



Digital Acquire 4

Program Documentation

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INTRODUCTION

The Bertec data acquisition software Digital Acquire™ is designed to collect data from Bertec force measuring devices and save the resulting output to either comma-separated, tab-separated, Matlab compatible files. Both the comma- and tab-separated files can be used by any program that supports reading such formats – for example, both Microsoft® Excel and OpenOffice can easily be used to read and analyze data. Any version of Matlab from version 4 and upwards can read the Matlab file.

Digital Acquire uses the digital USB output of the force plate. Data read from the force plate is already in an calibrated form. Therefore, no calibration matrix or analog scale factors are needed to use the software program. Digital Acquire incorporates many features such as manual and automated software zero capability, fixed or variable time data acquisition periods, and audible alerts when a signal channel reaches a threshold value. Digital filters with preset cutoff frequency values can be applied to the collected data before saving it to a file. Data channels to be saved can be selected individually so that excessive data does not take up valuable disk space on the computer. Visually, the incoming data can be seen using either the Chart or Center of Pressure displays.

Once the force plate is connected to the USB port of the computer, the software automatically recognizes the particular plate connected and displays the serial number. If a cable gets disconnected, a warning message is displayed immediately and no data collection can be performed.

Digital Acquire also supports multiple connected plates, either synchronized (where the signals from both plates are matched in time), or unsynchronized (where they are not). Synchronized plates require special hardware cabling between the plates.

Digital Acquire also supports both force plates and balance plates, and custom force devices.



The Digital Acquire software is written to collect data using the digital output of the force plate from AM6500 or AM6800 amplifiers via the USB port of the computer. It will not work with the analog output of the AM65XX or AM6800 amplifiers.

DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

Balance plate: a Bertec device that measures pressure and movement that is optimized for balance diagnostics.

Force plate: a Bertec device that measures pressure and movement.

Center of Pressure (CoP): The point on the surface of the platform through which the ground reaction force acts. It corresponds to the projection of the subject's center of gravity on the platform surface when the subject is motionless.

INSTALLATION AND SYSTEM SETUP

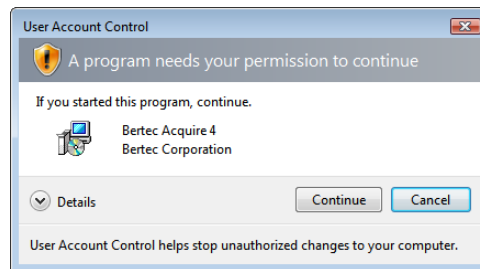
Your Digital Acquire system may have been packaged with either a portable force plate, a mountable force plate (such as gluing or bolting), or some other device. If so, please consult any additional documentation for the proper installation, configuration, and usage of those products.



Caution: The Digital Acquire program is designed to be used with a Bertec Balance Plate or Force Plate, or similar devices. These devices are connected to the computer via a USB cable, which can create a tripping hazard. Please use cable guides or raceways and route cables to avoid the possibility of patients, operators, and other personnel from snagging on, damaging, or tripping over loose cables.

Before installing the program, be sure that you are logged in as a Windows Administrator, or else you will need to perform a "run-as" function to start the install under your Windows Administrator credentials. If you are unsure, you will need to contact your organization's technical or network support personnel. Please note that Digital Acquire does *not* need to run as a Windows Administrator for most operations, once the program has been installed.

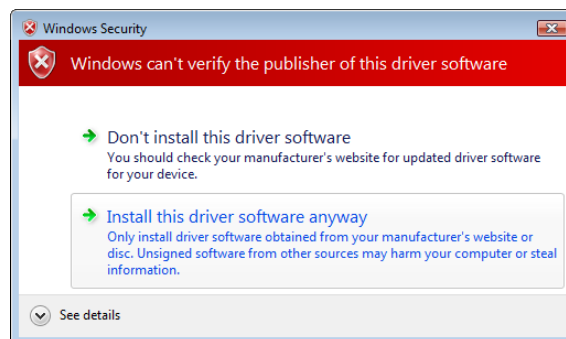
To install the Digital Acquire program, insert the CDROM that contains the Digital Acquire program. Windows should automatically detect the install program and start it for you. If it does not, use Windows Explorer to navigate to your CDROM drive and start the program **BertecAcquire4Setup.exe**. If you are using Windows Vista or Windows 7, you will get an additional User Account Control permission required prompt. Windows XP users will not get this warning.



