
Ariel Dynamics, Inc.

VECTORS MODULE

Revision 1.0



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ARIEL VECTOR PROGRAM

INTRODUCTION

One of the most common forces acting on the body is the ground reaction force, which acts on the foot during standing, walking or running. This force vector is three dimensional, consisting of two shear components (X and Y) acting parallel to the ground plus a vertical supporting force (Z). These forces can be measured using a multi-component force transducer. This transducer is commonly known as a force platform. The force platform also provides the location of the center of pressure of this ground reaction vector using the relative vertical forces seen at each of the transducers.

It is often valuable to combine the ground reaction force with the video data. The **ARIEL VECTOR** software is a Windows based program for superimposing the 3-dimensional ground reaction force vector onto an AVI video image using the **Ariel Performance Analysis System (APAS)**. Specialized laboratories study these vectors with the goal of improving sports performance, evaluating injuries or the effects of disease. The **VECTORS** program provides the clinician with the tool to observe any deviations between normal leg and foot alignments with the resultant force vector.

Although a few of **VECTOR's** features appear complex, they are relatively easy to master once you understand the underlying concepts. This manual is arranged to teach you these concepts in a logical order by showing you, in step-by-step fashion, how to use the **VECTORS** program.

WHAT'S NEW IN VECTORS 1.0

A few of the new features you will see in **VECTORS** version 1.0

1. **Superimposing a Vector Over an AVI Image.** Force vector is superimposed on corresponding AVI file display. Multiple windows can be opened for different views.
2. **Multiple Vector.** Force vectors can be superimposed on AVI file display in either a "single," "accumulate," or "multiple" mode. Multiple windows can be opened for different views.

3. **APAS Tool Bar.** A toolbar has been added to allow the user to activate individual APAS modules from within the main programs.

SYSTEM REQUIREMENTS

The following list provides the basic guidelines for the necessary components of the VECTORS program to provide the best possible performance. . The software requires a minimum of Microsoft Windows 95/98 and APAS-2000 Revision 1.0 or later (with the VECTORS option).

1. AMTI or BERTEC Force Platform system with Ariel software drivers.
2. One or more VHS/S-VHS Video Camera(s).
3. Ariel Performance Analysis System (APAS) software used to Capture the corresponding *.AVI and *.ANA file formats.

DATA COLLECTION RECOMMENDATIONS

Correct operation of the VECTOR program is dependent upon the configuration of the force platform and camera. While individual conditions may vary, the recommended hardware setup and data collection procedures are described below.

1. **Position the force platform.** The force platform should be placed to allow enough room for the camera to see all four corners of the force platform and obtain the desired field of view.
2. **Position the video camera(s).** The camera should be placed with the viewing axis centered and perpendicular to any one of the four sides of the force platform. Make certain that all four corners of the platform are visible with enough vertical height to include the area of interest. If desired, multiple cameras can be used to record both the X and Y-axes. Two files can then be opened in the VECTORS program to display the X and Y view axes simultaneously.
3. **Determine the synchronizing event.** Make certain that there is a synchronizing event that is "visible" to both the analog and video signals. This could be something as simple as the foot contacting the force platform or an electronic device that emits both a visible signal to the camera and an electronic signal to the A/D module.
4. **Simultaneously collect AVI & ANA data.** As the subject stands/walks on the force platform, simultaneously record the event using the Ariel ANALOG module and the video camera(s). As a reminder, the force plate should be zeroed prior to data collection. Make certain to include the SYNCHronizing event as close as possible to the data to be analyzed.
5. **Capture AVI file to APAS computer.** Run the Ariel CAPTURE module to capture the video image as an AVI format file to the hard disk of the computer.

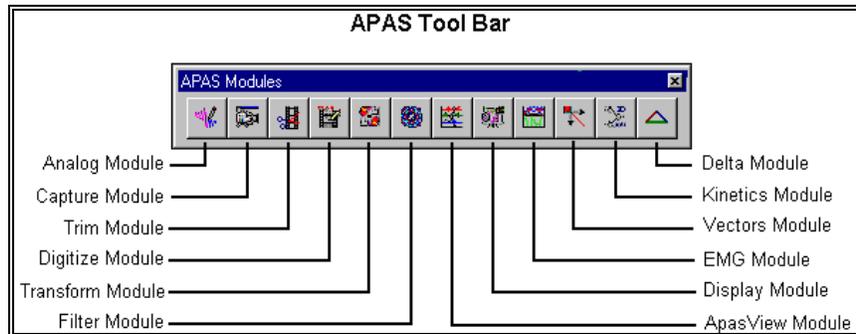
You are now ready to begin the **VECTOR** program and open a new file.

