3.7.27 3D digitizing

Digitizer support within form•Z allows a 2D or 3D hardware input device to be used as a method for controlling the graphic input to form•Z. This graphic input can be in the form of moving the cursor relative to the computer screen or in the 3D world space of the form•Z project.

Within form•Z, digitizers can be used in two modes: screen and world. In screen mode, the digitizer functions in 2D as an alternate to the computer’s mouse where an area of the digitizer’s workspace is mapped to the computer’s desktop. This mode allows for the selection of graphic interface elements such as icons and palettes, and for entering 2D screen coordinates, which are then mapped onto 3D the same way they are when using the mouse. This mode is not useful for direct 3D digitizing.

In world mode, the digitizer’s workspace is mapped into the form•Z project world space. This mode provides the ability to use accurate digitizer input directly with all form•Z tools, most notably the drawing tools. In this mode, 2D digitizers can be used to input data onto a form•Z reference plane and 3D digitizers can be used to input data directly in 3D.

Before using it, the digitizer must be calibrated in order to establish a relationship between the working space of the digitizer and the working space within form•Z. This requires the selection of a number of points in each space to define the necessary orientation and scale relationships. Each digitizing mode needs to be calibrated independently. Once calibrated, the digitizer can be used in the respective mode.

A digitizer is composed of a sensor that reads a location in 2D or 3D space and may also have additional buttons or pedals. In general, the primary button or pedal on the digitizer functions the same as the button on the computer’s mouse. However, especially when a digitizer has two pedals, their functionality can be customized, as discussed later in this section.
The digitizing process

The overall digitizing process works as follows:

- After the digitizer has been physically connected according to the installation instructions, it needs to be set up relative to your computer. You do this by executing the Digitizer Setup... command in the Options menu.
- Next you (optionally) calibrate the screen mode by executing the Screen Digitizer Calibration... command. After the calibration you can enter points in screen mode by selecting Screen Digitizer Input, which causes a check mark to be displayed in front of the item.
- Similarly, you calibrate the world mode by executing World Digitizer Calibration.... You digitize in world mode by selecting World Digitizer Input.... When you do, Screen Digitizer Input is deactivated. Only one of the digitizing modes can be active at a time.

After the two modes are calibrated and available, you can enter graphic input in one of three possible combinations:

- When both modes are off, input can be through the mouse, as when there is no digitizer connected to your computer.
- When screen mode is on and world mode is off, you can use the digitizer as a mouse, which continues to be available. Both can be used to draw and select interface features.
- When screen mode is off and world mode is on, you use the digitizer to input 3D geometry. You cannot use it to select interface features, which you can do with the mouse.
- While the screen and world modes cannot be active at the same time, you can easily and rapidly switch from one to the other so that you may use the world mode for 3D drawing and the screen mode for picking interface features.

In both screen and world mode, digitizing may occur in conjunction with any of the form•Z tools that require or can use graphic input. However, digitizing works mostly in conjunction with drawing tools, most notably with the Vector Line tool. This implies that the digitized geometry is entered as a connected sequence of points, which may be open or closed shapes. When using the Vector Line or similar drawing tools, the same conventions as when using the mouse apply.

- A point is entered by pressing the button or pedal programmed with the Enter Point action (see the Pedal parameters below), or the return/enter key.
- An open drawing sequence is terminated by pressing the button/pedal programmed with the End Drawing or End Drawing Through Point action.
- A closed drawing sequence is terminated by pressing the button/pedal programmed with the Close Drawing or Close Drawing Through Point action.

Generally, when drawing under the control of Screen or World Digitizer Input, the result is a set of open or closed shapes. The program knows nothing about the intentions of the user, nor does it check them for consistency or proper order. The last command in the group of the digitizer support, Capture Digitizer Mesh, allows you to do this. That is, you can instruct the computer to construct a mesh from a set of shapes you digitized. This mesh can be constructed using one of two available methods.

The digitizer supporting items are discussed in more detail in the next subsection.
The digitizer menu commands

The digitizer is controlled through six menu items at the bottom of the **Options** menu (Figure 3.7.27.1).

**Digitizer Setup...**

This item invokes the **Digitizer Setup** dialog (Figure 3.7.27.2) which controls the communications between **form-Z** and digitizer hardware. It also contains parameters that control the use of the digitizer within **form-Z**. Connect the digitizer as specified in the user’s manual that accompanies your digitizer hardware before using this dialog.

**Digitizer**: This pop up menu contains the list of supported digitizers. Select the digitizer that you are using. There is currently only one supported digitizer, the Microscribe 3D.

