:

	Terminal Block	
MiDAS Channel (as selected in Settings Window)	**Connect DI Sensor Signal (+) to pin #...**	**Connect DI Sensor Negative (-) to pin #...**
0	68	34
1	33	66
2	65	31
3	30	63
4	28	61
5	60	26
6	25	58
7	57	23

     If you have MiDAS 4.0 data acquisition module DA-171M, you can connect up to 32 differential inputs into your two terminal blocks. The first eight sensors are connected to the block connected to the cable labeled "MIO-68" and the remaining 24 sensors are connected to the block connected to the cable labeled "MIO-68 Extended Analog Input," as follows:

	Terminal Block	
MiDAS Channel (as selected in Settings	**Connect DI Sensor Signal (+) to pin #...**	**Connect DI Sensor Negative (-) to pin #...**

Window)		
0	68	34
1	33	66
2	65	31
3	30	63
4	28	61
5	60	26
6	25	58
7	57	23
	Extended Terminal Block	
MiDAS Channel (as selected in Settings Window)	***Connect DI Sensor Signal (+) to pin #...***	***Connect DI Sensor Negative (-) to pin #...***
16	68	34
17	33	67
18	32	66
19	65	31
20	30	64
21	29	63
22	62	28
23	27	61
32	26	60
33	59	25
34	24	48
35	23	57
36	55	21
37	20	54
38	19	53
39	52	18
48	17	51
49	16	50
50	49	15
51	14	48
52	13	47

53	46	12
54	11	45
55	10	44

- If your sensor is differential floating, you must also connect a bias resistor to the common lead from your sensor. Connect the other side of this termination to any of the Analog Ground screw terminals pins 24, 27, 29, 32, 56, 59, 64, or 67. See the diagram in the previous section for details on this bias resistor.

If your sensor is single-ended:

- Connect the signal (+) lead from your sensor to the screw terminals on the CB-68LPR Terminal Block corresponding to the selected MiDAS channel. MiDAS will automatically display only those channels that are available to you based on the data acquisition hardware model you have.

  If you have MiDAS data acquisition models DA-123M, -124M, -162M, -160M, DA-170M, then you can connect up to 16 sensors to your CB-68LPR Terminal Block:

MiDAS Pro Channel (as selected in Settings Window)	Connect SE Sensor Signal (+) to Screw Terminal #...
0	68
1	33
2	65
3	30
4	28
5	60
6	25
7	57
8	34
9	66
10	31
11	63
12	61
13	26
14	58
15	23

If you have MiDAS 4.0 data acquisition module, DA-171M, you can connect up to 64 single-ended sensors to the two terminal blocks (one on each end of the cable). You must connect the first 16 sensors to the terminal block connected to the cable labeled "MIO-68" and the remaining 48 sensors on the second block (on the cable labeled "MIO-68 Extended Analog Input"), as follows:

Terminal Block	
MiDAS Pro Channel (as selected in Settings Window)	Connect SE Sensor Signal (+) to Screw Terminal #...
0	68
1	33
2	65
3	30
4	28
5	60
6	25
7	57
8	34
9	66
10	31
11	63
12	61
13	26
14	58
15	23
Extended Terminal Block	
MiDAS Pro Channel (as selected in Settings Window)	Connect SE Sensor Signal (+) to Screw Terminal #...
16	68
17	33
18	32
19	65
20	30
21	29
22	62

23	27
24	34
25	67
26	66
27	31
28	64
29	63
30	28
31	61
32	26
33	59
34	24
35	23
36	55
37	20
38	19
39	52
40	60
41	25
42	58
43	57
44	21
45	54
46	53
47	18
48	17
49	16
50	49
51	14
52	13
53	46
54	11
55	10
56	51

57	50
58	15
59	48
60	47
61	12
62	45
63	44

- If your sensor is **single-ended grounded** (NRSE), connect the common lead from your sensor (or sensor system) to screw terminal 62 (AISENSE) of either terminal block.

  If your sensor is **single-ended floating** (RSE), connect a bias resistor to the common lead from your sensor(s). Connect the other side of this termination to any of the analog ground screw terminals pins 24, 27, 29, 32, 56, 59, 64, or 67.

10. Repeat steps 3-9 for each sensor that you wish to connect to MiDAS 4.0.

    Note: Always start at Channel 0 and proceed upwards, using the above charts.

    Note: MiDAS 4.0 will advise you of available and unavailable channels based on the type of hardware and sensor selection. MiDAS 4.0 will accept mixed differential, RSE and NRSE sensors. Always set the sensor type in MiDAS 4.0 prior to connecting the sensor and the signal conditioner to the Terminal Blocks.

11. When done connecting all your sensors, click on the OK button.

Chapter

8

Event Triggering

Chapter 8. Event Triggering

Understanding How MiDAS 4.0 Records Events

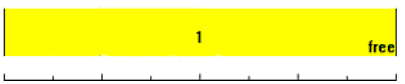
To prepare your recording projects, it is beneficial to understand how the different subsystems in MiDAS 4.0 work together, and how to configure them through MiDAS 4.0 for optimal results. In this section we will review the camera memory buffer and how to use triggering in respect to the memory buffer.

Understanding Memory Buffers

While MiDAS 4.0 is recording video from the cameras controlled by MiDAS 4.0, the video frames are streamed directly to RAM on board the camera, Frame Grabber card, or to the computer's memory, depending on the type of camera. Data is stored in the computer's memory. These combined memory sections are termed *the buffer*, and the buffers operate on the *First-In First-Out* principal. There is a limited amount of memory reserved for these operations. To keep the data current once the memory is full, the oldest is discarded to make room for the most recent. The way you configure these systems, through MiDAS 4.0, will allow you to capture the event of interest. The quantity of information you can store is fixed. How you configure MiDAS 4.0 will affect your different parameters. For example, reducing your resolution will increase the number of frames you can capture, and decreasing the sampling frequency of data sensors will, in kind, increase the amount of time for which you can sample data.

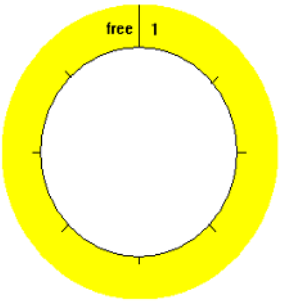
The Circular Buffer Concept

Consider the following bar to represent a memory buffer, in this example 128 Mb.



MiDAS 4.0 collects video and data into the buffer on a *first-in-first-out* basis. Once the buffer is full, the program starts to overwrite the oldest data, so that the most recently captured information is always available in the memory buffer.

This process of continuously writing in a loop is called a *Circular Buffer*. For that reason it is useful to examine the buffer with this diagram.



If you look at an example of recording a track runner, this will show why triggering performance is so significant. Obviously the race, start to finish is the informational set that you are interested in. Any video data before the start, or after the finish is not of interest, so you have to configure the triggering to capture this event. If you assume that 500 frames are needed to record the event, and that the *max frames*, based on the frame rate and resolution, is 525 frames without proper triggering you may miss important parts of the event.

If you were to trigger off of a microphone input with the sound of the starting gun, the data of concern will all happen post trigger. Therefore, you want to set the Trigger adjust to 0% which will allow for all frames saved to be after the trigger. This will allow for your video to start immediately after the starter gun.

If instead, you want to trigger with the runner crossing the finish line, the data you want is already in the buffer at the time of the trigger, so you want to adjust the trigger to *100%* which will give you all of the information already collected, 100% pre-trigger. If you are to trigger the recording when the runner passes the half way mark, you will then want to trigger at *50%*. If you have extra frames you can adjust all of the above by a few percentage points, to collect a few frames before or after the action of interest. The reporting boxes below will tell you how much time, and how many frames will be collected pre and post trigger.

MiDAS 4.0 will continue recording and collecting video and data into the *Circular Buffer* until it receives a command to stop and save the collected information, or abort the recording.

The Trigger Command and Settings

Triggering, regardless of type, does two things:

1. Signals the camera and any data card, how and when to institute memory buffer saving as you have configured it.

2. Establishes the **reference frame** at the point in time in which the trigger event was received.

Triggering does not necessarily stop a recording immediately. The relationship between the time at which the trigger signal is received and the time at which the recording is stopped is governed by the **Trigger Adjust** setting on the **Record** tab of the control panel. The *Trigger percentage* indicates the pre-trigger portion of the total acquisition, for a given collection of video images or data points. The remainder of information will be collected post-trigger.

For example, a trigger percentage of *0%* instructs the MiDAS 4.0 software to tell the camera to make the current frame, at the time of the trigger,zero and then collect a full buffer of frames and data as configured. A trigger percentage of *100%* instructs MiDAS 4.0 to stop acquisition immediately upon receipt of a trigger input (acquire 100% before the trigger and 0% after the trigger) and make the final frame of the sequence the zero frame, or reference frame.

The *reference frame*, or *zero frame*, is always the frame that is concurrent with when the trigger was received. Within any video, or data sequence, any frames with a negative number occurred before the trigger was received; frames with a positive number occurred following the trigger. It should be noted, however, that the reference *frame* of video and the reference *datum* do not necessarily coincide (see the *Data Buffer Lengths and Triggering* section below for further explanation).

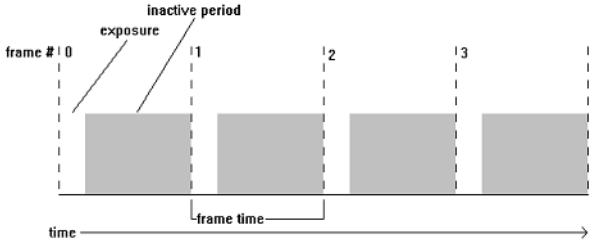
If the trigger % is	**and you have recorded**	**and the event is**	**then MiDAS 4.0 will**
100%	a full buffer	Trigger or Stop	Stop and return a full buffer, as recorded.
100%	a partial buffer	Trigger or Stop	Stop and return only those frames that were recorded.
0%	a full or partial buffer	Trigger	Continue recording one full buffer more, stop and return a full buffer.
0%	a full buffer	Stop	Stop and return a full buffer.
0%	a partial buffer	Stop	Stop and return only those frames that were recorded.
0% < t < 100%	a full buffer	Trigger	Continue to record the proscribed number of post-trigger frames, then stops and returns a full buffer.
0% < t < 100%	a partial buffer	Trigger	Continue to record the prescribed

			number of post-trigger frames, and return the available pre-trigger and the full post-trigger frames.
0% < t < 100%	a full buffer	Stop	Stop and return a full buffer.
0% < t < 100%	a partial buffer	Stop	Stop and return only the frames that were recorded.

Exposure Time and Frame Counting

If you have chosen an exposure time greater than 1.0X ,the camera will not acquire an image during the entire frame duration. Depending on the frame rate you have chosen, there is a fixed length of image acquisition. This period is a simple inverse ratio. If your *frame rate* is 500 frames per second the full exposure time is 1/500th of a second. This is for a full exposure (based on time, not related to any stops you may be using), you can reduce this electronic shutter speeds and decrease the amount of exposure time, for scenes that have a surplus of light. When you utilize a shutter speed in excess of 1.0X, the time that the sensor is gathering light is less than full exposure time. For the above example, if the Frame rate is 500 fps, and the shutter speed is 2.0x the exposure time of the sensor array will be 1/1000 of a second (1000 µsec). The mathematical representation of this is $^{1}/_{(n*\text{Frame Rate})}$ = Exposure Time, where **n** is the selected **Shutter Speed**.

A video frame is defined as the total time between exposures. The following drawing illustrates this relationship:



Depending on your type of camera, the exposure time will either be at the leading edge of the frame, or the trailing edge. Consult your camera manual for information specific to your camera.

This has important implications for recording video. If a trigger pulse is received during the inactive period of a frame, that frame will still be defined as the reference frame and the next frame the first post-trigger image. The result is that the reference

frame will be blank, and the first frame with an image will be frame #1. This is because the electronic shutter was "closed" when the trigger was received, and the acquisition of the image for the next frame had not begun yet.

Triggering vs. Stopping and Aborting Recordings

The normal mode of operation is to instruct MiDAS 4.0 to stop and save a recording when it receives a trigger. You may also force MiDAS 4.0 to stop a recording before receiving a trigger by clicking on the Stop button in the **Record** tab. This immediately stops the recording function, returns all of the frames in the buffer acquired prior to receiving the Stop command, and places the reference frame at the end of the sequence. In other words, the Stop command behaves as if the trigger were set to *100%*, no matter what the actual setting is. Once MiDAS 4.0 has carried out a trigger command or received a stop command, the program automatically switches from Record mode to Play mode.

The Reference Frame and Reference Data Point

MiDAS 4.0 places the reference frame and video/data per the following rules:

If...	**MiDAS 4.0 returns...**	**The reference frame is...**
the buffer has been filled prior to Trigger,	a full buffer of video/data.	the frame during which the trigger was received.
the buffer has been filled prior to Stop,	a full buffer of video/data.	the last frame recorded.
the buffer has not been filled prior to Trigger,	all frames acquired prior to trigger and the desired number of post-trigger frames.	the frame during which the trigger was received.
the buffer has not been filled prior to Stop,	all frames acquired prior to **Stop**.	the last frame recorded.
the buffer has not been filled, Trigger has been executed, and then Stop executed,	all frames acquired prior to **Stop**. No frames	the frame during which the trigger was received.