SCREEN LAYOUT

Prior to performing the **VECTORS** process, you should take the time to familiarize yourself with the format and contents of the various screens listed below:

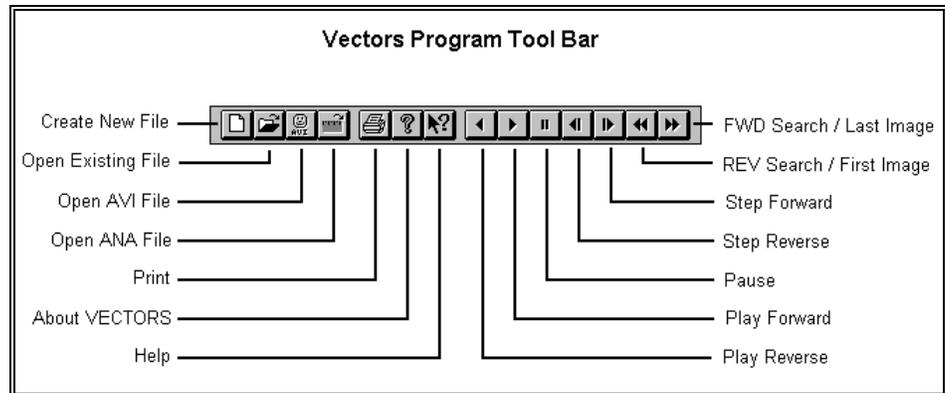
THE APAS TOOL BAR

You can activate any of the APAS software modules from within the current program by selecting the icons located on the APAS tool bar. The tool bar is toggled on/off using the APAS Toolbar command in the VIEW menu. A check mark in the left column of the menu indicates that the toolbar is currently active. The toolbar can be re-located anywhere in the main program window by dragging it with the mouse. Clicking the appropriate icon can activate the following program modules. Icons are pictorial representations of programs, commands or functions.



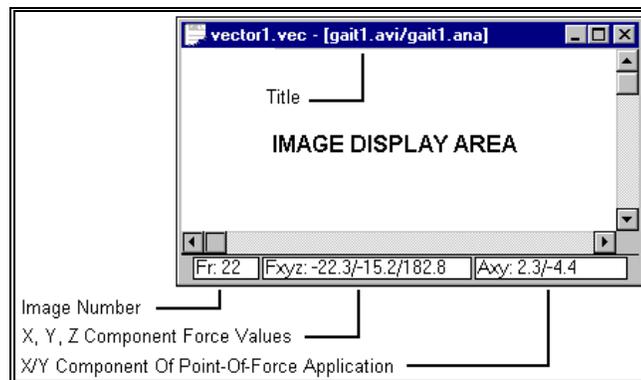
THE TOOL BAR

You can activate many functions by selecting the icons located on the **VECTORS** program tool bar. The tool bar is located near the top of the window. Icons are pictorial representations of commands or functions. You can access the following commands by clicking the appropriate icon.



THE VECTOR WINDOW LAYOUT

When a VECTOR file is opened, additional windows will be displayed inside the main VECTOR window. Multiple windows can be opened simultaneously. The **Vector Title** will be displayed at the top of each Vector Window. The Vector Window title incorporates the *.VEC filename that consists of the *.ANA filename and the associated *.AVI file being used.



The Vector Window Status bar is divided into three fields and is located at the bottom of each View Window. The first field displays the **Image number** of the currently displayed AVI file. When a vector file is opened, the program will default to Image (Frame) #1.

The second field displays the current **Fxyz** status. These numbers represent the numerical values for the three orthogonal forces (X, Y, Z) corresponding to the currently displayed image and are used to compute the displayed vector image. These values are obtained directly from the ANA file.

The **Ax/y** field displays the current **Ax/y** status. These numbers represent the numerical values for the X/Y coordinates of the center-of-pressure along the respective axes from the center of the force platform.

Scroll Bars located immediately above the View Status bar and also at the right side of the View Window allow the image to be scrolled left/right and up/down. The small arrow in the upper right corner of the View Window can be used to expand the window to the full screen.

