3D Creator™

Set-Up and Usage Guide for Rhino

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As with many instructions, it can be helpful to read a couple of steps ahead or your current step so as to put the current step "in context" of the others. Better, it is recommended that you skim through all of the sections of these instructions so as to gain a feel for the different aspects involved in your first equipment set-up.

Author's Note: These instructions are intended to help you avoid wasting time and or damaging your equipment. Please take a few extra minutes to read and follow them and it will save you lots of time later!

General Equipment Set-up

In this section, generic set-up of the equipment is discussed. Once completed, the equipment is used to aid you in proper equipment placement and use.

Equipment Connection

- Remove the tripod from the 3D Creator carrying case and extend the legs. The "head of your tripod should now be at lest level and preferable above the object that you are measuring.. Inspect the head of the tripod so as to understand the basic operation of the quick release mechanism prior to having your hands busy with the sensor array!
- Remove the sensor array from the carrying case, and slip off the protective plastic sleeve, if present. Orient the camera so as to engage the foot of the quick release mechanism (mounted to the sensor) into the shoe on the head of the tripod, opening the quick release mechanism to allow the foot to seat. Confirm that the sensor is fully engaged and stable prior to letting go!
- Once firmly installed, orient the camera so as to be horizontal. Remember that it is generally a good idea to be above object to be measured.
- Remove the control unit from the carrying case. It is the silver box that is about 10"L x 6" W x 2" D. Place it in a location where it will be in close proximity to your computer. Connect the Control Unit to the Sensor Array using the gray 25 foot cable. Note at the sensor end that the red dot on the two mating parts of the connector should be lined up prior to insertion. The other end of the cable is plugged into the rear panel of the control unit. It is recommended that the screws be tightened for permanent installations; this is probably not necessary for a one or two-day setup.
- Connect the 6 foot serial cable to the back of the control unit, and to the serial port on your computer. If you do not have a serial port on your computer, it will be necessary to use the serial-to-USB adapter (supplied), plugging the adapter into your computer's USB port and to the loose end of the serial cable.

- Use of the serial-to-USB adapter will require that the software to make it work (drivers) be installed. So, if necessary, locate the CD with these drivers from your 3D Creator case, insert it into the CD drive and follow the installation instructions.
- Connect the power supply for the Control Unit to the back of the control unit and, using the separate power cord, connect it to power.
- The probe cradle and probe are next removed from the case. Place the (heavy) charging base in a suitable location, and connect its power supply to it, again with a separate power cord. Confirm that the green light on the power supply comes on when connected to power. When the probe is placed in the cradle, the green LED will change to red if charging is needed. Hint: if the LED does not change to red, and you suspect that the battery is not fully charged, try turning the probe power switch on and then back off while the probe is sitting in the cradle.
- Turn on the Control Unit by actuating the small rocker switch on the rear of the unit. A single short beep will be heard after only a few seconds, followed by 8 ascending tones after about 25 seconds. These "up tones" indicate that the system is connected properly and functioning.
- Note that the blue triangle shaped component is still in the carrying case. It was not forgotten, its use is frequently not required, and is discussed elsewhere.
- Before proceeding to the software setup, let's take a few minutes to discuss equipment positioning.

Equipment Placement

- Now that the various components of the system are unpackaged and positioned relative to each other, we can take a few moments to discuss placement tactics for successful measuring.
- The 3D Creator is a "line-of-sight" system. The probe and sensor are constantly communicating back and forth with each other. This means that the one large receiver port in the middle of the probe, and the 4 transmitter LED's at the corners of the probe "handle" must always be able to be "seen" by the sensor array. In order for this to occur, three items are critical: 1) positioning the sensor (and the DRF, if it is to be used) properly relative to the points where data is to be taken, and 2) holding the probe such that the infrared receiver and the four infrared transmitters are not covered by fingers and 3) orienting the probe so that it is within view of the sensor.
- Once you have set everything up as per the instructions that follow, and you are ready to take data points, it is a good idea to take sample points at the extremes of your planned measuring area to make sure that your equipment is set up such that it has the required viewing area.