Note: Some cameras do not add a frame after receiving an external trigger. That is, if the trigger is set to 100% and an external event trigger is received in the middle of a video frame, the camera immediately stops and returns all the frames prior to the

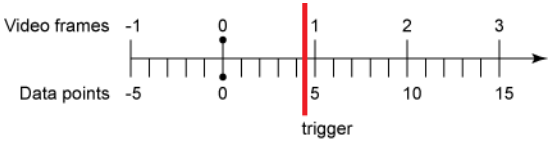
trigger frame. In this case, there is no reference frame, and the last frame is frame number -1. Most cameras continue recording for one or two frames after receipt of an external trigger ensure that the trigger frame is captured.

Data Buffer Lengths and Triggering

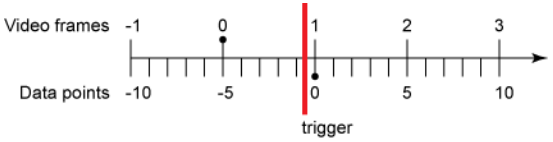
MiDAS 4.0 handles both video and data. Often data is collected at a much higher rates than video. MiDAS 4.0 simplifies the integration of your video and data by controlling the different rates of video and data capture through hardware management.

The number of data points per frame of video is referred to as the *samples per frame* or *sample rate*. Part of configuring MiDAS 4.0 for recording is selecting the *samples per frame*, which, along with the amount of video frames to acquire and the trigger location, will determine the number of data samples that will be acquired.

When your **Trigger Percentage** is less than *100%* and more than *0%*, and the points per frame are greater than 1, the point of reference for your *0* data needs to be determined. When you have just completed a recording, you will switch to the Play mode. The default will be Video Centric mode. In this mode, the *0* data point will be referenced to the time of the *0* video frame. The *0* video frame is the video frame during which the trigger occurred.

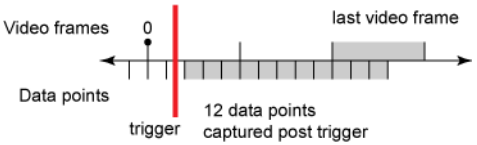


You may then choose to switch to **Data Centric** mode. In **Data Centric** mode, the *0* data point is the data point that occurs immediately following the trigger. This may or may not correspond to the *0* Video frame. The *0* video frame will continue to be the video following during which the trigger occurred. In a data-only project, the *0* data point is always that data point, immediately following the trigger.

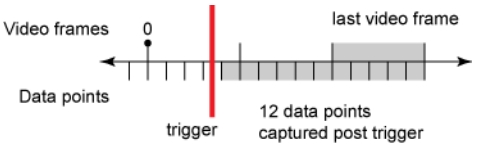


It is important to note that the number of data points captured post trigger is calculated independent of the amount of video frames captured post trigger. Consider a video consisting of 6 video frames, with 5 data points per frame, and a trigger percentage of 40% post trigger.

If the trigger is received between the second and third data point of the 0 video frame, we will have 12 post trigger data points. The final video frame has only four corresponding data points, even though we were acquiring 5 data points per frame.



If the trigger is received between the fourth and fifth data point of the 0 video frame, we will still have 12 post trigger data points. However, the final video frame will have 5 data points.



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Chapter

9

Saving and Loading

Chapter 9. Saving and Loading

The term *video* in this section is interchangeably defined as either 1. a single video file that contains a series of frames, or 2. a sequence of individual still image files, each sequentially numbered for playback in the correct order. The most common video format is `.avi`. The most common formats for image sequences are `.bmp` and `.tif`.

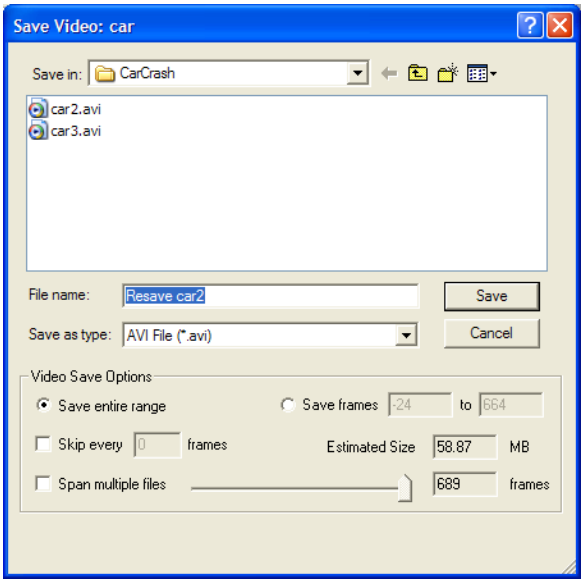
The nature of saving multiple related files with associated data, frame annotations and other information, can be complex. MiDAS 4.0 simplifies many of these issues and offers a variety of ways of saving files to assist in your organization, depending on what file(s) you want to save, and how you want to save them. When saving, you can limit the range of frames to reduce the file size, and limit it to the area of interest. You can also save videos in different file formats.

It is important to understand what you want to save. In this section we will explain the different saving procedures. When saving any video or data file, MiDAS 4.0 will automatically recognize the type of file you are trying to save, and present the appropriate **Save As** window. If you have multiple files, MiDAS 4.0 will recognize this as well and present you with the **Synchronized Save window**.

Saving Video Files

Video files and data files may be saved independently. To save a video file without synchronized data, make sure that the file you want to save is in the active window, then continue with the following procedure:

1. From the File menu, choose Save Video/Data File As.... A dialog box will appear.



2. Next to File name: type a name for the file.

3. Under Save as type: select the desired file format from the drop-down menu.

AVI File — (`*.avi`) will save the file as a standard AVI. If you select this option you will be asked to choose from a selection of codec options, including no compression, after you click save.

Bitmap Sequence — (`*.bmp`) will save the video as a sequence of bitmap images. As with all image sequences, it's important to choose an easily identifiable filename, as saving a sequence will create a large number of files, each with an incrementing number on the end, representing frame number.

JPEG Sequence — (`*.jpg`) will save the video as a sequence of files compressed in the `*.jpg` format. If you choose this option, a separate dialog box will come up to allow you to choose the compression level for each image. As with all image sequences, it's important to choose an easily identifiable filename, as saving a sequence will create a large number of files, each with an incrementing number on the end, representing frame number.

TIFF Sequence — (`*.tif`) will save the video as a sequence of files compressed in the `*.tif` format. As with all image

sequences, it's important to choose an easily identifiable filename, as saving a sequence will create a large number of files, each with an incrementing number on the end, representing frame number.

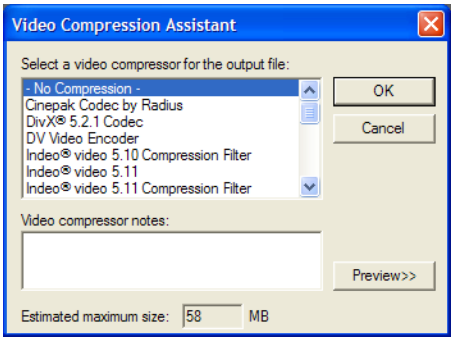
4. There are a variety of saving options that will allow you to modify the range of frames you will save.

Save entire range	This will save all frames in the video.
Skip every X frames	This will allow you to drop a number of frames equal to the integer you put in the frames box. For instance, if you place 2 in the field it will drop two frames, save a frame, then drop two frames, and save a frame again. It will continue through the video in this fashion until complete.
Span multiple files	Select the check box to enable this function. Use the slider or type an integer value in the text field to set the frame length of each file. Saving with this option will divide your video into multiple files with the frame length that you specified. The files will load and play seamlessly as though they were one video. Although you can enable this option for saving still image sequences, it will have no effect.
Save frames	This will allow you to choose a range of frames. The range will be limited to a start and end frame number that you specify.
Estimated size	This displays the estimated size of the video file based on the settings you have set.

Video Compression

If you have selected to save a video as an `.avi` file, MiDAS 4.0 will open the Video Compression Assistant window. The various codecs listed in this dialog box are provided by your operating system.

It is recommended that you save using the -No Compression- option. When video compression is utilized, video information can be lost, and artifacts can be introduced. MiDAS 4.0 provides these alternatives for your convenience when storage space is limited. Using compression on videos that will be analyzed in the future is not recommended.

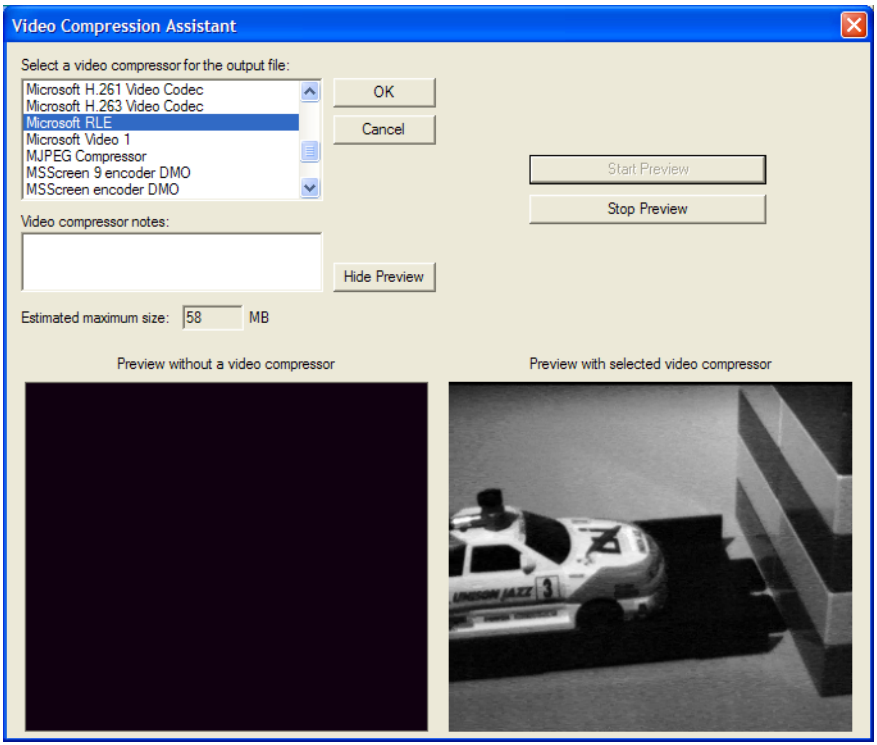


To use video compression:

1. In the upper scroll pane, select one of the video compression codecs listed. In the lower pane, notes about the function of the chosen codec are displayed.

   Note: The displayed list of codecs is derived from those codecs installed in your operating system.

2. If you wish, you can preview that results of applying a codec on the saved file. Click on the Preview button, and the window will expand to show two preview windows and Start Preview and Stop Preview buttons. The uncompressed and compressed videos will play concurrently.



3. Click on the Start Preview button to start the video comparison preview. Click on Stop Preview to stop it.

4. Press OK when you are ready to save the video.

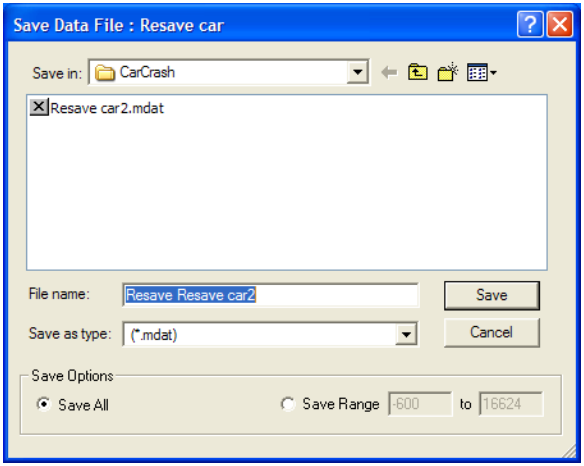
Saving a Sequence of Image Files

It is possible to save a video as a sequence of still image files. This will create a large number of files, one for each frame. Organization of these files is important. When saving as a sequence MiDAS 4.0 will take your filename and append an underscore _, followed by a number. The number is incremented for each consecutive frame. MiDAS 4.0 will not allow you to overwrite previously saved files. It is recommended that you create separate directories for each image sequence. This will help in organization of the file sequences.

Saving Data Files

Video files and data files may be saved independently. To save a data file without synchronized video, make sure that the file you want to save is in the active window, then continue with the following procedure:

1. From the File menu, choose Save Video/Data File as.... A dialog box will appear.



2. Next to File name: type a name for the file.

3. Under Save as type: select `*.mdat` format. This is the MiDAS 4.0 data format.

4. You may modify the range of data points you will save.

Save entire range	This will save all data points.
Save range	This will allow you to choose a range of data points to save.

Saving Synchronized Video and Data

If your project contains video and data files with similar file names, the **Synchronized Save List** dialog box will appear when you choose Save Video/Data File As... from the File menu.