THE STATUS BAR

The status bar provides information about the current status of the image file. The status bar is located at the bottom of the Vector window.



The far left side of the status bar indicates the current status of the Vector file. This field will usually state **READY**. The far right side of the status bar displays the currently selected IMAGE option. When a new file is opened, this field will default to **PAUSE**. During the playback of the vector/image file, this field will indicate the playback mode (i.e. Play Forward or Play Reverse).

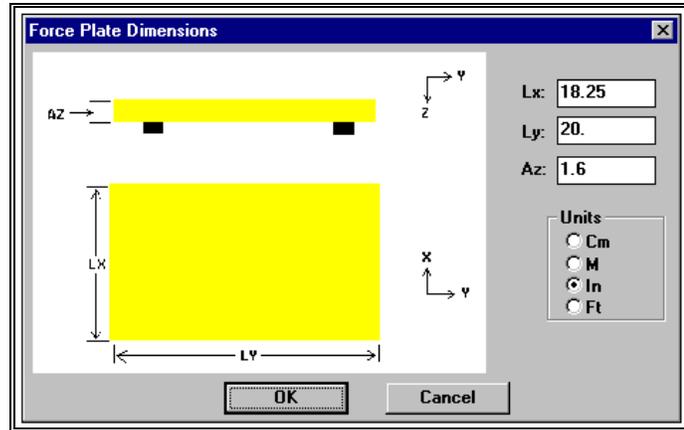
TO START THE VECTOR PROGRAM

1. Double-click the **VECTORS** icon located in the **APAS System** window group. The main Vectors window will appear.

CREATING A NEW VECTOR FILE

The following steps are recommended for correct operation of the VECTORS program.

1. Choose the **NEW** command from the **FILE** menu. This will open a new *.VEC document.
2. Select the **VIDEO FILE** command from the **FILE** menu to open an associated Video (AVI) File.
3. Select the **ANALOG FILE** command from the **FILE** menu to open an associated Analog (ANA) File.
4. Choose the **DIMENSIONS** command from the **SETUP** menu to make certain the force platform parameters is set correctly.



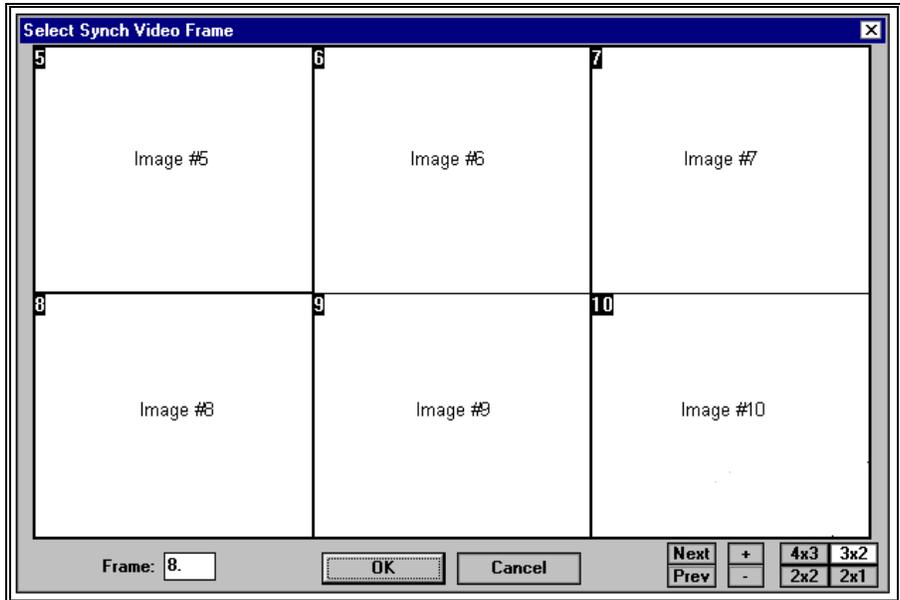
This menu displays the X and Y dimensions of the platform, the distance from the top of the platform to the transducer (Az), and the units of measure. The Az value can be found with the calibration sheet included with your particular force platform. This information is automatically input from the ANA file and should not require any changes.

5. Choose the **CALIBRATE** command from the **SETUP** menu to specify the camera axis and Calibrate the 4 corners of the plate.