Windows Vista and Windows 7 UAC prompt

Click the Continue button to proceed past this. The installer will walk you through the installation procedure for the Digital Acquire program, and will ask you standard questions as to where you would like to install the program (the default is C:\Program Files\Bertec\Acquire4), and if you want icons on the desktop.

Part of the installation process is installing device drivers for both older and newer Bertec Balance Plates and Force Plates. Since these device drivers have not been signed off by Microsoft, you will get two warning messages indicating this. Windows Vista and Windows 7 users will get a message that looks like this:



Windows Vista and Windows 7 device driver prompt

In order to continue and properly install the device drivers, you will need to click **Install this driver software anyway**. If you don't click this button, then the device drivers will not be installed and the plate devices will not work. Note that you will see this message twice, and that you will have to click **Install this driver software anyway** both times.

Windows XP users will get a similar message box:



Windows XP device driver prompt

In order to continue and properly install the device drivers, you will need to click the **Continue Anyway** button. If you don't click this button, then the device drivers will not be installed and the plate devices will not work. Note that you will see this message twice, and that you will have to click **Continue Anyway** both times.

CONNECTING BERTEC DEVICES

Connecting a Bertec Force Plate or Balance Plate for the first time will cause Windows to load the device drivers for it. You may get a message prompt indicating that it is doing so. The actual messages and interaction is different between Windows XP and Windows Vista/Windows 7.

WINDOWS XP

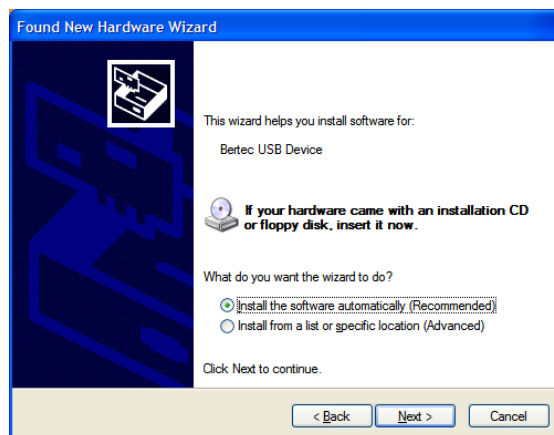
Connect the plate device to the computer using the supplied USB cable. It does not matter which end you plug in first, however, it is generally easier to plug the cable into the plate and go to the computer and plug that end in, rather than plugging the cable into the computer first.

If this the first time that you are connecting this plate to a specific USB connector on your computer, your Windows XP system will display a message box similar to the following after a few seconds:



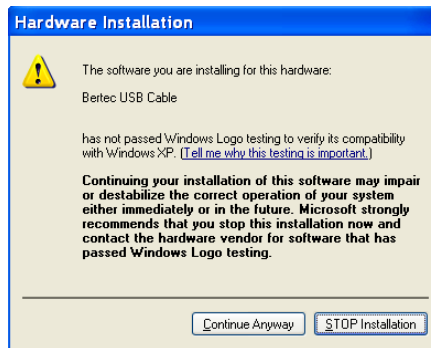
Windows XP and connecting Bertec Device

Make sure that the "No, not this time option" is selected, and click the **Next** button. There is no harm in selecting either of the Yes buttons, but there nothing on Windows Update for these device drivers to use.



XP driver installation

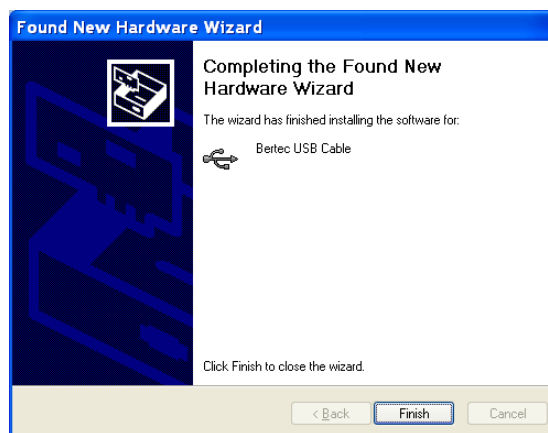
Make sure that the "Recommended" option is selected, and then click the **Next** button. Depending on the device you have connected, you may get a warning message that is the same as what was shown during the installation:



XP driver installation warning

As during the program installation, you will need to click the **Continue** button.