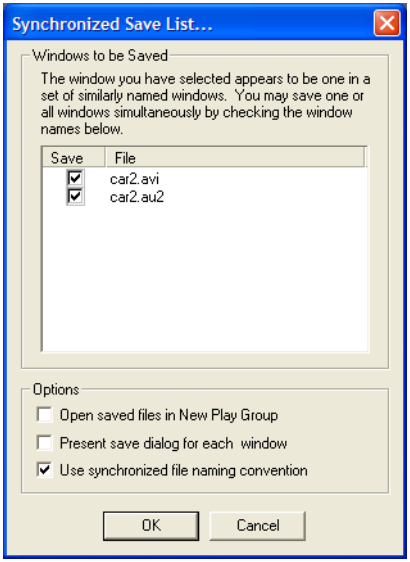
1. In the upper portion of the window will be a list of files that MiDAS 4.0 believes are related. You can select which files you want to be synchronized by leaving the checkbox on the left selected. If you do not want a file to be included in the synchronization, just de-select the check box.

2. Open saved files in New Play Group will automatically create a play group file containing all of the synchronized files, and open the videos in a new play group window.

3. Present Save dialog for each window will prompt a separate saving dialog box for

each file to be saved, allowing you to modify the save options.

4. If Use synchronized file naming convention is selected, MiDAS 4.0 will append an incrementing label at the end of the file name: {D1}, {D2}, {D3} for data, and {V1}, {V2}, {V3} for Video. This option is enabled by default.



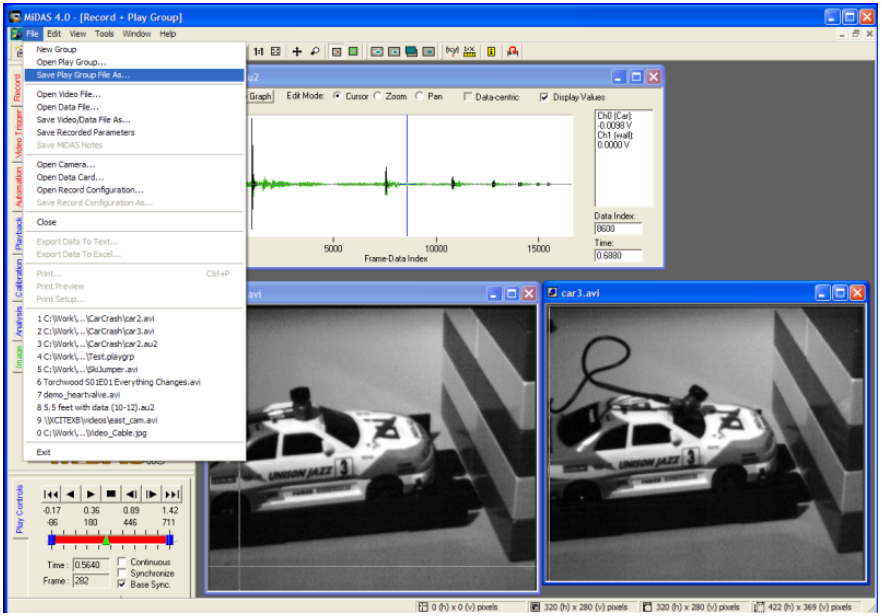
Play Group Files

Play Group files (`*.playgrp`) contain a user-defined collection of video and/or data files that are used in conjunction with each other. The MiDAS 4.0 Play Group system allows the user to group these files together, and simplifies the opening of multiple related files for analysis.

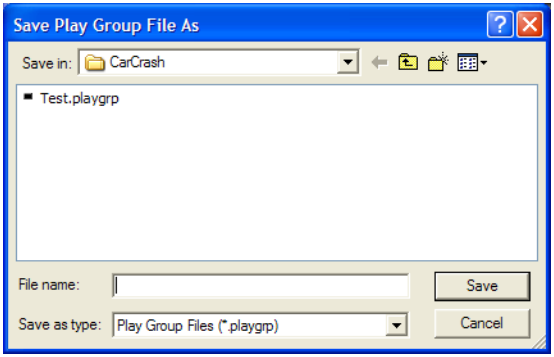
Saving Play Group Files

To save a play group, you must first open all of the various files that you want to include in the play group. These can be any combination of video and/or data files. Once you have opened those files, and you have assembled the play group as you wish, you can save them as a play group. It is important to note that the play group file does not include the actual video and data information. It is a list of references to the location of the video and data files. The file references are relative to the directory in which the play group file is saved. These play group files can be updated using any text editor. It is recommended that you save the play group file in the same directory as the video and data files. If the contents of the play group are saved in a network directory, the play group file must be saved in the same network location, not on your local machine.

1. Open the video and data files you want to save in your play group. From the File menu, select Save Play Group File As...



2. A Save Play Group File As dialog box will open. Select the desired file location, enter a file name, and click Save.



MiDAS File Formats

MiDAS 4.0 saves information in a variety of file formats. It is important to know these formats to keep them intact as a group when transferring files. It is best to keep all associated files within the same directory. In addition, MiDAS 4.0 is backwards compatable with the previous versions of MiDAS file formats. Below is a list of current and legacy MiDAS file formats.

AVI Standard Microsoft Windows Video format. MiDAS can save video into the `.avi` file format, and play `.avi` formats, as long as the proper codec is loaded on your computer.

BMP Standard bitmap image file format. MiDAS can save video as a series of sequential `.bmp` images.

TIF Standard tag image file format. MiDAS can save video as a series of sequential `.tiff` images.

JPG Standard jpeg compressed image file format. MiDAS can save video as a series of sequential `.jpg` images.

MDAT MiDAS 4.0 data file. Tab-delimited text files that contain all the information from data collection.

PLYGRP MiDAS 4.0 play group file. This is where MiDAS 4.0 stores the locations of the various files that make up a play group.

CAM MiDAS camera file for the Lens Calculator. This file contains the information about each camera (resolution, frame rates, etc.) for each camera. CAM files are editable in a text editor.

NTV MiDAS 4.0 Notes storage file. This is where the MiDAS notes for a video is stored. The `.ntv` file will be stored in the same directory, with the same name as the file that it references.

XLS Standard Microsoft Excel file format, MiDAS 4.0 analysis data can be saved in this format.

CFG MiDAS configuration file. Contains all the configuration information about your video or data files, This is where MiDAS 4.0 stores the frame rate, shutter speed, etc. of the original recording.

CLR MiDAS color balancing file. Contains the Bayer decoding coefficients for color files, plus any color temperature settings and gray balance settings.

LUT MiDAS image processing look-up table values. Contains settings for modifying an image using MiDAS image processing tools.

AU1 Reserved for MiDAS-LC data files

AU2 MiDAS 2.0 and previous data files. Tab-delimited text files that contain all the information from data collection.

AU3 MiDAS Professional binary file. This file stores a variety of information including MiDAS Notes, Tracked points withing a video, and other similar forms of information.

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Chapter

10

Playing Projects

Chapter 10. Playing Projects

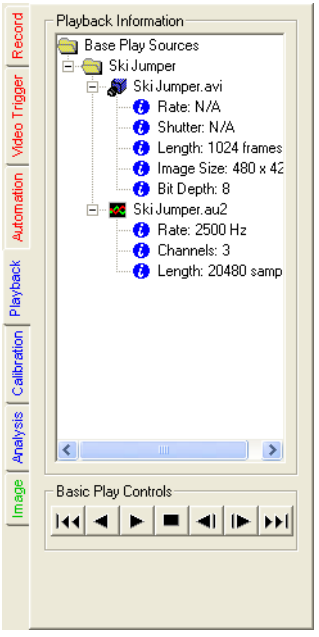
Viewing Recordings in MiDAS 4.0

Once you have successfully made a recording, MiDAS 4.0 switches into Play mode. In Play mode, the controls associated with recording, both on the control panel and the project toolbar, are replaced by controls for viewing, calibrating and processing recorded video and data. In this chapter we will address the basic controls for reviewing video in MiDAS 4.0. For more advanced settings and for information on reviewing synchronized video and data, please refer to Chapter 7, *Data Acquisition Theory*.

Opening Files for Review

If you have not just completed a recording or are opening a video file in a new instance of MiDAS 4.0, begin by opening a new Play project, either by selecting New Group in the File menu or by clicking on the New Play Project button on the toolbar. Then choose Open Video File..., Open Data File..., or Open Play Group... in the File menu. You may also click on the Open File button on the toolbar.

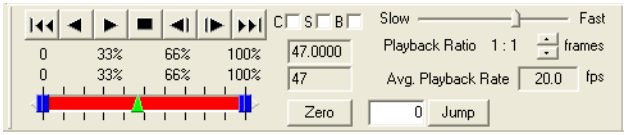
When MiDAS 4.0 is in Play mode, the control panel displays a Playback tab. The Playback tab lists the open video and/or data files. It also lists recording information for each file, such as rate, shutter speed, and size.



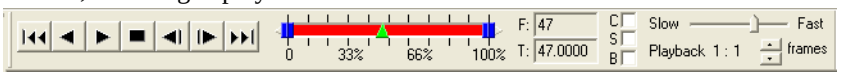
The Play Controls

There are four types of Play Controls to let you modify your workspace to your preference. You can switch between the four panels by clicking on the Play Controls icon on the toolbar .

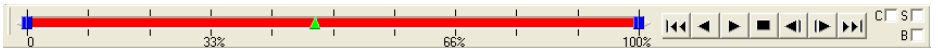
1. Standard play bar.



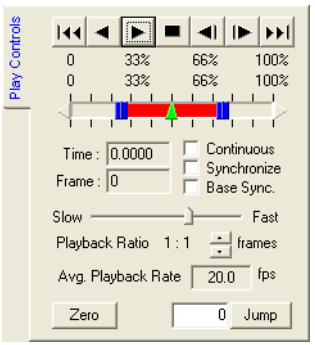
2. Thin, or abridged play bar.



3. Long Play Bar used for greater slider resolution.



4. Play Control panel, docked under the control panel.



Basic Playback

Jump to first frame

Play backward

Play forward

Stop

Step back one frame

Step forward one frame

 Jump to last frame

Setting the Current Frame, Active Range and Zero Frame

Directly beneath the playback buttons is a slider representing the range of the video sequence. The green triangle indicates the current position, while the red area of the slider indicates the active range of the sequence.

The slide bar allows you to quickly move to a specific part of the video. To advance the video to a desired frame, click and drag the green triangle or single-click anywhere within the active range (red region).

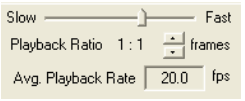
The blue rectangles at either end of the slider allow you to set the active range of the video. Click and drag the blue rectangles to mark the beginning and end of the playback range. Moving the blue rectangles does not crop the video permanently. Double-clicking anywhere on the slider will expand the active range to span the entire video.

The frame number and time of the current frame relative to the zero point are displayed next to the playback slider. Click the Zero button to set the current video frame and its corresponding data point as the zero reference. Video frames and data points prior to the zero reference will numbered with negative values. Video frames and data points after the zero reference will be numbered with positive values.

The Jump button allows you to enter a frame number and immediately jump to that frame. If the frame number you enter is outside of the active range, MiDAS will jump to the nearest frame.

Setting the Playback Rate

Set the playback rate by clicking and dragging the slider post towards the right or left. The actual playback rate is determined by many factors, including the number of synchornized videos, the video RAM, and the speed of the computer processor. The average playback rate may displayed below the playback rate slider in frames per second (fps).



The playback ratio setting allows you to select the ratio of frames displayed to actual frames. The default setting is 1:1, which plays all frames. A ratio of 1:*n*, where *n* is an integer greater than 1, plays every *n* frames and increases the playback rate. Adjust the value of n by clicking on the up and down arrow buttons.

Continuous and Synchronized Playback

The **C** checkbox selects a continuous playback mode. When this option is selected, the video will play in a loop, going back to the beginning of the video when it reaches the last frame.

The **S** checkbox selects synchronized playback. This option allows for the synchronization of the playback of multiple video files. When synchonized, two or more videos and data sets will play at the same frame rate.

To enable synchronized playback, do the following:

1. Position each video at the desired initial frame for synchronized playback.
2. Select the **S** checkbox in the play control panel for each video. This sets the starting position to the current frame for each video.
3. Press the **Play** button in any one of the synchronized video display windows, and all the synchronized windows will play simultaneously.

To remove a video from synchronization:

1. Stop the playback and click in the video window that you would like to remove from synchronization.
2. De-select the "S" checkbox in the play control panel.
3. Resume playback.

The **B** checkbox (base synchronization) will be automatically checked when opening a play group that utilizes it. Base Synchronization is the inherent synchronization of a video and data set that was recorded together originally. It is normal to keep this synchronization in place during playback.

Chapter

11

Scene Calibration

Chapter 11. Scene Calibration

Overview

In order to correlate a video image with real-world measurements, we must first calibrate the image.

Calibrating an image:

- converts video pixel values to real-world dimensions (e.g. inches, meters, etc.),
- rotates the image to compensate for any unwanted tilt introduced during recording
- establishes an origin (0,0) and X,Y coordinate system for motion analysis (direction of motion).

In order to calibrate an image, MiDAS 4.0 needs measurement information about some feature in the image. We suggest that you include a horizontal ruler in the picture or some equivalent frame of reference that has both a well-defined scale and known rotational orientation. After an image is calibrated, you can change the units of measure at any time.