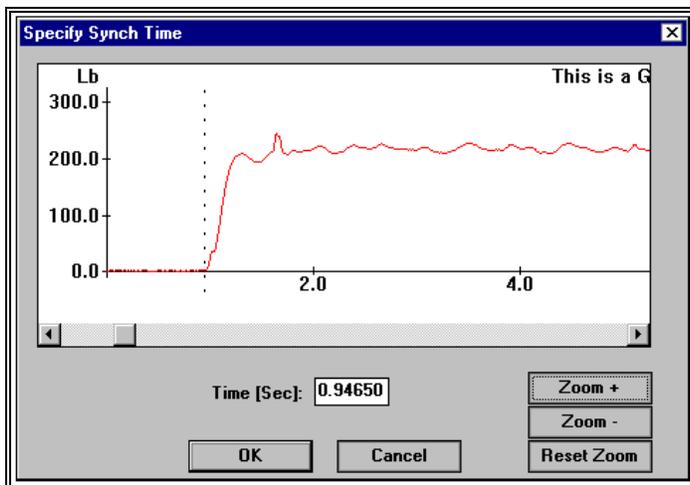


The user must first specify the location of the video camera in relation to the force plate. This axis is relative to the force platform coordinate system and represents the axis projecting from the center of the platform to the camera. Available selections are X, -X, Y and -Y. Then digitize the four corners of the plate as instructed. Digitizing begins with the Front-Left corner of the plate and proceeds with Rear-Left, Rear-Right, and Front-Right corners.

6. Select the **SYNCH, VIDEO** commands from the **SETUP** menu to specify the Synchronized frame of video. Select the Synch Video Frame using the cursor and the left button of the mouse. The video images will be displayed in the Synch Video Frame window. Selecting the buttons in the lower right corner of the window can change the format of the display. Images can be advanced/reversed one-at-a-time by selecting the +/- button. Selecting the Next/Previous buttons will step advance by the number of images currently displayed.



7. Select the **SYNCH, ANALOG** commands from the **SETUP** menu to specify the Synchronized Time in the analog (ANA) file. A dashed vertical line will appear at the currently selected Synch Time. The Synch Time can be selected using the left mouse button or by entering a numerical value. Selecting the **ZOOM+** button will expand the displayed graph. **ZOOM-** will reduce the size of the graph. Selecting **RESET ZOOM** will restore the graph to the original size.



At this point, the program is ready to overlay Vectors on the video image.

CREATING OVERLAY VECTOR ON VIDEO IMAGE

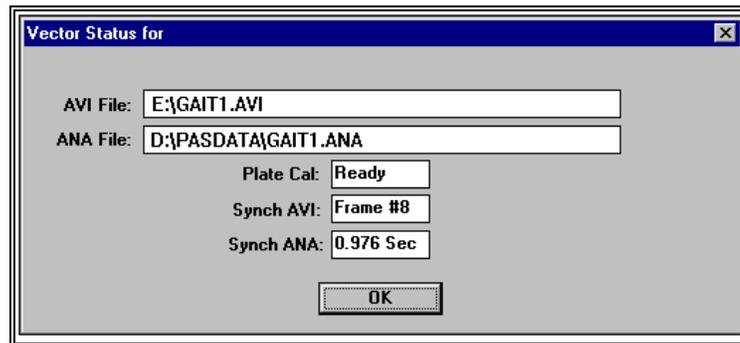
Once the VECTOR file is created and the Calibration and Synchronization process have been completed, the program is ready to overlay Vectors on the Video image. This can be accomplished using the commands in the **IMAGES** menu. The various standard VCR commands/icons are used to **PLAY**, **PAUSE**, **REWIND**, **FAST FORWARD** and **STEP** the images. The **LOCK**

command can be selected when multiple windows are open. When the **LOCK** command is active, the **IMAGES** command affects all open windows. If the command is not active, the **IMAGES** commands only affect the active window.

STATUS DISPLAY OF A VECTOR FILE

The Status of a Vector file can be displayed at any time. This menu provides a quick check on the current state of the active file.

1. Select the **STATUS** command from the **VIEW** menu to display the Vector Status window. The current status for each piece of information required by the VECTOR program will be displayed. This information includes the path for the AVI and ANA file, status of the Plate Calibration, and the SYNCH points for both the AVI and ANA files. Any field that indicates "MISSING" requires the user to perform the necessary step to complete the missing information before the Vector display can be generated.