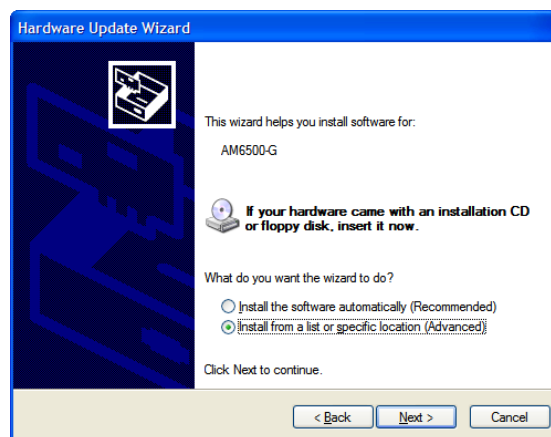
When the driver installation is complete, the following should appear:



XP driver installation completed

Click the **Finish** button.

Under certain conditions, Windows XP will sometimes not be able to automatically install the default drivers for the devices. If this is the case, un-plug and then re-plug in the USB cable, and when the following message box comes up, select the "Advanced" item to let you enter a specific directory:

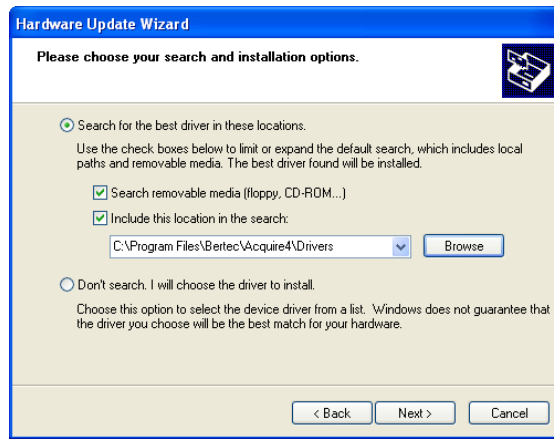


XP driver installation with Advanced selected.

The device drivers for Bertec hardware are installed with the application, and are in:

C:\Program Files\Bertec\Acquire4\Drivers

Enter that directory, or browse to it using the **Browse** button. Note that if you are using Windows XP 64 Bit Edition, you will have "Program Files (x64)" instead of just "Program Files".



Windows XP driver location



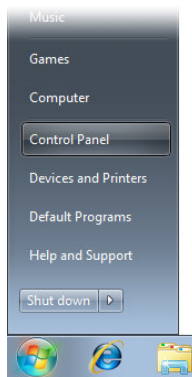
Note that Windows XP considers each USB connection port on your computer as a new device connection, and will prompt you as above each time you use the port for the first time. To make the procedure easier for you, we recommend that you either use the same USB connection port all the time, or else take the time to "preload" each port by connecting the USB cable to each one and perform the above steps, one port at a time.

WINDOWS VISTA AND WINDOWS 7

Both Windows Vista and Windows 7 handle connecting the device to Windows in a much more simplified fashion than Windows XP. In most cases, simply connecting the device is all that is needed, and Windows Vista or Windows 7 will not prompt you for the device, but instead just inform you that it has been connected via a small message on the bottom right of the Windows desktop. Unlike Windows XP, Windows Vista and 7 should transparently use the Bertec device on any available USB port on your computer.

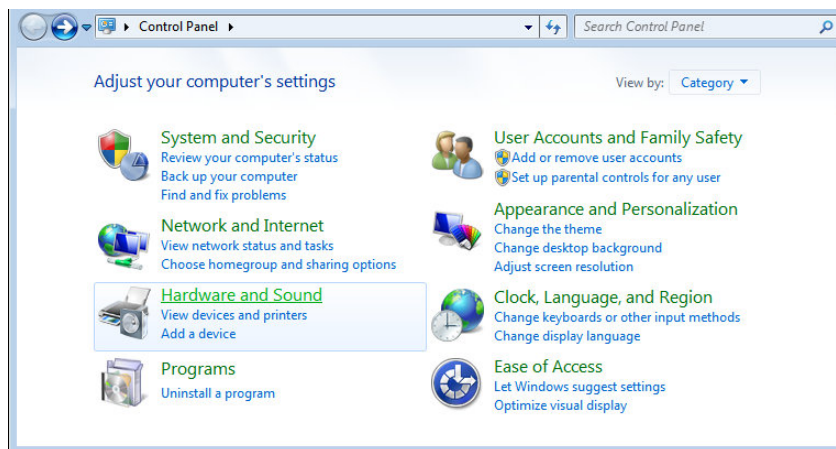
However, in some rare cases, Windows will not "see" the device properly, and not even give you the option to install drivers for it. In this case, you will need to manually inform Windows to search for the device. The steps below outline this procedure. Again, note that this should be a *rare* occurrence for most installations, but we are documenting it here for completeness.