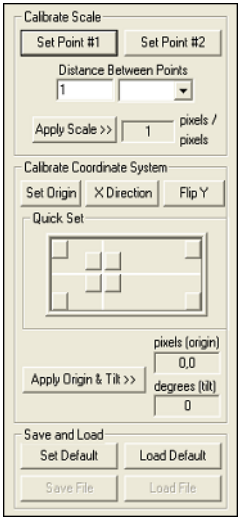
Image calibration is controlled by the settings on the Calibration tab in the control panel.

Calibrating the Scale

In order to set the calibration scale:

1. Within the video image, find a known reference object. Left-click on one end of the object, using the reticle as a guide.
2. In the Calibration tab, click on Set Point #1.
3. Within the video image, left-click on the other end of the object.
4. In the Calibration tab, click on Set Point #2.
5. Type the distance between the points and choose the unit of measure from the drop-down menu.
6. Click on the Apply Scale >> button to set the scale factor.

7. The calibration will apply to the recorded image, until either the recording is closed, or the calibration settings are saved or loaded.

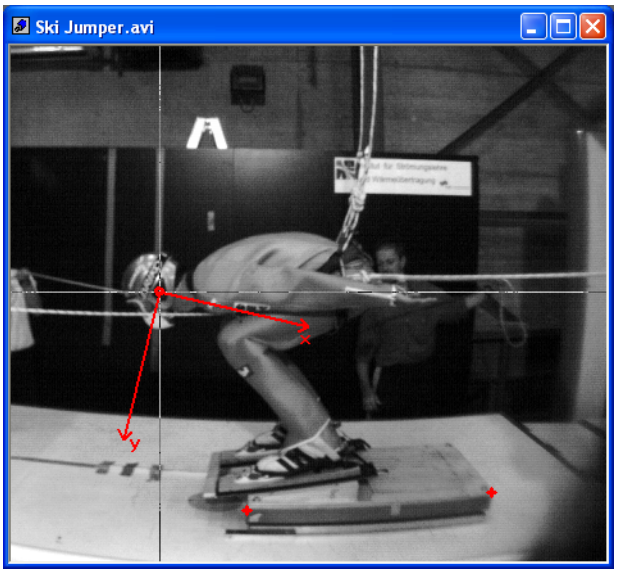


Calibrating the Coordinate System

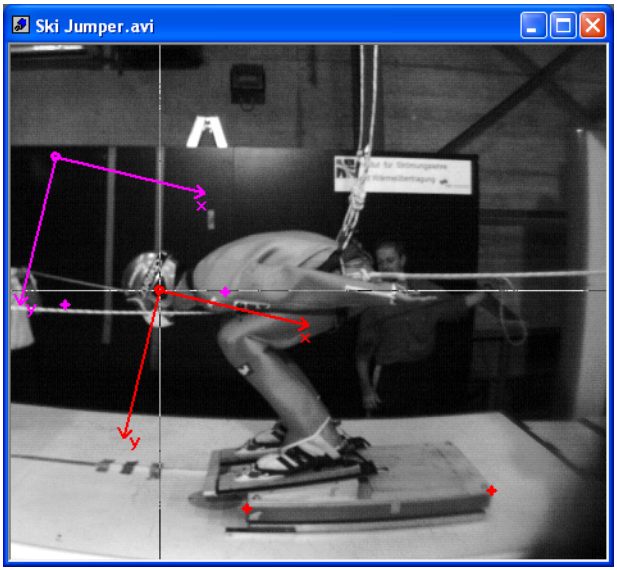
The coordinate system is defined to include the origin (0,0 point) and the X and Y axes. The coordinate system is used in the motion analysis of video.

To calibrate the origin and axes of the coordinate system:

1. Choose a point in the image that will serve as the origin of your coordinate system. Left-click on that point, using the reticle as a guide. On the Calibration tab, click on Set Origin. The coordinate system marker moves such that its 0,0 position is on the selected point.



If View Calibration is selected in the contextual menu, the previous marker position is shown in purple, and the current marker position is shown in red.



2. Left-click on the image at a point along the positive X-axis direction. The coordinate X,Y markers will rotate to align the X direction with the new reticle position.

3. In the Calibration tab, click on the X Direction button.

4. In the image, the coordinate markers will automatically rotate to align the X axis

between the origin and the current point.

5. A default Y-axis will also be drawn at a 90-degree angle to the X-axis. To flip the Y axis (e.g. reverse the positive Y direction), click on the Flip Y button in the Calibration tab.

6. Click on the Apply Origin & Tilt >> button to set the calibration. The origin location and the tilt angle are shown in the text boxes on the Calibration tab.

Saving and Loading Calibration Settings

This feature is not currently available in MiDAS 4.0.

Displaying Calibration

The calibration markings can be toggled on and off at any time - for example, during image processing, during analysis or during normal viewing. Right-click in the video in which you want to turn calibration on or off and Analysis > View Calibration from the contextual menu. If calibration markings are still visible after you have deselected View Calibration, switch to a tab other than Calibration in the Control Panel.

Chapter

12

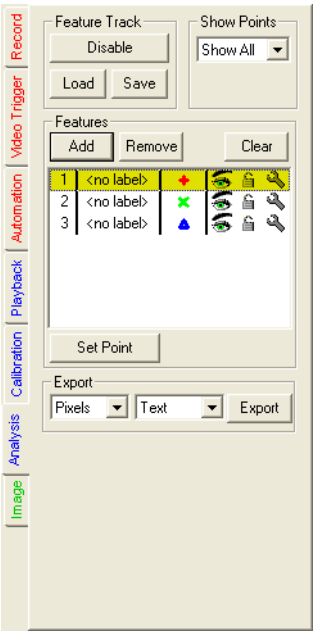
Video Analysis

Chapter 12. Video Analysis

Feature Tracking

MiDS 4.0 allows for the manual tracking of features. This gives the user the ability to select a distinct feature and determine its frame by frame motion characteristics like position and velocity over time, with respect to the plane of the image. Manual tracking requires the user to step through the video one frame at a time, using the muse and reticle to select the location of the feature in each frame.

MiDAS 4.0 can have a maximum of 64 features defined for tracking. A feature as described as the time series of a point of interest in the video. A feature is made up of individual points, one per each frame of video. Each point is defined by the user.

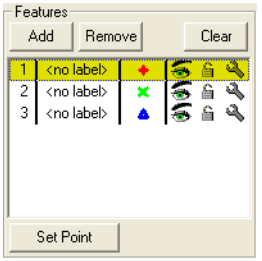


Enable/Disable	This enables and disables feature tracking.
Load	If you have done a previous feature tracking on a video, you can save and apply it to a video later. Tracking information is saved separately from the video. Feature track files have the `.ftk` file extension.
Save	You can save your feature track analysis and configuration to a file for application

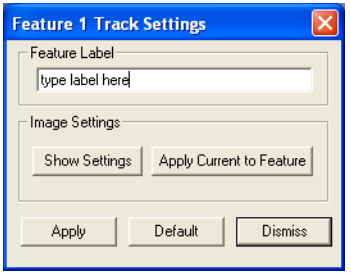
	to the video file in the future. All feature track files have the `.ftk` file extension.
Show points	This drop down menu allows you to manage which tracking points will be shown on the current frame. This will help you to clear the screen while selecting points. The choices here are applied to all features. The choices are: Show All - shows all tracking points ; Show Past - shows tracking points for all previous frames ; Show Current - shots tracking points in the current frame only ; Show None - hides all tracking points.
Add	Click this button to add a feature to the set.
Remove	Removes a feature and its associated tracking points. Select the feature in the list of features below the remove buttons, then click the Remove button.
Clear	Click this button to clear all tracking points associated with the selected feature.
Set point	Once you have selected a point, slick the select point button. This will commit the point to tracking. Once you have selected a point for each feature in a frame, the video will advance one frame. You can also perform "Set Point" by using **CTRL + right-click**.
Export	Once you have completed your tracking you can export the data to a text or Excel file. You can choose your desired unit of measure from the drop-down menu; pixels are the default. If you have calibrated your video, you can export in engineering units. Select the data file format from the second drop-down menu. The choices are: Text - comma delimited `.txt` file with header information ; Excel Blank - Excel spreadsheet with no formatting ; Excel Formatted - Excel spreadsheet with a pre-configured template. Once you have configured your export parameters, click the Export button. If you

	are using text format or blank Excel format you will be prompted to save the file, once you click save the file will open in the associated program. If you are using Export with an Excel Format, you will be prompted to choose the Excel template.

You can choose to track up to 64 Features, and you can configure them individually to keep them organized.



Each feature is numbered as it is added. **Double-click** on the Feature Label field to open the Track Settings dialog box and change the label. If you have not set the Feature Label previously, <no label> is displayed in this field.



You can also modify the point marker. **Double-click** on the point to modify its style, color, pen width, and size. The Marker Editor dialog box allows you to choose from 4 different marker styles: cross, X, triangle, and square. You can select a color from the Windows color palette. In addition, you can choose the pen width (stroke boldness) and size of the marker. The preview pane at the bottom will display your marker as you have configured it.

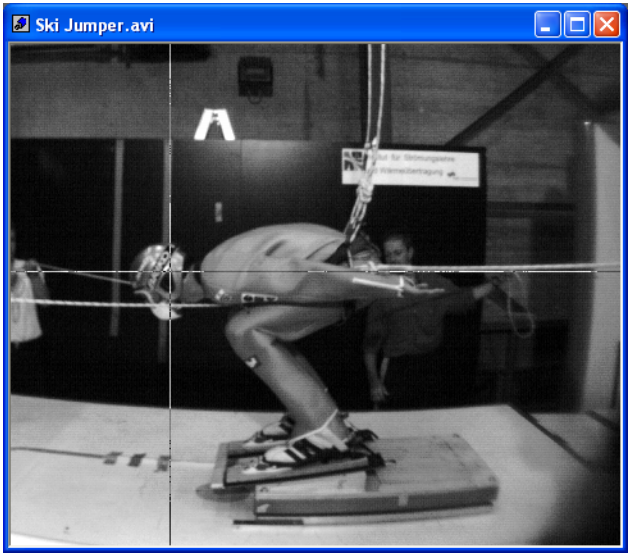
Next to each feature on the Analysis tab are three icons, an **eye**, a **lock**, and a **wrench**. The **Eye** will enable or disable visibility of tracking points. The **lock** will disable the addition of marked points. The **wrench** will open up the Track Settings dialog box.

Tracking

Once you have configured the features you wish to track, you can start to manually track these features. In your video, locate the frame where you want to start your tracking. Tracking will start with the feature highlighted in the Features pane of the Analysis tab; make sure you select the feature you wish to start with.

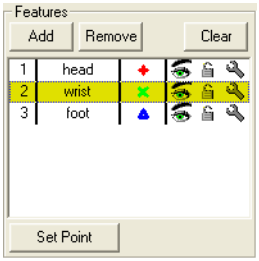
Tracking

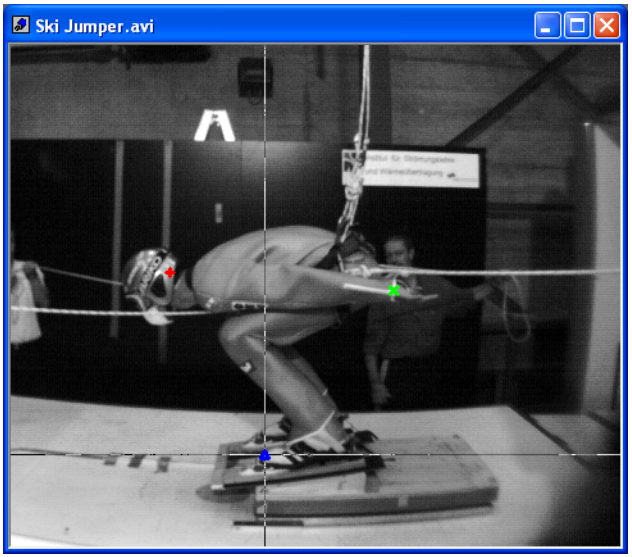
1. **Left-click** on the image at the location of the feature you wish to track. The reticle wll snap to this location.



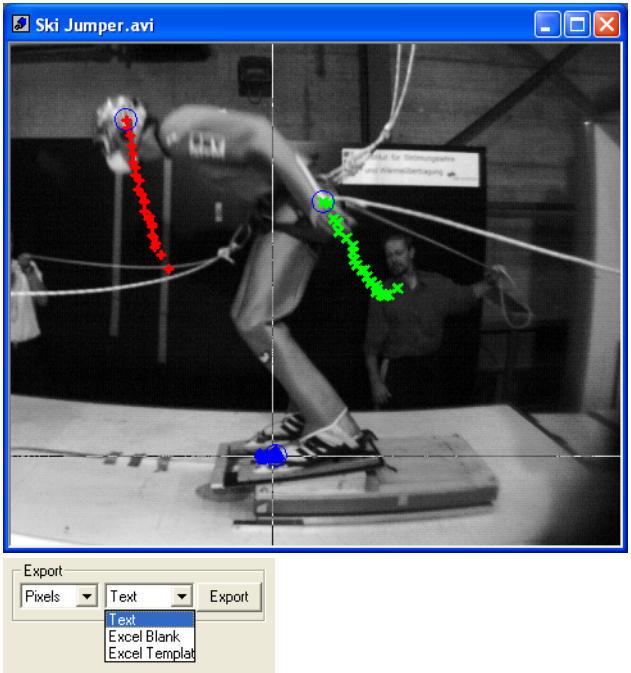
2. Click the Set Point button in the Analysis tab of the control panel. This will draw a point marker on the image frame. The Features pane of the Analysis tab will advance to the next feature in the list. Repeat this process for each feature. Once you have marked one location point for each feature in the list, the video will

advance one frame.