SAVING A VECTOR FILE

Once the VECTOR overlay file has been created, the entire file can be saved as a project (*.VEC file) for later use. The SAVE/SAVE AS commands can be used to save all the information that is used to create the overlay. This includes, camera viewing axis, force platform calibration, analog and video synchronizing information as well as the associated analog and video files. There are two options for saving the Vector file:

1. Choose the **SAVE** command from the **FILE** menu. This command will Save the current information using a sequentially numbered default file name (vector1.vec, vector2.vec etc.) and Save it to the current drive and directory. The *.VEC extension will be added automatically.

OR...

2. Select the **SAVE AS** commands from the **FILE** menu. The Save As dialog box will appear showing the current file name, directory, drive and file type. At this point, you can enter the desired name for the VECTOR file. Please note that the file must have the VEC extension.

RESTORING PREVIOUSLY CREATED VECTOR FILE

VECTOR files can be created and saved to retain the necessary information for displaying the Vector overlay. Files can then be Restored at a later time for comparison and/or analysis. There are two methods to Restore a previously created Vector file:

1. Choose the **OPEN** command from the **File** menu. The **OPEN File** Dialog box will appear. Select the desired drive, directory and *.VEC file and click the **OK** button.

OR...

2. Select the File Open icon from the VECTOR Tool Bar. The **OPEN File** Dialog box will appear. Select the desired drive, directory and *.VEC file and click the **OK** button.

Select the **STATUS** command from the **VIEW** menu to determine the status of the active file. If everything is complete, the Vector overlay can now be performed using the commands from the IMAGES menu.

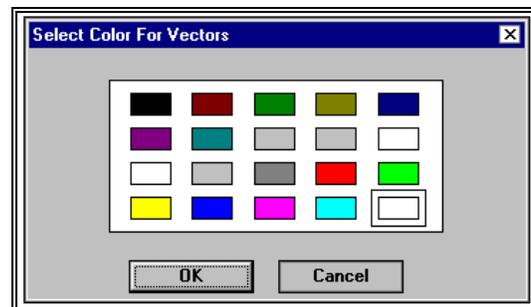
When multiple files are open, it is often useful to LOCK the images together. This causes all IMAGE commands to affect all open windows. When multiple windows are not LOCKed together, IMAGE commands only affect the active window.

VECTOR OPTIONS

CHANGING THE VECTOR COLOR

Depending on the color and quality of the AVI image, the force vector superimposed on the image might be difficult to see. Displaying the vector in a different color can often enhance visibility of the vector. The color of the vector can be changed by the following process:

1. Select the **COLORS, VECTOR** command from the **OPTIONS** menu. You will be presented with a color palette of the available colors. The box around the color designates the currently selected color. Select the desired color with the left mouse button. Press the OK button to save the selected color choice. Select the CANCEL button to abort this menu without saving the changes.



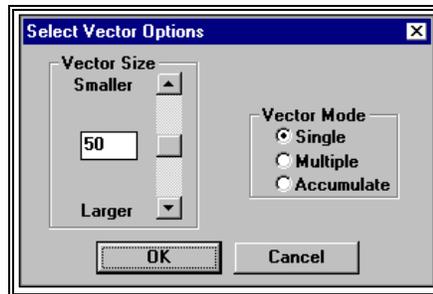
CHANGING VECTOR PARAMETERS

Depending on the relative force applied to the force platform, the force vector superimposed on the image might be difficult to see. Scaling the size of the displayed vector can often enhance visibility of the vector. The relative size of the vector can be changed by the following process:

1. Select the **VECTOR** command from the **OPTIONS** menu.

You will be presented with the Vector options menu. The relative size of the displayed vector can be altered using the button on the scroll bar. Moving the button up will make the displayed vector smaller, while moving the button down will increase the size of the vector. If desired, you can also change the size of the vector by entering a numerical value in the SIZE field.

The Vector Mode option is selected to display the superimposed vector in a single, multiple or accumulate mode. The current selection is indicated to the left of the Single/Multiple/Accumulate option. Single will display a single vector corresponding to the current image. Multiple will display all the vectors for the current vector project. Accumulate sequentially displays the vector with the current image while leaving the previous vectors displayed on the screen.