To do this, select the Windows icon in the bottom-left of your desktop to open the Start menu., and select the **Control Panel** item.



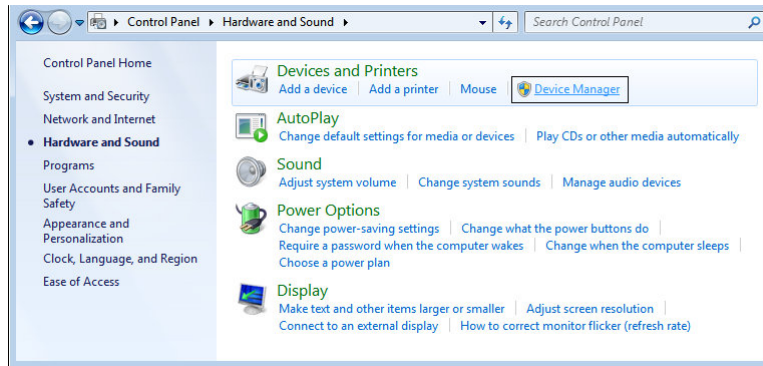
Windows Vista and Windows 7 control panel menu item

When the Control Panel page opens, select the **Hardware and Sound** item:



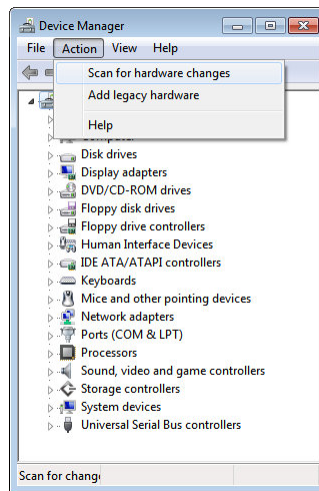
Windows Vista and Windows 7 control panel

In the Hardware and Sound control panel, select the **Device Manager** item on the top-right - this is in the Devices and Printers item, which is the first one in the list:



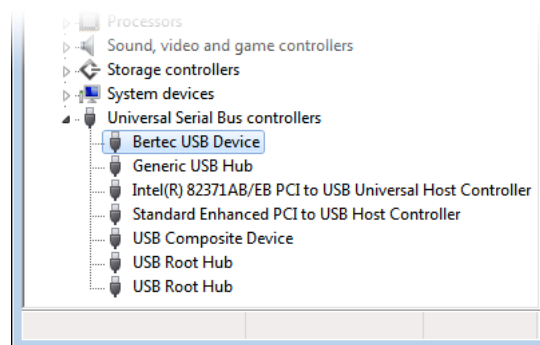
Windows Vista and Windows 7 Hardware and Sound control panel

In the Device Manager, make sure that the top item is selected (this is your computer), and select the **Action** menu, and then select the **Scan for hardware changes** menu item:



Windows Vista and Windows 7 Device Manager

This will make Windows Vista and Windows 7 look for newly attached hardware that it did not automatically "see" before. Windows will install the device drivers with no further prompting from you. After this has completed, the Bertec device should be shown in the Universal Serial Bus controllers section:



Windows Vista and Windows 7 Device Manager after successful install

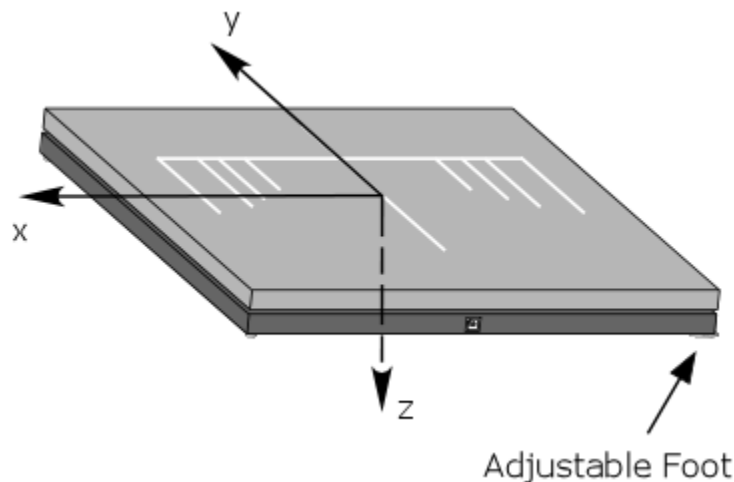
DATA ACQUISITION AND LOAD CALCULATIONS

All Bertec products use a novel 16-bit digital technology for signal acquisition and conditioning. The output signal of the load transducers are already digitized and conditioned in the force plate by using state-of-the-art electronics developed by Bertec Corporation. With this new technology the output signal has a very high signal-to-noise ratio, which means increased sensitivity and accuracy for the force plates. In addition, the digital technology makes the use of calibration matrices obsolete, since each plate comes with the calibration matrix already digitally stored on it. The connection between the plate and the computer is with a standard USB A-B connection cable.

The digital output of the system is always in the form of calibrated data in their respective units selected by the user (N and N•m, or lb and lb•in).

CALCULATING LOAD VALUES

Each balance or force plate is calibrated individually and the calibration matrix is stored digitally in the force plate, providing a completely calibrated output. The origin of the coordinate system is centered on the top surface of the force plate (see **Standard balance plate coordinate system** and **Center of Pressure equation**, next page). The standard coordinate system is such that the positive y-direction is opposite to the connector end, the x-axis is to the left when looking in the y-axis direction, and the z-axis is defined downwards by the right hand rule.



Standard balance plate coordinate system

The center of the coordinate system is at the top center of the plate, with the positive y-axis opposite to the connector end, the x-axis to the left when looking at the connector, and z-axis downward.

CALCULATION OF THE POINT OF APPLICATION OF FORCE AND COUPLE

A load system acting on a balance or force plate can be completely described by the three load components (i.e. the vertical force and two moment components) calculated from the **Center of Pressure** equation. Alternatively, the same information can be given as the vertical force component and the point of application of the force vector (x_p , y_p). The point of application of the force is calculated from the force and moment components as:

$$x_p = -\frac{M_y}{F_z}$$

$$y_p = \frac{M_x}{F_z}$$

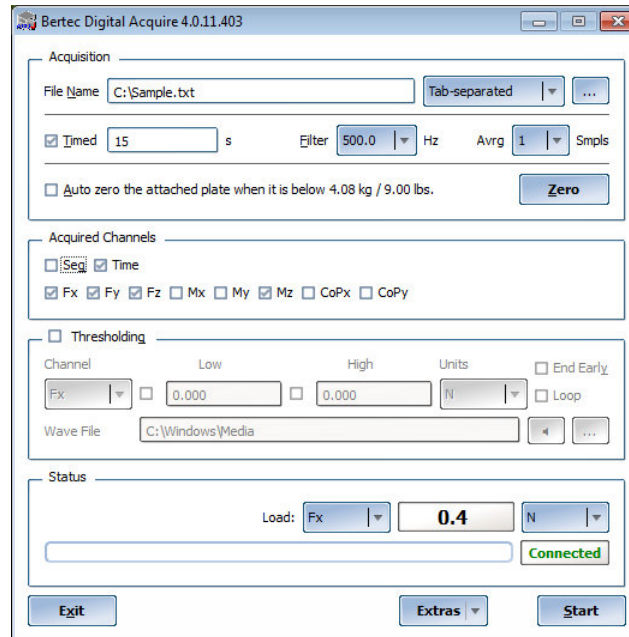
Center of pressure equation

Where x_p and y_p are the coordinates of the point of application for the force (i.e. center of pressure) on the plate.

The center of pressure values are automatically computed by Digital Acquire, and can be selected as an output channel to the data file.

PROGRAM OPERATION

Once the software is properly installed it can be started by either clicking the “Start” button on the Windows® desktop task bar and then selecting “Programs” and “Bertec” from the list followed by the “Acquire” entity, or double-clicking the desktop icon that was installed. Before starting the program, make sure that all the cables to the force plate, external amplifier (AM6500 or AM6800), and computer are properly connected. The Digital Acquire program consists of a single main window that incorporates all of the controls and features for collecting and displaying data from Bertec force plates.