3. After you have tracked all of the features through the period of interest, you will have full set of tracking points, as illustrated below. You can then save these points to a MiDAS 4.0 `.ftk` file or export them to a text or Excel file using the Export tool.


Ski Jumper.avi
Export
Pixels
Text
Export
Text
Excel Blank
Excel Templat

Chapter

13

Caliper Tool

Chapter 13. Caliper Tool

Overview

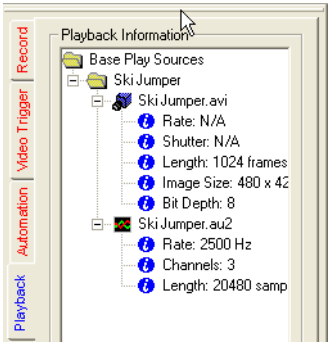
MiDAS 4.0 allows the user to make measurements directly within a video using the Caliper feature. The Caliper tool allow you to measure length, distance, and velocity. These measurements may be calibrated to real-world units using the Add Scale Calibration button on the toolbar.

Calibrating the Scale

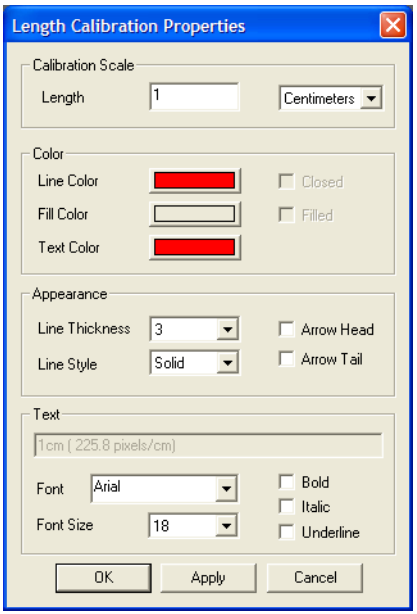
Calibrating the scale will allow you to measure distance and velocity in real-world units such as meters and inches. You may calibrate the scale before or after using the caliper tool. If you choose not to calibrate the scale in your image, the default measurement units will be pixels and pixels/sec.

1. Click on the Add Scale Calibration button on the toolbar.

2. Click and drag on the image to draw a calibration line. The calibration line should span an object or feature of known length.



3. The Length Calibration Properties dialog box will appear. Enter the real-world length of the calibration line you drew. Click OK. The scale length will be displayed on your image.



4. In the Length Calibration Properties dialog box, you can also adjust settings for the appearance of the calibration line, including colors, line thickness, and font.

Using Calipers to Measure Length

1. Click on the Add Measurement Point button (xy) on the toolbar.

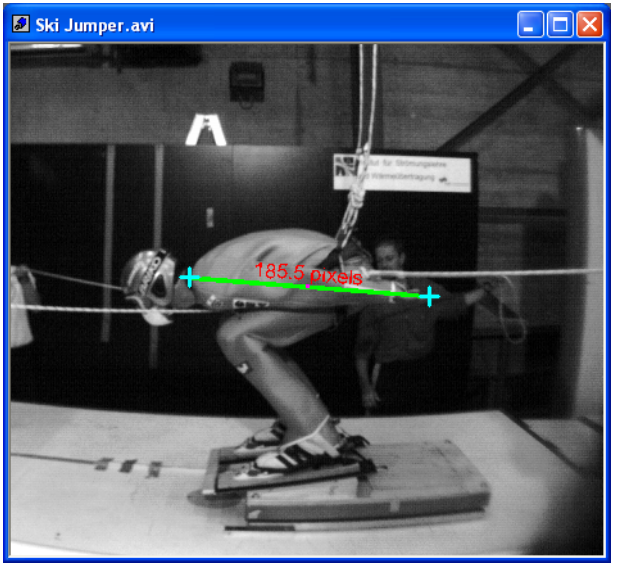
2. In the image, click on the beginning point of the length you want to measure. A blue cross + will mark this point.

3. Click on the Add Measurement Point button (xy) again.

4. In the image, click on ending point of the length you want to measure. A second blue cross + will mark this point.

5. Place your mouse cursor over the first measurement point that you added. The blue cross will turn red. Next to the cross, the (x, y) coordinates of the point and a measurement icon will appear.

6. **Left-click** on the measurement icon and **drag** towards the second measurement point that you added in Step 4. A line will be drawn between the two measurement points. The distance between the two points will be noted alongside the line.

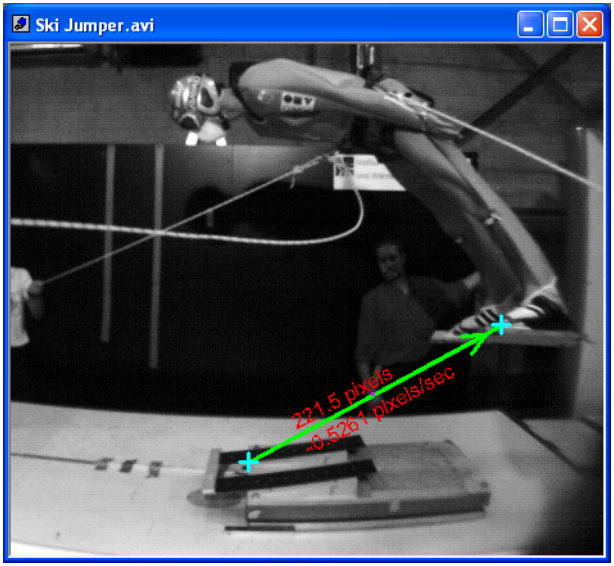


7. If necessary, **left-click** and **drag** either of the blue measurement points to adjust the caliper. The length annotation will update accordingly.

Using Calipers to Measure Distance and Velocity

1. Click on the Add Measurement Point button on the toolbar.
2. Click on an object or feature in the image that you want to track. A blue cross will mark this point .
3. Use the Play Controls to advance forward or backward to another frame in the video. The object or feature that you want to track should have moved.
4. Click on the Add Measurement Point button again.
5. Click on the object/feature location in the current frame. A second blue cross will mark this point .
6. Place your mouse cursor over the first measurement point that you added. The blue cross will turn red. Next to the cross, the (x, y) coordinates of the point, frame number, and a measurement icon will appear.
7. **Left-click** on the measurement icon and **drag** towards the second measurement

point that you added in Step 4. A line will be drawn between the two measurement points. The velocity of the point and the distance it moved will be noted alongside the line.



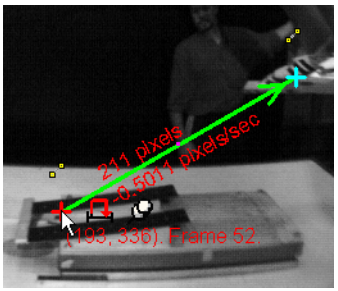
8. If necessary, **left-click** and **drag** either of the blue measurement points to adjust the caliper. The velocity and distance annotations will update accordingly.

Moving a Measurement Point in the Current Frame

1. **Left-click** and **drag** the measurement point to adjust its location. The velocity and distance annotations will update accordingly. If you are unable to move the measurement point, the measurement point is in a different video frame.

Moving a Measurement Point in Another Frame

1. Place your mouse cursor over the measurement point. The blue cross will turn red. **Click** on the Go to Frame icon that appears to the right of the red cross. The video will jump the the frame in which the measurement point is located.

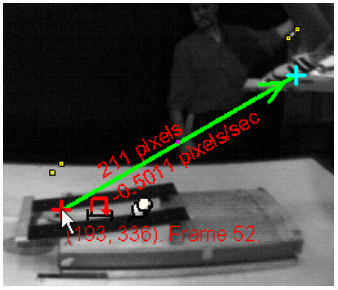


2. **Left-click** and **drag** the measurement point to adjust its location. The velocity and distance annotations will update accordingly.

Moving a Measurement Point from One Frame to Another

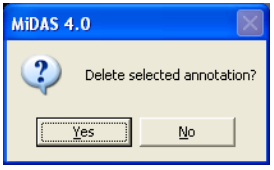
1. To move a measurement point from another video frame to the current frame, place your mouse cursor over the measurement point. The blue cross will turn red. Click on the Move Point icon that appears to the right of the red cross.

   The measurement point will be moved to the current frame. If the Move Point icon does not appear, the measurement point is already in the current frame.



Deleting Calipers

To delete a measurement point, **left click** on the measurement point and press the **Delete** key on the keyboard. A dialog window will appear asking you to confirm the deletion. Click Yes.



Repeat these steps for each measurement point that you would like to delete. The process is the same for deleting measurement lines and calibration lines. There is no Undo function.

Chapter

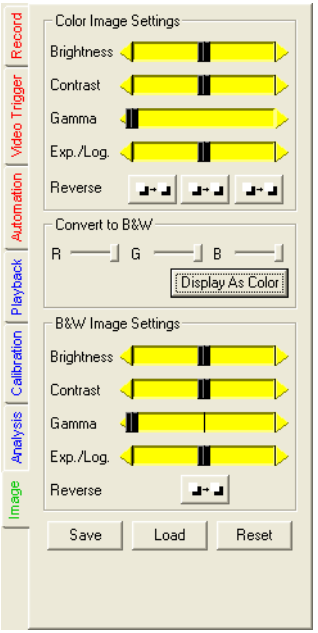
14

Image Processing

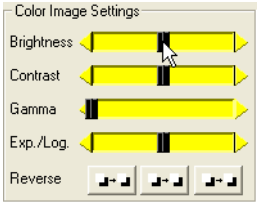
Chapter 14. Image Processing

Image Settings

MiDAS 4.0 includes a standard set of controls for modifying image properties sugh as brightness, contrast, and gamma correction. In the Image Processing tab of the Control Panel, you can adjust these parameters, save the settings, and load previously saved settings. The main purpose of image processing is to optimize the image for analysis.



There are two sets of identical sliders, one for color images, above, and one for monochrome (black and white) images below. For color images, the red, green and blue channels are modified as a group by default and controlled by a single slide control. To modify the RGB channels separately, **double click** on the slider control.



The slider control will separate into individual red, green, and blue sliders that can be adjusted independently. The slide controls for monochrome images cannot be seaparated into RGB channels. The various image settings are:

Brightness	Adjusts the brightness of the image. Moving the slider to the right will increase brightness by moving pixel intensity values towards white (255). Moving the slider to the left will decrease brightness by moving pixel intensity values towards black (0).
Contrast	Adjusts the contrast of the image. Moving the slider to the right will increase contrast by moving pixel values towards white (255) or black (0). Moving the slider to the left will decrease contrast by moving pixel values towards gray (128).
Gamma Correction	Adjusts the gamma of the image. Adjust the gamma is similar, but not identical, to adjusting the Exp./Log. slider. Moving the slider to the right will increase the brightness of the image.
Exp./Log.	Adjusts the image output using nonlinear functions. Moving the slider to the right uses a logarithmic palette, increasing the contrast in dark regions and decreasing the contrast in light regions. Moving the slider to the left uses an exponential palette, increasing the contrast in light regions and dcreasing the contrast in dark regions.
Reverse	For color images, click on any of the three Reverse buttons to invert the corresponding RGB channel. Red is reversed to Cyan, Green is revered to Magenta, and Blue is reversed to Yellow. For monochrome images, there is a single Reverse button for inverting black and white.
Display as B&W	Converts color images to monochrome images using the conversion factors indicated by the R, G, and B sliders.
Save	Allows you to save image settings into a `*.lut file` (Look Up Table format) for later use.
Load (from File)	Allows you to apply a previously saved `*.lut file` to the current video.
Reset	Sets all adjustments to their default levels.

Reversing Channels

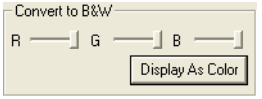
You may convert images between color and monochrome and adjust the individual color channels of the image. Note that all analysis engines use only monochrome representations of images.

To reverse a monochrome image or individual channels of a color image, click on the reverse buttons at the bottom of the color and black and white sections of the panel.

Reverse — Changes the color palette such that whites and blacks are reversed. In addition, for color images, each individual channel of RGB color is reversed. Red is reversed to Cyan, Green is reversed to Magenta and Blue is reversed to Yellow.

Converting between Color and Monochrome

To display a color image as monochrome or to reset a monochrome image to its original color (if recorded in color), the following options are available:



Display B&W / Display As Color — Converts color images to monochrome images using the conversion factors indicated by the R, G, and B sliders. Once a video is converted to black and white, the button will display **Display As Color**, to revert back to an RGB (Red, Green, Blue) image.

R Scale — Amount of red channel to include when converting from color to monochrome.

G Scale — Amount of green channel to include when converting from color to monochrome.

B Scale — Amount of blue channel to include when converting from color to monochrome.