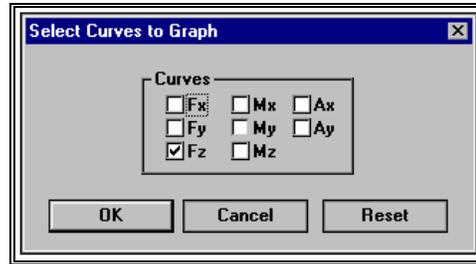
GRAPH OPTIONS

The numerical data used to compute the displayed force vector are displayed in the lower portion of the VEC project window. This data corresponds to the current image and is updated when the image is advanced or reversed. The force platform data can also be displayed in graphical format.

GRAPHING THE VECTOR DATA

Depending on the particular application, it may be useful to display the graphical data along with the superimposed vector. The graphical display of the vector data can be created by the following process:

1. Select the **NEW** command from the **GRAPH** menu. You will be presented with a palette of the available force platform data curves. Selected curves are designated by the check mark in the box to the left of the curve. Select the desired curves with the left mouse button. Press the OK button to open a new window with the curve data in graphical format. Select the CANCEL button to abort this menu without saving the changes. Select the RESET button to clear all selected curves.



ZOOMING

1. Select the **ZOOM** command from the **VIEW** menu. The displayed image can be set to one of five zooming factors.

AUTO - Scales the displayed image to fit in the open window.

Zoom 0.5x - Reduces the displayed image to approximately one-half of the normal size.

Zoom 1.0x - Scales the displayed image to normal size

Zoom 2x - Zooms the displayed image to approximately twice the normal size.

Zoom 3x - Zooms the displayed image to approximately three times the normal size

VECTOR QUICK REFERENCE

1. Select **FILE, NEW** (or the New Document icon in the Tool Bar) to Open a new *.VEC document.
2. Select **FILE, VIDEO FILE** (or the AVI icon in the Tool Bar) to open an associated Video (AVI) File.
3. Select **FILE, ANALOG FILE** (or the ANA icon in the Tool Bar) to open an associated Analog (ANA) File.
4. Select **SETUP, DIMENSIONS** to make certain the force platform parameters are set correctly.
5. Select **SETUP, CALIBRATE** to specify the camera axis and Calibrate the 4 corners of the plate.
6. Select **SETUP, SYNCH, VIDEO** to specify the Synchronized video image.
7. Select **SETUP, SYNCH, ANALOG** to specify the Synchronized time in the analog (ANA) file.
8. Select **IMAGES, PLAY FWD** (or the Play Forward icon in the Tool Bar) to start the vector overlay sequence.
9. Select **FILE, SAVE AS** to save the Vector project.
10. Select **FILE, EXIT** to exit the VECTOR program.

CHANGING VECTOR PARAMETERS

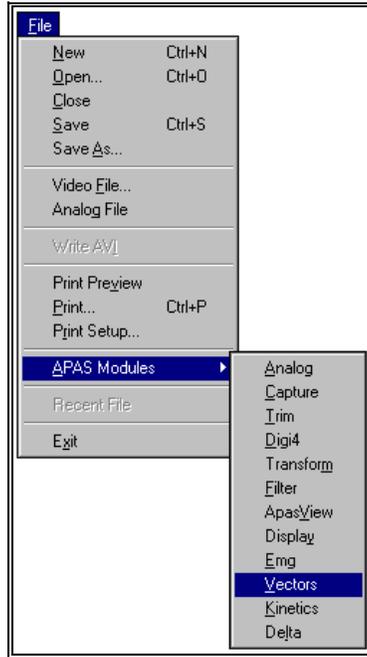
- 1.* Select **OPTIONS, COLORS** to set the Color of the displayed vector.

2. Select **OPTIONS, VECTOR** to set the relative size of the vector and/or the vector mode.
3. Select **FILE, SAVE** to save the Vector parameters with the *.VEC file.

VECTOR MENUS

Listed below are the various menus for the VECTOR program. Select the desired menu to see a description of the available commands for each menu.

FILE COMMAND MENU



New

Selected to open a new *.VEC file for creating a Vector project.

Open

Select the OPEN command to open an existing *.VEC file. . When this option is selected, the Open File dialog box will appear.

Close

Select the CLOSE command to close the currently open file.

Save

Select the SAVE command to SAVE the current *.VEC image file. When this option is selected, the Save File dialog box will appear.

Save As

Selected to SAVE the current file AS another name.