The Digital Acquire program interface window

The Digital Acquire program interface window is divided into five sections: Acquisition, Acquired Channels, Thresholding, Status, and the buttons at the bottom to Exit, Start/Stop data collection, and select Extra functionality.

THE ACQUISITION SECTION

The Acquisition section is used to set parameters related to data collection such as name of the file to save data, the file format (either Comma-separated, Tab-separated, or Matlab format), length of data acquisition period, digital filter cutoff frequency, selection of manual or automatic software zero feature, the Filter, and if the data should be averaged or not.

FILE NAME

In order to save the data to a file, the File Name field should designate a valid file name and location. The location and name can either be entered manually, or the Choose icon (blue button with ellipsis) next to the field can be clicked to select a specific file and location. The output file can be formatted as either comma-separated values with column headers (suitable for Microsoft® Excel or OpenOffice), tab-separated values without column headers, or as Matlab v4 file format. The output format is controlled via the drop-down selection to the right of the filename entry field. The “...” button lets you pick the output using Windows.

If the file name belongs to an existing file, the program will prompt with a confirmation message to overwrite the file before starting data acquisition.

TIMED DATA COLLECTION

The length for the data acquisition interval can either be fixed or unlimited. A fixed time period for data acquisition can be set by checking the Timed box and entering a period length in seconds. Pressing the **Start** button at the bottom of the window will start data collection, and it will stop automatically after the specified time period runs out. If the Timed button is *not* checked, then the data collection period has no time limit and the user should stop data collection manually. For the user-controlled time period, data collection starts by pressing the **Start** button. As soon as this button is pressed, it will transform into a **Stop** button, which can then be used to terminate data collection. The unlimited time data collection feature relieves the user from the guesswork of how long the data collection period should be set so as not to miss valuable data.

FILTER AND AVERAGING

The sampling frequency for data acquisition is fixed at a value of 1000 Hz. Bertec force plates, balance plates, and other devices have a built-in anti-aliasing filter of 500 Hz. Additionally, a software filter can be applied by selecting from a list of preset cutoff frequencies listed in the drop-down menu of the filter box. The drop-down menu lists nine different cutoff frequencies: 500, 333, 250, 200, 167, 143, 125, 111, and 100 Hz. 500 Hz belongs to the anti-aliasing filter; no additional filtering is applied in the software. The other cutoff frequencies are achieved by averaging successive data points. In other words, averaging 2 sequential data points yields 333 Hz, 3 data points provides 250 Hz, etc.

Separate from the Filter is the Avrg Smpls option which allows the user a choice of averaging data samples, from 1 (no averaging) to 20 (where 20 values are averaged together and reported as a single value). The Average Samples option is provided for users who are expecting to collect very large runs of data (usually measured in hours) that would generate large multi-megabyte files and wish to have the program pre-process the results before they attempt to analyze them.

AUTO ZERO AND THE ZERO BUTTON

The Digital Acquire software incorporates the capability of removing the signal offset due to additional equipment on the force plate. The software's Zero feature sets the mean values of the signals from all channels to zero. Zeroing can be performed both manually and automatically. Pressing the **Zero** button will remove the offset in each signal channel. Alternatively, checking the **Auto Zero** box will result in the software zeroing automatically every 3 seconds when it is not loaded. This feature is active only when the load on the **Fz channel** is below a certain value (about 9 lbs), and the variations in the signal are negligible.

The **Zero** button will zero the plate using whatever the current loaded weight is. Unlike the **Auto Zero** check box, this has no regard for the load of Fz on the plate, or even if the device in question has an Fz channel. Be aware that clicking the Zero button while there is a load on the plate will offset *all* values being read. If this is an incorrect action, remove the weight from the device and click the Zero button again.



In order to use the automatic zero feature with heavy objects, put the object on the force plate, zero the signals manually using the Zero button while the automatic zero function is turned on by checking the Auto Zero box. This will behave similar to a "Tare" button on an electronic scale.

THE ACQUIRED CHANNELS SECTION

The Acquired Channels section allows selection of the data channels to be saved to the output file. If the box for a channel is not checked, then the output file will not contain any data for that channel. The Sequence (Seq) checkbox records a count of the data from the device when the Start button is pressed - this starts from 1 and goes up by one for each row. By default this is not checked.