Saving Image Settings

Once you have finalized your Image Settings, you can save them for usage at a later time. You can also apply these saved settings to another video image. For example, you may optimize one image for tracking performance and then apply those same image processing settings to all videos in the same experiment or application. The image adjustment settings are saved in a LUT (Look Up Table) format for later retrieval.

The save/load buttons are found at the bottom of the Image Settings control panel.

Save Save current settings to file. Image processing files have the `*.LUT` file extension.

Load Allows previously stored image settings to be loaded for this video.

Reset Returns all image settings to their default levels.

Advanced Camera Settings

Some cameras have additional settings that will give the user added help in configuring the camera to give the best possible image. These setting will affect the sensor gain, controlling the on-board amplifiers to further increase the brightness of the image. It is important to be careful in these adjustments, as too high of an amplifier gain can result in a saturated image. The advanced settings are:

Binning Binning combines multiple pixels to form one larger pixel. This has two effects: it will increase the brightness of the image, and it will reduce the resolution. However, due to the geometry involved in the binning process, the loss of resolution will be the inverse root of the sensitivity gain. For instance for 2 x 2 binning the gain will be 4x, while the resolution loss will be 1/2. For 3 x 3 binning the gain will be 9x, while the resolution loss will be 1/3. The brightness is gained by capturing the light over a larger area.

Gain The gain setting applies an amplification factor to the camera, boosting the signal and noise levels. Gain is primarily used to compensate for low light or bright light levels. Not all cameras have the same gain scales. Some express gain as a multiplier and others as a dB gain level.

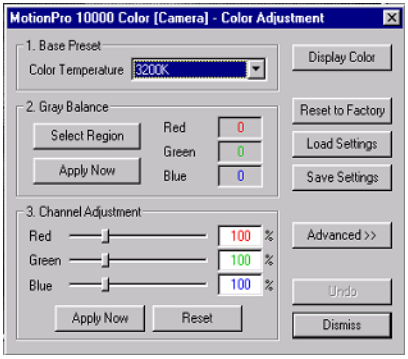
Pixel Gain — This is dynamic range amplification of the digital signal, before post processing. It allows you to amplify the lower *bits*, which allows you to amplify the darker portions of the image, or the higher *bits*, to increase the amplification of the brighter portions of the image.

These functions are camera specific. For more details please consult your camera manual.

Camera Color Adjustment

Some video cameras generate images using the *Bayer format*. To create a color image, a pixel array must use separate sets of pixels, each filtered to different colors, normally Red, Green, and Blue. When using the *Bayer format*, each of these pixels create a gray scale image that corresponds to the intensity of that particular color. To display a color image it then combines these three gray scale images, applying the amount of Red, Green, and Blue based upon the amount of white (with white 255 being full saturation of that particular color) within the corresponding gray scale for that particular color. Put simply, each of three images is converted to a monochrome pattern, which instead of being black and white, becomes Black and one of the primary colors. These are then overlaid on top of each other, the result being a full color image. These Bayer images are converted to color images using a set of nine color coefficients. These color coefficients can be modified to account for color temperature, gray balance, and color balance.

The coefficients for a given camera are set using the Color Adjustment window shown below. This window can be accessed by right-clicking in the live camera display window and selecting Camera Color Adjustment.



The buttons along the right side of the Color Adjustment window dialogue perform the following operations:

Display Color / Display Bayer — This button switches between displaying the images in the raw Bayer format or in normalized color. When displaying in color, the

	update rate of the live window will be slower due to the added computations required for the conversion to a color display. This button will only effect the live window display.
Reset to Factory	This button will reset the camera's stored values, set by the manufacturer.
Load Settings	The **Load Settings** button will allow you to apply a set of previously saved settings. It is important to use settings on only the same camera type.
Save Settings	Once you have made adjustments to the Color that satisfy your needs, you can save these settings to a file. This is useful when you are setting up a new test with similar parameters.
Advanced / Basic	The **Color Adjustment** window has two different modes for the interface, the basic version above, and the advanced version, which allows for direct modification of the nine color coefficients.
Undo	This button will undo any changes you have made since opening the **Color adjustment** dialogue box.
Dismiss	This button will close the window, keeping the adjustments you have made.

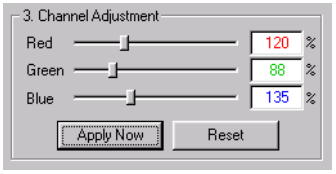
There are three numbered sections along the left side of the window. Applying the setting in this order assists in getting the best color balance.

The first section, **Color Temperature**, allows you to choose from the factory presets, or enter into the Manual Settings that will allow for user adjustments. **Factory Preset** utilizes the pre-loaded settings in the camera; this will give you an excellent starting point for adjustments. Manual Settings are the user configured settings that can be saved and applied at another time. The third selection in the drop down box is for **Daylight**, which uses a different set of color temperature settings for natural light versus artificial light.

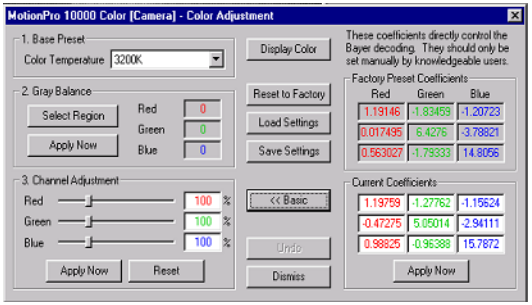
Once you have selected **Manual Settings** or one of the lighting condition pre-sets, you can make a coarse adjustment to the settings by applying the **Gray balance**. Using the **Gray balance** you will select an area of the image in the live window that is close to gray, or should be gray. Click on the Select Region button, then choose the area of gray in the *live image window*. It is important to find an area close to gray, or the balance will be shifted. Once you have chosen the area, you can then click the Apply

Now button. This will set the red/green/blue values to bring the color inside of the box to gray. These values will be applied to the entire image.

If after gray balancing, you wish to make some additional adjustment to the color, you can modify the color balance sliders in the **Channel Adjustment** section. Within the **Channel Adjustment** slider, values of 100% represent the value of red/green/blue as specified in the **Gray Balance** section. In the above figure we show a red value of 52. In Channel Adjustment ,*100%* means that the value used is 52. If the slider is adjusted to *150%* MiDAS 4.0 will use a value of 78. The Sliders will default to *100%* and you can adjust them as desired. If a slider is set to *0%*, this will cancel the adjustments made for that color in **Gray Balance**.



If you wish to perform additional fine adjustments to the color coefficients, you can modify each of the coefficients directly using the advanced version of the color adjustment dialogue. Under the **Color Adjustment** window, select the **Advanced>>** button. The **Advanced** dialog displays the factory preset coefficients, which are in a grayed box and cannot be changed, and the current color coefficients. There are nine total coefficients. The reason that nine coefficients are used is the nature of the Bayer method for color reproduction. In a color pixel array there is not an equal amount of sub-pixels (the individual red, green and blue sensors on the array) for each displayed color pixel. Generally 50% of the sub-pixels are green, 25% are Blue, and the remaining 25% are Red. As a result we need to weight the intensity of each individual sensor to balance the resulting image. Depending on the source of lighting utilized to illuminate an image, that light will have a varying amount of intensity in certain areas of the spectrum. To adjust for these spectral differences, we must vary the influence each of these sensors has on the final image. These coefficients form a 3x3 matrix used in Bayer decoding. The color balance sliders from the third section *Color Adjustment* represent the multipliers for the red, green, and blue components, while the 3X3 matrix of coefficients adjusts how the colors are integrated.



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Persistence of Settings

Appendix A. Persistence of Settings

Persistence of Settings

The guiding principle for changing camera settings is to maintain as many settings a possible and only change those values which must be changed to be compatible with the user-defined setting. MiDAS 4.0 follows these rules when changing camera settings:

If you change...	Then... Frame Rate	Resolution and Active Area	Shutter Speed	Max. Frames
Frame Rate	The frame rate is changed to the new setting.	Resolution is maintained if it is compatible with the new frame rate. If the resolution must change, the center of the active area is maintained unless it reaches the border of the sensor area, in which case it is shifted to remain completely within the sensor area.	The shutter speed multiplier (1x, 2x, etc.) is maintained. If the shutter speed was a custom setting, the custom setting (in Âµsec) is maintained, as long as it is less than 1x at the new frame rate.	If the Max. Frames value is *less than* the total number of available frames at the new frame rate, the Max. Frames value will stay the same. If the Max. Frames value is *greater than* the total number of available frames at the new frame rate, the Max. Frames value will be set to equal the total number of available frames.
Resolution and Active Area	The frame rate does not change. Resolution options are listed in the	The center of the active area will be maintained as the resolution is changed. If the	The shutter speed is not affected by changes in resolution and active area.	If the Max. Frames value is *less than* the total number of available frames at the

	drop-down menu based on the selected frame rate, so it is not possible to select incompatible resolutions.	border of the sensor is reached, the active area is shifted to remain completely within the sensor area.		new resolution, the Max. Frames value will stay the same. If the Max. Frames value is *greater than* the total number of available frames at the new resolution, the Max. Frames value will be set to equal the total number of available frames.
Shutter speed	The frame rate is *not affected* by changes in shutter speed.	The resolution and active area are *not affected* by changes in shutter speed.	Shutter speed is changed to the new setting.	Max. Frames is *not affected* by changes in shutter speed.
Max. frames	The frame rate is *not affected* by changes in max. frames.	The resolution and active area are *not affected* by changes in max. frames.	The shutter speed is *not affected* by changes in shutter speed.	Max. frames is changed to the new setting.

Appendix

B

MiDAS Notes

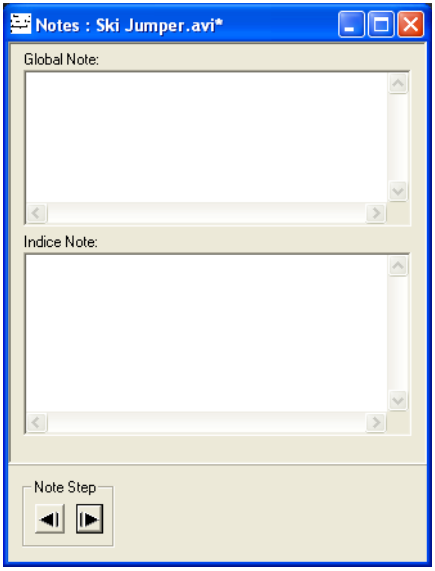
Appendix B. MiDAS Notes

MiDAS Notes allow you to add text notes to your projects. An Indice Note is linked to an individual video frame or data point. A Global Note is linked to an entire video or data sequence.

Creating MiDAS Notes

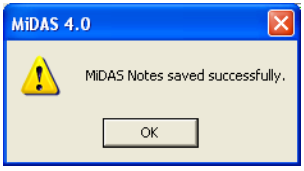
1. Open a video or video/data sequence.

2. Select MiDAS Notes from the Tools menu. The MiDAS Notes window will appear.

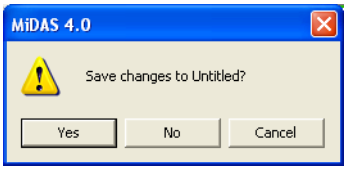


3. Enter notes in the text fields. If you want to add an Indice Note, use the Play Controls to advance to the desired video frame before entering the note.

4. Select Save MiDAS Notes from the File menu. Click OK when the MiDAS Notes saved successfully dialog box appears. If you save an Indice Note, a green square will be added to the bottom right corner of the video frame.



5. If you do not want to save your notes, click the Close Window button on the MiDAS Notes title bar. A dialog box will appear, asking if you would like to save your notes. Click No.



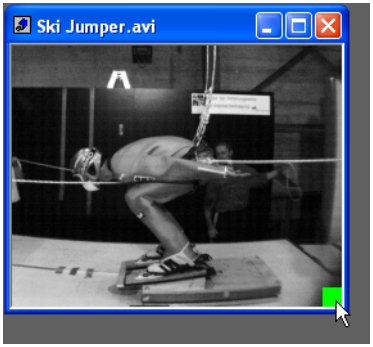
Opening Previously Saved MiDAS Notes

1. Open a video or video/data sequence.

2. Select MiDAS Notes from the Tools menu. The MiDAS Notes window will appear.

3. Use the Note Step buttons to browse through Indice Notes. The video will advance to the corresponding video frame as you browse the Indice Notes.

Alternatively, you may use the Play Controls to find video frames with a green square in the bottom right corner, denoting an Indice Note. Right-click on the green square to open the MiDAS Notes.