Video File

Selected to open a previously captured AVI format VIDEO image file to be used for the vector display. This file must be associated with a corresponding analog (ANA) file.

Analog File

Selected to open a previously created ANA format ANALOG file to be used for the vector display. This file must be associated with a corresponding video (AVI) file.

Write AVI

Selected to save the current *.VEC project to an AVI file. The new AVI file will contain the captured video images as well as the superimposed vectors.

Print Preview

Selected to check or examine the positioning on one or more pages. When you give the Print Preview command, a new window will be open showing the document position as it would appear on paper. To close the Print Preview window, select the Cancel button to go to the previous mode.

Print

Select the Print command to send the current file to a printer.

Print Setup

Selected to adjust the printer settings prior to issuing the PRINT command.

APAS Modules

Selected to open additional APAS modules while keeping the current program open. When this command is selected, the user will be presented with a list of APAS modules.

Recent File

Selected to open one of the most RECENT FILEs that were used. Files are opened by selecting the desired file name.

Exit

Selected to EXIT the VECTOR program and return to the APAS group in Microsoft Windows program manager.

EDIT COMMAND MENU



Undo

Select the UNDO command to retrieve edited data. The UNDO command reflects the last change you made, such as Undo Delete or Undo Insert.

Cut

Select the CUT command to remove the selected item and temporarily copy it to the Windows Clipboard. The items are placed in the clipboard so that it can be Pasted into another area of the same application or into another Windows application. To avoid losing this item, you should Paste it before performing any additional editing.

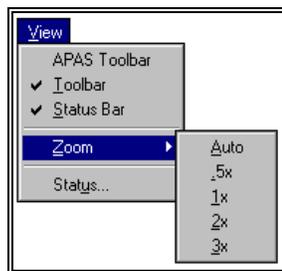
Copy

Select the COPY command to make a COPY of the selected item and temporarily copy it to the Windows Clipboard. The items are placed in the clipboard so that it can be Pasted into another area of the same application or into another Windows application. To avoid losing this item, you should Paste it before performing any additional editing

Paste

Select the PASTE command to insert a copy of the item currently in the Windows clipboard. This item could have been cut or copied from almost any Windows application.

VIEW COMMAND MENU



APAS Toolbar

Selected to toggle on/off the APAS toolbar. When this option is active, the APAS toolbar will be displayed and allow the user to select additional APAS modules while keeping the current program open. The toolbar can be positioned to the desired position by dragging it with the mouse.

Toolbar

Selected to display or remove the VECTORS Toolbar located at the top of the view window. This command acts like a toggle switch. The check mark next to the Toolbar command indicates that the Toolbar will be visible. Selecting this option again, will remove the check mark and remove the Toolbar from view.

Status Bar

Selected to display or remove the VECTORS Status Bar located at the bottom of the view window. This command acts like a toggle switch. The check mark next to the Status Bar command indicates that the Status Bar will be visible. Selecting this option again, will remove the check mark and remove the Status Bar from view.

Zoom

Selected to alter the size of the displayed image. This command can be selected at any time.

AUTO is selected to enlarge the display to the full size of the current window.

0.5x is selected to reduce the size of the display to 1/2 of the original size.

1x is selected to restore the display to the original size.

2x is selected to increase the original size of the display by a factor of 2.

3x is selected to increase the original size of the display by a factor of 3

Status

Selected to display the status of the required information in the active window. This information includes:

AVI file - Lists the specified path for AVI file. "None" indicates that the AVI file has not been selected.

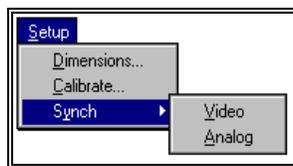
ANA file - Lists the specified path for ANA file. "None" indicates that the ANA file and has not been selected.

Plate Calibration - Status of Plate calibration. "Missing" indicates that this step has not been completed. "Ready" indicates that the camera axis has been specified and the four corners of the platform have been digitized.

Synch AVI - Image number of the AVI file to be used as a SYNCHronizing point. If the SYNCH, VIDEO command has not been completed, this field will display the "MISSING" label.

Synch ANA - Time value for the ANA file to be used as a SYNCHronizing point. If the SYNCH, ANALOG command has not been completed, this field will display the "MISSING" label.