**Communications**: This group of items instructs **form-Z** how to communicate with the digitizer by specifying where the digitizer is actually connected to the computer and at what speed the communications should occur.

**Port**: This menu indicates where the digitizer is connected. Select the port where the digitizer is connected. On the Macintosh, this menu contains two items: **Printer Port** and **Modem port**. On Windows, this menu contains four items: **COM1** through **COM4**.

**Baud**: This menu indicates what speed communications should occur between **form-Z** and the digitizer. Choose a setting based on the capabilities of your digitizer hardware and computer as described in their respective manuals. If multiple choices are possible, the faster (bigger number) will give better results. If you get an error at one speed, try using a slower speed.

**Sensitivity**: This parameter controls how sensitive **form-Z** will be to the motions of the digitizer. The larger this number is, the more the digitizer sensor must be moved before **form-Z** will recognize and respond to the motion.
Snap Tolerance: Recall that, when working with the mouse and you use Object Snaps, you can set the Tolerance in the Object Snaps dialog, which can be invoked from any of the Snap icons. This Tolerance is set in Pixels, which is appropriate when working with the screen units. However, it does not suffice when you work in 3D world space, as is the case with 3D digitizing. For the latter, this field in the Digitizer Setup dialog allows you to set the tolerance using real 3D units.

Use Extended Cursor: When this item is selected, which is the default, the extended cursor is automatically used when the digitizer is in world mode, regardless of the setting of this option in the Windows menu. This makes it much more obvious when the world mode is active and gives visual feedback on the location of the digitizer.

Pedals: This section contains options relating to the digitizer’s pedals. If your digitizer has only one pedal, only the settings for the Left pedal will have any affect.

Beep When Pedal Is Pressed: When this option is on, the computer will beep when a digitizer pedal is pressed to indicate input has occurred. This option is off by default.

Left Pedal Action: This pop up menu contains a list of 5 possible actions that can be executed when the Left pedal is pressed (Figure 3.7.27.3). The default is Enter Point (Single Mouse Click), which is identical to a single mouse click in the graphics window. When the pedal is pressed, the digitizer’s current location is taken as an input point and added to the current drawing. The remaining options, Close Drawing, Close Drawing Through Point, End Drawing, and End Drawing Through Point are as described in section 3.2.7 of this Addendum 2.9.5.

Right Pedal Action: This pop up menu controls the action that is executed when the Right pedal is pressed. Its menu items are the same as for the Left Pedal Action menu. The default is End Drawing Through Point.

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<thead>
<tr>
<th>Left Pedal Action</th>
<th>Enter Point (Single Mouse Click)</th>
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<tbody>
<tr>
<td>Close Drawing</td>
<td>Close Drawing Through Point</td>
</tr>
<tr>
<td>End Drawing</td>
<td>End Drawing</td>
</tr>
<tr>
<td>End Drawing Through Point</td>
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</tbody>
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Figure 3.7.27.3: The Left Pedal Action pop up menu.
Screen Digitizer Calibration...

This item is used to map the digitizer’s workspace to the computer’s screen. This requires the selection of three points in the digitizer’s workspace that correspond to the upper left, upper right, and lower left corners of the computer screen. If this item is selected and the Digitizer Setup dialog was not invoked since launching form-Z, the Digitizer Setup will be automatically invoked to establish the digitizer settings.

Clicking on this item invokes the Digitizer Screen Calibration dialog, shown in Figure 3.7.27.3. This dialog has a small image of the screen on the left and text on the right. The dialog will prompt for the selection of the three points and will mark which point is being selected with a red highlight in the screen image. Select each point by placing the digitizer’s sensor at the desired location and pressing the primary button/pedal or the return/enter key on the keyboard. Once the third point is selected, the dialog automatically closes and the calibration is complete.

![Digitizer Screen Calibration dialog](image)

Figure 3.7.27.3: The Digitizer Screen Calibration dialog.

Screen Digitizer Input

This item is only available after Digitizer Screen Calibration... has been completed. When selected, the digitizer input is used to control the cursor relative to the screen. This allows the selection of interface elements, such as icons and palettes, just as it would be done with the computer’s mouse. This mode does not disable the use of the mouse. form-Z will recognize which device is in use and move the cursor accordingly.

The primary use for the screen mode is to use it in conjunction with the world mode. By establishing a screen calibration along with a world calibration, you can switch back and forth between screen and world mode without having to physically put down the digitizer and pick up the mouse.
World Digitizer Calibration...