Appendix

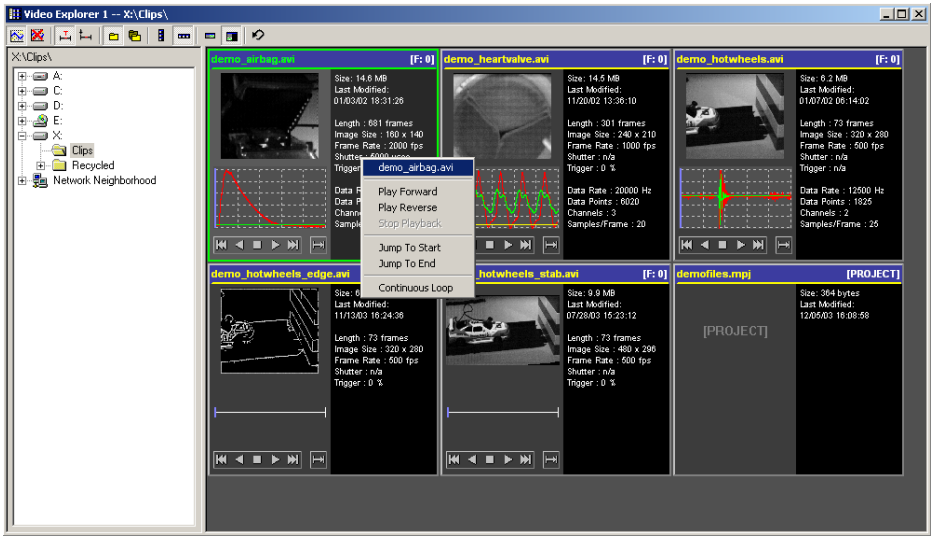
C

Video Explorer

Appendix C. Video Explorer

Overview

The Video Explorer provides a convenient method of previewing and organizing video and data files. The Video Explorer presents a complete Windows Explorer directory panel along the left side of the screen and a thumbnail preview of each video and corresponding data in the main area. The Video Explorer displays all the recognized video files within the currently selected folder. You can also play the video files within the preview pane.



Settings

There are a number of settings that affect how the Video Explorer will appear and search for video files. These are set using the toolbar.

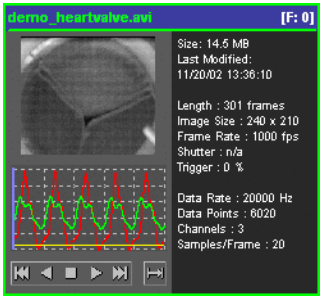
The Video Explorer toolbar consists of the following icons. All icons have *screen tips*.

Show Data	Display Data in the preview pane.
Hide Data	Hide data in the preview pane.
Show Trigger Frame	Utilizes the trigger frame of a video as the preview image.

Show First Frame	Utilizes Frame #1 as the preview image.
Show Videos in Current Directory	This limits the displayed images in the desktop window to those in the selected directory.
Show Videos in Subdirectories	This will display all videos in the currently selected directory, as well as all directories below.
Align Vertical	Aligns video preview panes top to bottom.
Align Horizontal	Aligns video preview panes left to right.
Compact View	Displays only the Video preview with data (if selected).
Normal View	Display video and data (if selected) play controls and video information.
Refresh	the previews of available videos.
Zip Files	Compresses a directory of videos. When selected a dialog box will appear allowing you to customize the compression.

Preview Pane

Multiple items are displayed for each video tile when the Video Explorer is set to display in a Normal View. In a Compact View, only the video and data thumbnails are visible.

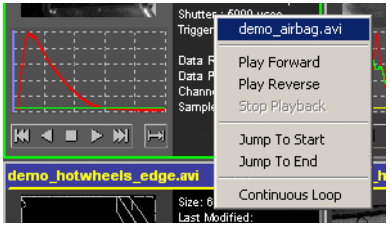


Filename	The filename of the video is displayed in the title bar.
Current Frame Number	The current frame number being shown is displayed in the upper right corner.

Video Thumbnail	A thumbnail image of the video is shown on the left panel.
Data Thumbnail or Timeline	If data is present, a thumbnail drawing of the data is shown beneath the video. If data is not present, a timeline is drawn. The data thumbnail or timeline may be clicked on to display a different video frame.
Play Controls	Standard play controls are provided for playing the video. These include: rewind, play reverse, stop, play forward, jump to end, and a button for setting continuous playback.
File Size and Modification Time	The file size and modification time are shown on the right panel.
Video Information	about the video length, size, and record information is shown in the right panel.
Data Information	If data is present, information about the data record information is shown in the right panel.

Viewing and Playing Video and Data

Each video can be played by using the play controls underneath the data graph area or by using the context (right click) menu.



You can also jump to any frame in the video by clicking in the data graph area.

Opening Video Files

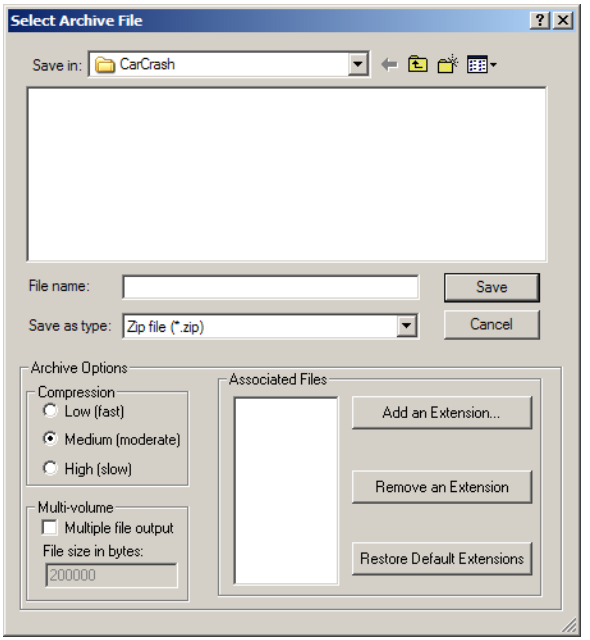
There are multiple ways to open a video file from the Video Explorer window:

- Select the video(s) you wish to open. They will be highlighted in green. Hit **Enter** and the video(s) will be opened in MiDAS 4.0. You will not be switched automatically to MiDAS 4.0, so you may open more videos.

- Double-click within the video image that you wish to open and a video window will open.
- Drag and drop the video image that you wish to open onto any Project window.

Compressing Directories

Often it is necessary to move collections of videos from one computer to another. Since many videos have very large file sizes this can be difficult. The MiDAS 4.0 Video Explorer can be used to compress directories of Video Files to ease the moving of large numbers of large files.



First select the directory you want to compress, then click on the Zip Icon . When the dialog opens you will be able to input the desired filename, as well as the type of archive you would like to use, the default is `.zip`.

Below the File Name and Save as Type, are 3 sections.

Compression	this allows you to choose the level of compression, this will effect the speed at which the process will take. Slower speeds mean higher compression, as well as smaller file sizes.
Multi-volume	This will allow you to span the archive over multiple

files. It is useful if you plan on archiving the files to CD or DVD, or if you are limited on the total size of e-mail attachments. Once you've selected the checkbox, manually enter the maximum size you require.

Associated File

The MiDAS 4.0 will automatically archive those file extensions associated with MiDAS data and MiDAS notes. If you need to add additional files you can use the buttons to add and remove the extensions you wish to be archived. Restore Default Extensions will restore the selection list to only those MiDAS 4.0 file extensions.

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Appendix

D

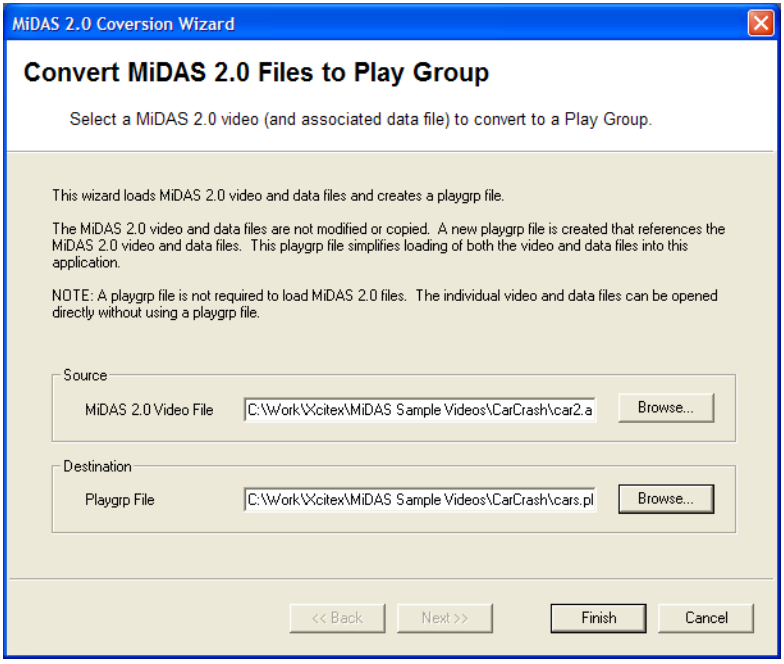
MiDAS 2.0 Conversion Wizard

Appendix D. MiDAS 2.0 Conversion Wizard

Overview

Previous versions of MiDAS utilized data file formats different from the `.mdat` format currently used in MiDAS 4.0. MiDAS 2.0 utilized the `.au2` file format. For your convenience, you can utilize the MiDAS 2.0 Conversion Wizard to organize your older MiDAS 2.0 videos and associated data files into a MiDAS 4.0 Play Group file.

1. Select MiDAS 2.0 Conversion Wizard from the Tools menu.



2. Under Source - MiDAS 2.0 Video File, click on the Browse... button and navigate to the MiDAS 2.0 video file you wish to include in the play group. *Note: It is important that the associated .au2 data file have the same name as the video file.*

3. Under Destination - Playgrp file, click on the Browse... button and navigate to where you would like to save the `.playgrp` file. It is recomended that you save the playgroup file in the same directory as the video.

4. After you have selected the file and destination, click Finish. MiDAS 4.0 will create and open the play group.

Note: This wizard will only work with the .au2 file formats.

Appendix

E

ProAnalyst 3-D Capture Wizard

Appendix E. ProAnalyst 3-D Capture Wizard

Overview

MiDAS 4.0 can be used to acquire video for 3-D analysis using software packages such as ProAnalyst 3-D Professional Edition. The ProAnalyst 3-D Capture Wizard assists you in capturing calibration images and videos from multiple cameras. These images are loaded in ProAnalyst as a `*.mpj` project file.

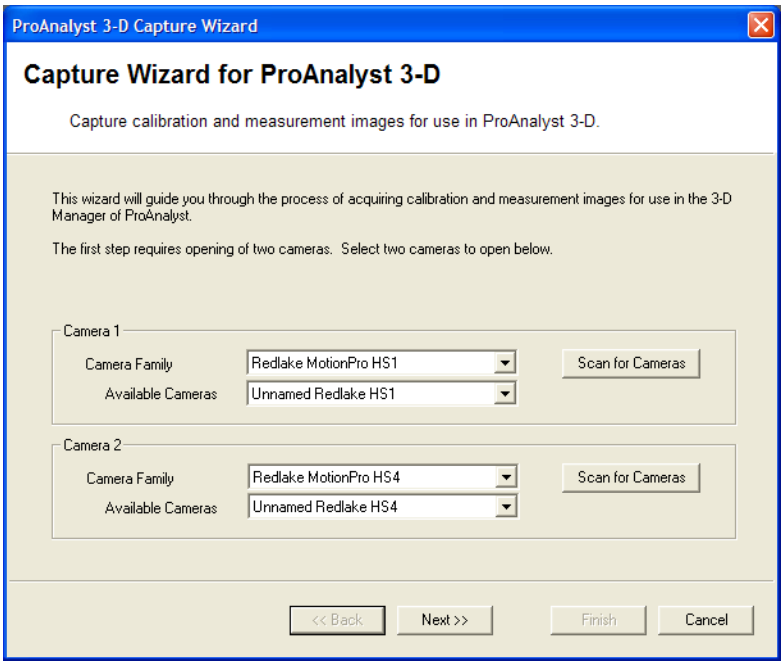
Calibration is required in order to compute precise 3-D coordinates of points in the camera view. Calibration requires a calibration fixture. This fixture can be a standard fixture supplied by Xcitex or a custom-made piece with geometric pattern. This fixture is placed in the field of view of both cameras. All reference points on the fixture must be visible by both cameras.

Prior to capturing the videos of the actual event for measurement, a set of calibration images must be acquired. The fixture must be placed in the field of view of both cameras. Then capture an image of the fixture with each camera. ProAnalyst can utilize these images to determine the position of the cameras and their relationship to each other in 3-dimensional space. If the cameras are disturbed in any way after these calibration images are taken, a new calibration must be computed. If the cameras are not moved between events, the same calibration may be used for each event.

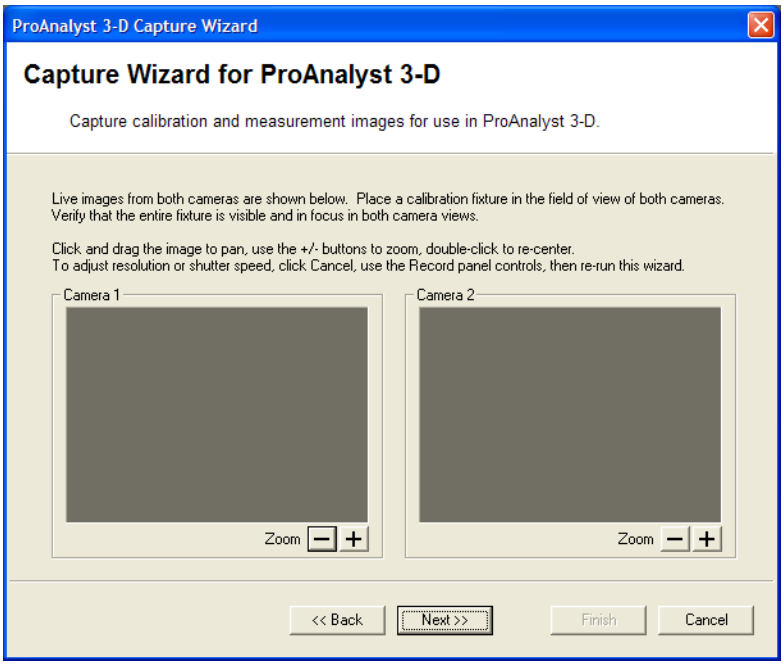
The ProAnalyst 3-D Capture Wizard is located in the Tools menu.