The Time checkbox records when the data was collected, in seconds. This is incremented by the amount equal to $1/f_s$, where f_s is the sampling frequency of the data.

The other checkboxes are shown depending on what the connected plates have. In the above image, a 6-component force plate is connected, and Digital Acquire can compute the CoP X and Y values automatically.

All of the force channels are saved in Newtons (N), the moments in Newton-meters (N•m), and the CoP values are in meters (m).

THE THRESHOLDING SECTION

The Thresholding options allow the user to attach .wav sound files to each acquired channel. Separate low and high threshold values may be set for each channel, along with the units the values are expressed in, and each channel may also have a separate warning sound. To set a threshold, click the Thresholding option checkbox to turn it on, and then select a channel from the pull-down menu. The limits, units, and sound may be adjusted for each channel. To browse for sound files, click the blue button with the ellipsis. To play the current sound that is shown in the Wav File entry field, click the play button to the right of it (this looks like a small speaker icon). If the **Loop** checkbox is checked, then the sound will continually play as long as the threshold is exceeded. Checking the **End Early** option will stop the sound as soon as the reading is below the threshold, even if that occurs in the middle of the .wav file.

THE STATUS SECTION

The **Status** section displays a real-time value of a channel from the force plate, the connection status, and progress. The **Load** pull-down menu gives the user the option of displaying one of the channels that are available for the attached device - this will be the same checkboxes as in the Acquired Channels section. The **Unit** pull-down menu can be used to change the unit of the displayed force. The unit choices vary depending on the channel type - this will be either Newtons (N), pounds (lb), or kilograms (kg) for forces, and for moment channels it will be N•m, lb•in, or lb•ft.

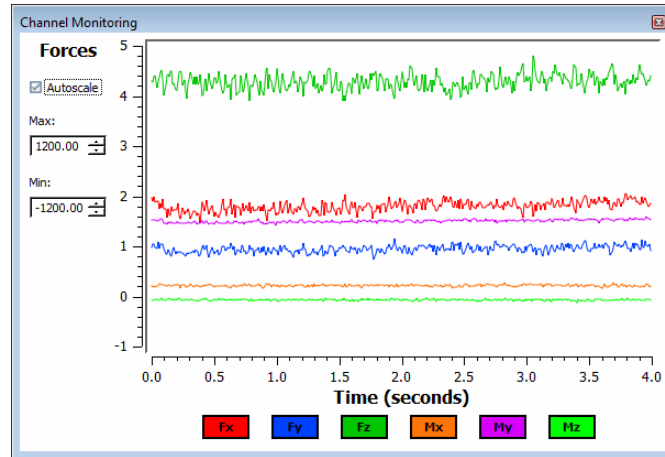
The Progress Bar shows how far along the collection process is going. If the **Timed** checkbox in the Acquisition section is checked, then this will fill from left to right as a percentage. If the Timed checkbox is *not* checked, this will just show an animation.

THE EXIT, EXTRAS, AND START/STOP BUTTONS

The buttons at the bottom of the Digital Acquire window let you **Exit** the application, chose one of the **Extra** features, and either **Start** or **Stop** the capturing of data.

EXTRAS: CHART

Clicking the **Extras** button and then **Display Chart** shows the **Channel Monitoring** display. This display automatically shows the channels that are selected in the **Acquired Channels** section. The amount of time being display is controlled via the **Timed** data capture entry. Both the **Filter** and **Average Samples** controls affect how the data appears in this display.



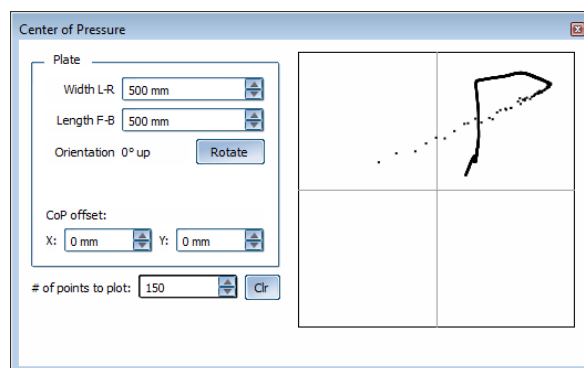
The Channel Monitoring Chart Display

The Chart display can either autoscale the values from the channels currently selected to fit on the display, or you can choose to uncheck the **Autoscale** checkbox and enter the maximum and minimum values yourself in the Max and Min edit boxes. These values have up and down controls next to them that can be manipulated with the mouse, or they can be typed into directly.