SETUP COMMAND MENU



Dimensions

Selected to display information pertaining to the force platform. Required information includes: the X and Y dimensions of the platform, the distance from the top of the platform to the transducer (Az), and the units of measure. The Az value can be found with the calibration sheet included with your particular force platform. This information is automatically input from the ANA file and does not require any changes.

Calibrate

Selected to specify the camera axis and calibrate the video image with the analog data. When this command is selected, the user must first specify the location of the video camera in relation to the force plate. This axis is relative to the force platform coordinate system and represents the axis projecting from the center of the platform to the camera. Available selections are X, -X, Y and -Y. Then digitize the four corners of the plate as instructed. Digitizing begins with the Front-Left corner of the plate and proceeds with Rear-Left, Rear-Right, and Front-Right corners.

Synch

Selected to specify the SYNCH point for the video image and the analog file. For the VECTORS program to work correctly, the AVI file must be SYNCHronized with the ANA file to "time-match" the data. The program performs this function based on a common SYNCH point that is visible both on the video and on the analog channel and is specified separately for each. When this option is selected, you will see the options for VIDEO and ANALOG.

VIDEO is selected to specify the SYNCH point for the video file. When this option is selected, the Select Synch Video Frames menu will appear. Sequential images can be displayed in a 2x1, 2x2, 3x2, or 4x3 layout by selecting the buttons in the lower right corner. The image number is displayed in the upper left corner of each

picture. Images can be advanced/reversed one image at a time by selecting the +/- buttons. Alternatively, you can advance/reverse by the number of images currently displayed by selecting the Next/Previous buttons. Select the SYNCH frame using the left mouse button. The current SYNCH frame value is entered in the FRAME field. Select OK to enter the SYNCH frame as your choice or ABORT to return to the previous menu.

ANALOG is selected to specify the SYNCH point for the analog file. When this option is selected, the Specify Synch Time menu will appear. Select the SYNCH point on the displayed graph using the left mouse button. A dotted line will appear on the graph to designate the SYNCH point. The ZOOM +/- buttons can be used to increase/decrease the resolution of the displayed graph. Selecting RESET ZOOM will restore the graph to original size. Select OK to enter the current value and proceed or CANCEL to abort.

IMAGES COMMAND MENU



Lock

The LOCK command is used when there are two or more windows open. When the LOCK command is active, the FORWARD/REVERSE commands will affect all the windows. If the LOCK command is not active, the FORWARD/REVERSE commands affect only the active window. The LOCK command is active when the check mark appears to the left of the LOCK command.

PlayFwd

Selected to PLAY the AVI file in the Forward mode.

PlayRev

Selected to PLAY the AVI file in the Reverse mode.

Pause

Selected to PAUSE the AVI file on the current image.

StepFwd

Selected to STEP the AVI file one image at a time in the Forward direction.

StepRev

Selected to STEP the AVI file one image at a time in the Reverse direction.

Rewind

Selected to FAST-REWIND to the first image of the AVI file.

FastForward

Selected to FAST-FORWARD to the last image of the AVI file.

GRAPH COMMAND MENU



New

Selected to open a window and display the force plate data in a graphical format. When this option is selected, you will be presented with a menu of available data channels. Selections include Fx, Fy, Fz, Mx, My, Mz, Ax and Ay.

OPTIONS COMMAND MENU



Colors

Selected to set the color of the vector that is superimposed on the AVI video image.

Vectors

Selected to adjust specific parameters that deal with the displayed vector. This includes setting the relative size of the vector display and selection of either "Single" or "Multiple" vector display.

NTSC

Selected to specify the video format of the AVI image file. The video standard in the United States is NTSC (60 Hz) and is selected when the checkmark is to the left of the NTSC command. Selecting the NTSC option again will toggle the checkmark off. When the checkmark is not visible, the software assumes that AVI file is European PAL (50 Hz) video format.

WINDOW COMMAND MENU



Cascade

Selected to arrange all programs that are window sized in an overlapping CASCADE. This will not arrange a program that has been minimized to an icon.

Tile

Selected to re-size the program windows to fit side-by-side on the screen. Since Windows will include all programs that are window-sized in the tile setup, it is best to minimize all programs that are not currently being used so it will not take up space on the screen.

HELP COMMAND MENU



Index

Selected to provide an INDEX of Help related topics for the VECTORS program

Using Help

Selected to provide instructions on using the Help Windows.

About Vectors

Provides information about the VECTORS program