Using the ProAnalyst 3-D Capture Wizard

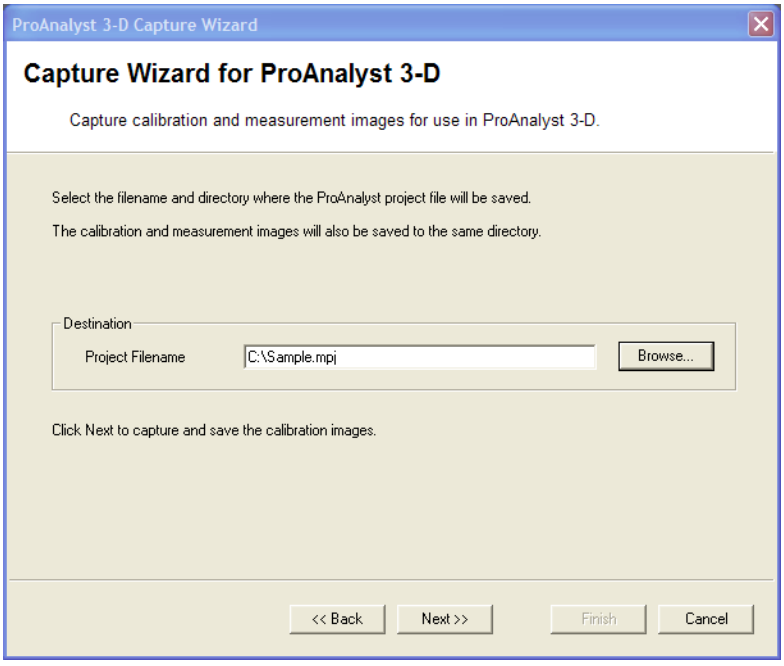
1. The ProAnalyst 3-D Capture Wizard will guide you through the process of capturing calibration images. The first step is to open two cameras. Select your cameras from the drop-down menus. Click Next.



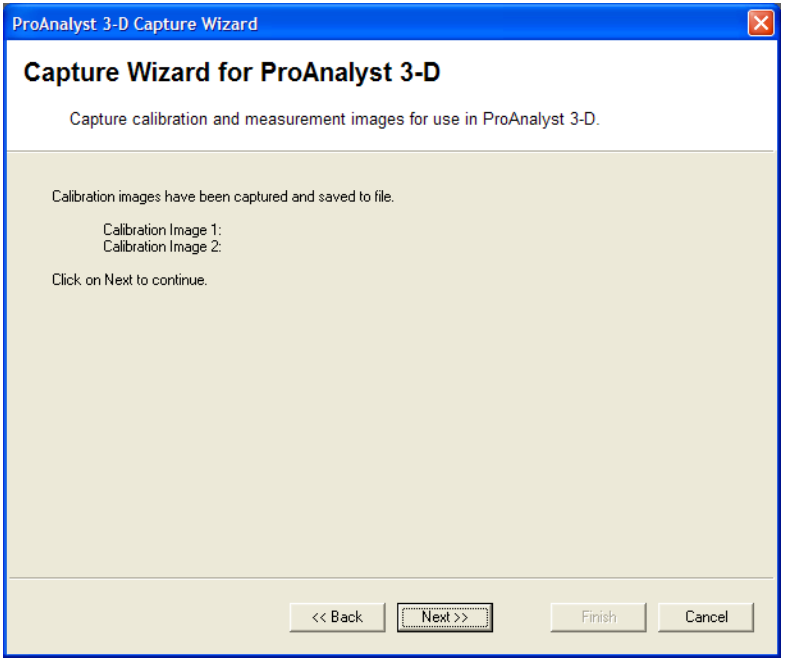
2. Use the live images from each camera to adjust their fields of view. Make sure all reference points on the fixture are visible by both cameras. Within this window you can use your mouse to pan the image, and the + and - buttons to zoom the image. Once you have framed the image as desired, click Next. An image from each camera will be captured and stored into memory.



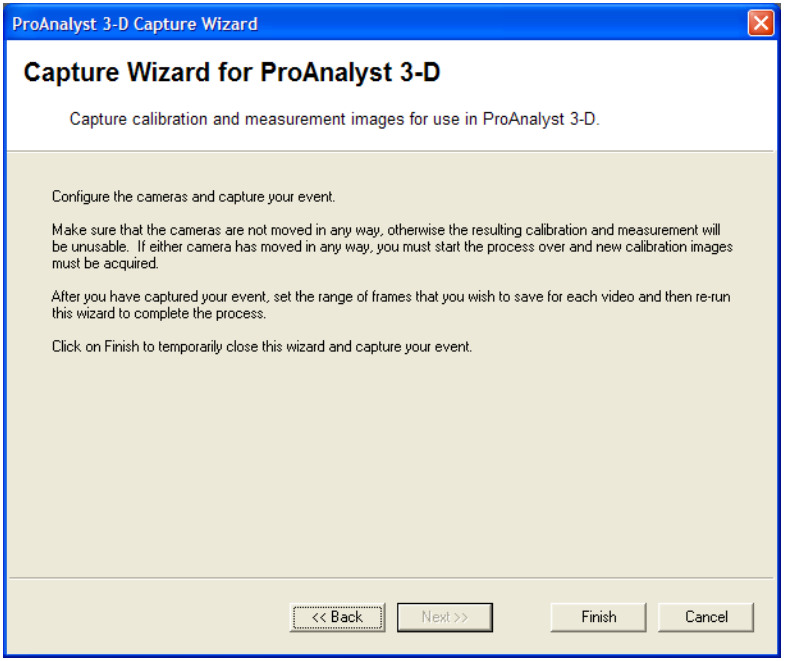
3. The wizard will open the Project Filename dialog. Choose a filename for your ProAnalyst 3-D project, and click Next. The Project file will be created and the two camera calibration images will be saved to the directory.



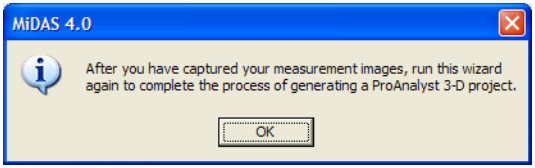
4. A confirmation dialog will appear. Click Next.



5. A guidance message will appear. Read the instructions and click Next.

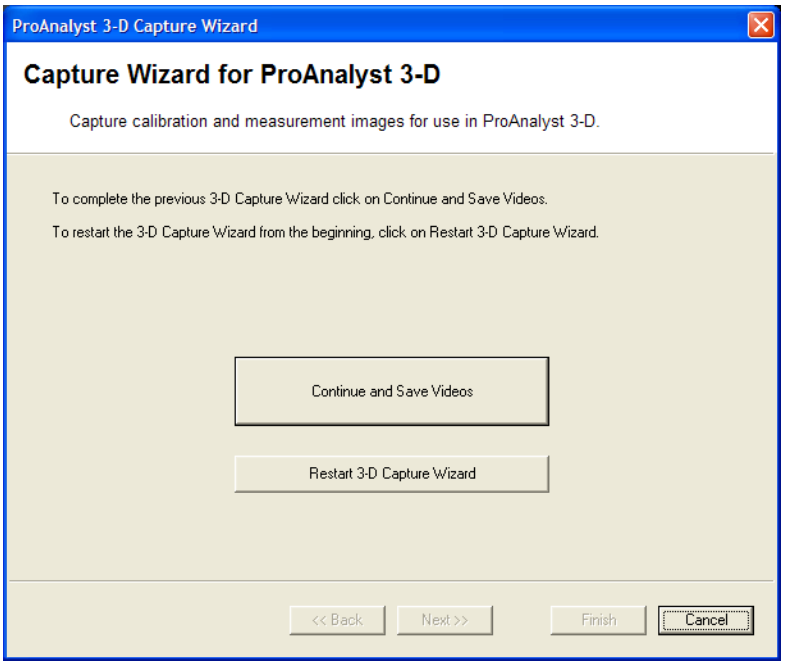


6. A dialog box will appear telling you that you may now capture your event. Click OK.

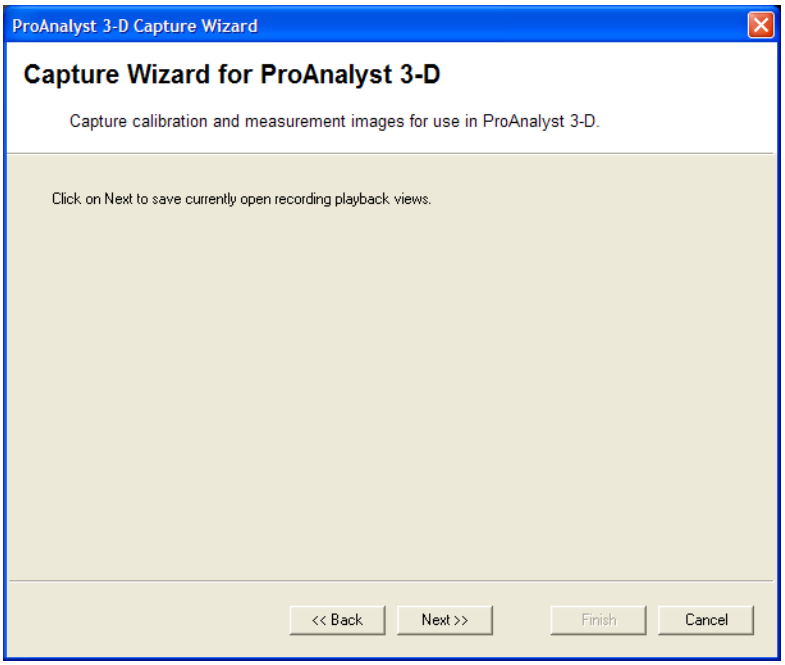


7. The ProAnalyst 3-D Capture Wizard will close while you capture your event. Make sure the positions of the cameras have not changed prior to capturing the event. After you finish recording, keep the video windows open and select the ProAnalyst 3-D Capture Wizard from the Tools menu again.

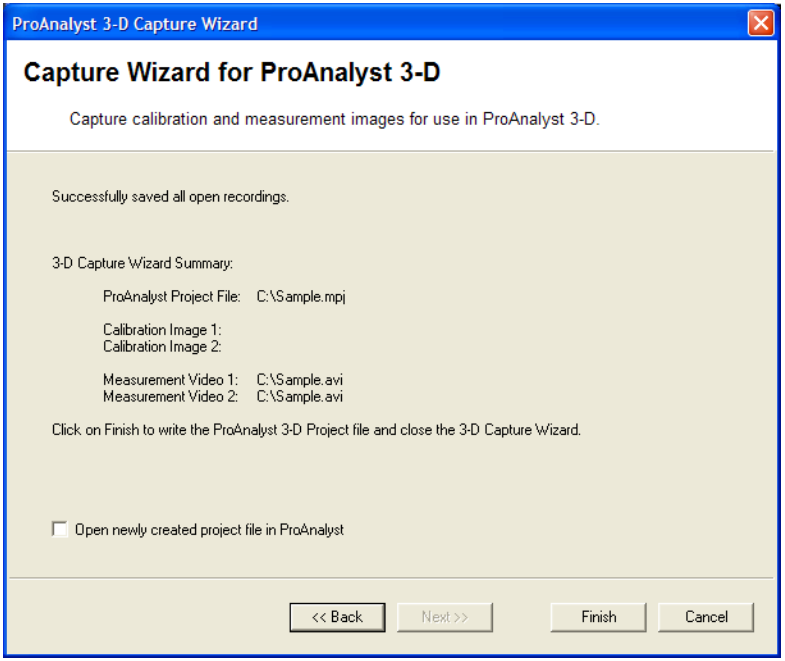
8. The wizard will allow you to choose between saving the videos and restarting the 3-D capture process. If your recording was satisfactory, click Continue and Save Videos.



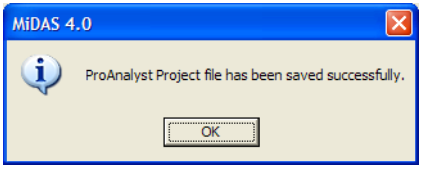
9. A dialog box will appear notifying you that the current videos will be saved. Click Next.



10. The videos will be saved in the previously saved ProAnalyst project folder. The window will inform you of the file names and their locations. Click Finish.



11. A success message will appear. Click OK.



12. You may now start ProAnalyst and begin analyzing these videos.

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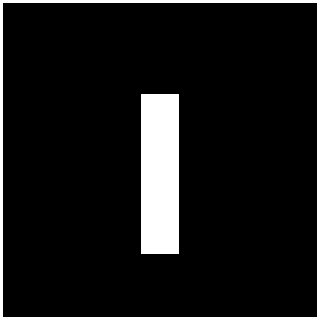

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