This item is used to map the digitizer’s workspace to the form•Z project space. If this item is selected and the Digitizer Setup dialog has not invoked since launching form•Z, it will be automatically invoked to establish the digitizer settings.

Clicking on this item invokes the World Digitizer Calibration dialog, shown in Figure 3.7.27.4. This dialog offers three different ways to establish the relationship between the digitizer’s work space and the form•Z world space. All methods require the selection of at least one point with the digitizer and corresponding input in the form•Z space. Each step is described in the prompts palette and can also be entered numerically. Select the desired option and, when the dialog is closed by clicking on OK, calibration will begin.

Reference Point And Scale: With this method, a single point from the digitizer is calibrated to a point in the form•Z space and a scale factor is numerically entered. This is the simplest calibration but it does not allow for orientation alignment. That is, the orientation (x,y,(z) axis) of the digitizer is assumed to correspond to the form•Z world axis. The steps are:

- Using the digitizer, identify the origin point.
- Using the mouse, identify where that origin point is within the form•Z modeling space.
- Numerically enter the desired scale factor in the prompts palette.

Reference Plane And Scale: With this method, three points from the digitizer are calibrated to the current reference plane along with a scale factor. The points are the origin of the reference plane, a point on the X axis of the reference plane, and a point on the Y axis of the reference plane. The steps are:

- Using the digitizer, identify the origin point, a point on the X axis, and a point on the Y axis.
- Numerically enter the desired scale factor in the prompts palette.

3 Points: This is the most general and flexible method, but requires the most input; three points from the digitizer and three from form•Z. With this method, the three points from the digitizer are mapped to the form•Z space to establish the orientation and scale. The steps are:

- Using the digitizer, identify the 1st, 2nd, and 3rd point.
- Using the mouse, identify where the 1st, 2nd, and 3rd digitizer point is within the form•Z modeling space.

This calibration method is also the most useful for re-calibrating when the object being digitized or the digitizer itself moves (often called “leap-frogging”). This is accomplished by choosing three points on the object being digitized that have already been digitized and snapping to those same three points in the form•Z world space (using Point Snap).
**World Digitizer Input**

This item is only available after **World Digitizer Calibration**... has been completed. When selected, the digitizer input is used to control the **form•Z** input into the workspace used within the **form•Z** tools. The mouse is still available for selecting interface elements, but it can not be used within the **form•Z** project window. If the **Use Extended Cursor** option is on in the **Digitizer Setup** dialog (which is recommended), the location that is drawn is clearly visible. It is less visible when the extended cursor is not used.

In this mode, all input in the project is in world space from the digitizer. All **form•Z** tools work with the natural 3D input. This includes drawing tools as well as picking, snapping etc.
Constructing a mesh from the digitized shapes

While a variety of form-Z tools can be used to construct meshed objects from the digitized shapes, there is also a menu command that will automatically mesh them.

**Capture Digitizer Mesh**

Selecting this menu item initiates the digitizing process, which is indicated by a check mark in front of the item in the menu. All surface objects that are created from this point will be used to construct a final meshed object. When the desired shapes have been digitized, the **Capture Digitizer Mesh** item is selected again, which generates the final meshed object.

At the time of the second selection of the item, the **Digitizer Mesh Capture Options** dialog (Figure 3.7.27.5) is invoked to allow selection of options for the construction of the mesh.

**Mesh Construction Method**: This group of options determines how the meshed object is constructed. Two options are available: **Thread Profiles** and **Join Patches**.

**Thread Profiles**: This method works with a set of open lines, which are the profiles of the mesh. The faces of the mesh are constructed by connecting (threading) corresponding pairs of points from neighboring profiles. That is, each point of each profile is connected to a corresponding point on the next profile. The profiles should be drawn in the same direction. When the **Closed** option is on, faces are also constructed from the last to the first profile creating closure in this direction. An example is shown in Figure 3.7.27.6.

**Join Patches**: This method makes a single mesh from a set of adjacent closed shapes. The mesh is constructed by stitching individual shapes where they touch. The order in which the shapes are drawn is not important. However, for this method to work properly they should be carefully digitized to insure that their points are close enough to be recognized as adjacent. Using Point Snaps is recommended for this construction method. An example is shown in Figure 3.7.27.7.

**Triangulate**: When this option is selected, the mesh is triangulated as it is constructed. The **Triangulation Options**... button invokes the standard **Triangulate Options** dialog discussed in subsection 4.5.6 of the User’s Manual.

**Status Of Objects**... This button invokes the **Status Of Objects** dialog whose options work as for all the modeling tools (see subsection 3.7.14 in form-Z User’s Manual and Addendum 2.9).