To close the Chart, either click the close button (the red box with an X in it) on the top-right of the display, or select Extras and then Display Chart to toggle the display off.

EXTRAS: CENTER OF PRESSURE

Clicking the **Extras** button and then **Display CoP** shows the **Center of Pressure** display. This display shows in a visual form the tracking values of the CoPX and CoPY channels. If these two channels are not available, then the Center of Pressure display will not be able to show anything of value.



The Center of Pressure Display

The size of the attached plate can be controlled by entering the proper size in mm. Some typical sizes are 500x500, 600x900, and 1500x350. The **Orientation** – that is, “which way is up” can be shifted 90 degrees each time the **Rotate** button is clicked. This is useful if the plate itself is mounted in such a way where the subject is facing a different direction than expected.

The **CoP Offset** is used to change where the **Origin** of the center of pressure is at. For example, if you have a 1500x350 plate and the center of pressure is computed from a corner instead of the middle, you might enter -750 for the X and 175 for the Y.



The Plate Size, Orientation, and Offset values *only* affect the display of the center of pressure on *this* display; they do *not* affect the data being collected and written to a file.

The **# of points to plot value** is how many “tracers” or “trails” you wish left on the display. These points are left behind as the center of pressure indicator moves around, and old ones are removed as new ones are added. Once the subject has stepped off the plate (there is no pressure), the trails will stop collecting until pressure is re-applied.

The **Clear (Clr)** button is used to erase all the current points that are plotted.

DATA COLLECTION

A step-by-step procedure for data collection is as follows:

- Check all the cables, and make sure that they are properly connected.
- Turn on the external amplifiers, and allow the system to warm up for at least 5 minutes.
- Start the Digital Acquire software by double clicking on the icon on the desktop of the Windows[®] operating system.
- Enter or choose the name, location, and type of the text file for the data to be saved.
- If you want a fixed time interval for data collection, check the **Timed** box, and enter an interval length in seconds. If you want to start and stop data collection manually, uncheck the **Timed** box.
- If you want the software to remove signal offset periodically by taking a software zero, check the **Auto Zero** box. If you do not check this box, zero the signals by pressing the **Zero** button before each data collection.
- If you want to filter the collected data digitally, select a cutoff frequency from the **Filter** drop-down menu. Leaving the filter cutoff at 500 Hz will result in no filtering.
- Select the channels you want to save in the **Acquired Channels** section.
- If the **Auto Zero** box is not checked, then press the **Zero** button for manual signal offset removal.
- Click the **Threshold** checkbox for the Threshold section if you wish to set low or high thresholds for any of the channels. Select the sound file to be associated with each threshold.
- Press the **Start** button to start data collection. The Start button will change to a **Stop** button.
- If the **Timed** box is not checked, press the **Stop** button to stop the data collection process. If the Timed box is checked, then data acquisition will stop automatically after the specified time interval expires.
- Data will be saved to the file that you specified while collecting data. Therefore, no additional action is required.
- You can change which **Load** is displayed at any time, even when there is no data being collection (data monitoring).

TROUBLESHOOTING

Problem: the Digital Acquire program is not capturing data

Solution: make sure that a compatible Bertec device is connected via the USB cable and that the current drivers are installed. If the Digital Acquire program cannot detect the device, the Status section will show "No Devices" in red. If the device is connected and Digital Acquire still does not see the device, exit the application and reinstall it. If that does not resolve the program, contact Bertec Technical Support.

Problem: the Bertec device reads incorrect data, such as too much weight on the plate

Solution: the plate cannot be auto-zeroed and will need to be manually zeroed out. Click the **Zero** button on the bottom-right of the program. If that does not resolve the program, contact Bertec Technical Support.

For any other issues, please contact Bertec Technical Support.

DOCUMENT REVISION HISTORY

Date	Revision	Description	Author
9/1/2009	1.00	Initial Revision	Todd Wilson
6/17/2010	1.01	Zero button moved	Todd Wilson
3/25/2011	1.02	Revised wording, added chart and cop display	Todd Wilson
11/28/2011	1.03	Added diagram of force plate and cop formula	Todd Wilson