Software Setup, Using 3D Creator with Rhinoceros 3

Now that the hardware is set up and operating, it is time to get your computer working.

Installing the 3D Creator Plug-in for Rhino 3

- Install Rhinoceros 3 software onto your computer first if your computer does not already have Rhino installed. It is necessary to load Rhino first because the 3D Creator Plug-in software that comes with the 3D Creator searches for the Rhino 3 installation, and will not install if Rhino 3 can not be found on the computer.) To do this, load the Rhinoceros CD into your CD drive and follow the instructions. Note that for later steps, installation of Rhino automatically places a Rhino icon on the desktop of your computer.

- Next, insert the "3D Creator SDK and Rhino 3 Plug-in" CD into the CD drive. This CD is found in the jewel case inside the 3D Creator carrying case. Use an explorer window (right click on START and select "EXPLORE") to navigate to the CD; run the installer file "CreatorPlugin.msi" by double clicking on the file.

- When the CreatorPlugin install has finished, the Rhino software needs to know where to find the 3D Creator plug in. To do this, start Rhino 3 by double clicking on the icon on your desktop. When it has opened, go to the Tools pull-down menu and select "Plug-in Manager".

- In the Plug-in Manager dialog box, select the "Install" button. The "Load Plug In" dialog box will open. In the Load Plug-in dialog box, find the 3D Creator plug-in file called "3DCreator.rhp". This will require navigating to " Rhinoceros 3.0\Plug-ins\3DCreator\3DCreator.rhp. Select "3DCreator.rhp" and then click on the "Open" box. Scroll down to the bottom of the plug-ins list. The 3D Creator now appears as a selectable plug-in at the end of the loaded plug-ins list in Plug-in Manager dialog. Click on 3D Creator. Close the Plug-in Manager dialog box.

- If not already done following the instructions above, make sure the 3D Creator digitizer is connected to the host computer with the serial cable and the Sensor array is connected to the digitizer. Start the 3D Creator digitizer by actuating the rocker switch on the rear panel. The two blue lights on the front panel should illuminate. Wait for the 8 ascending tones that indicate startup is complete, this should take approximately 25 seconds.

- Back in Rhino 3, select "3-D Digitizer" in the Tools pulldown menu. Then, select the Connect option. In the command window at the top left corner of the screen, you will see a prompt such as:

    Select digitizer (Digitizer=Faro Digitizer):

Click on the text **Digitizer=Faro Digitizer** in the command line**,** to display a complete list of digitizers in the same command line. Click on **3D Creator** from among the list of digitizers. If the connection is successful, the messages

3D Creator Connected.
Version: 3D Creator 1e Camera SN: ssssss Calibrated on yyyy/mm/dd

are displayed, where ssssss is the serial number of the sensor and yyyy/mm/dd is the year, month, and day of the camera calibration.
If the connection is not successful, the messages

3DCreator Connection FAILED.
3DCreator Disconnected.
Unable to connect to the digitizer.

are displayed. Check the serial cable connections and the serial port settings on the host computer.

- When the 3D Creator digitizer is connected for the **first time only**, the Comm Port Settings dialog box is displayed. Select the values that apply for the particular com (serial) port you are using on your computer. Usually, the default values displayed will be correct except for the port number. The default numbers should be the following:

  - Bits per second: 115,200
  - Data Bits: 8
  - Parity: none
  - Stop Bits; 1
  - Flow Control: Hardware

- The port number will vary depending, among other factors, on whether you are using a serial port or a USB port. If you are using the serial port, the port should be “COM1”. If you are using the serial to USB converter, the port should be “COM7 or “COM8” .

- You can’t start measuring quite yet! A 3D Creator message box is displayed warning that a tool must be connected and activated before any measurements can be taken. This message box will not be displayed again when reconnecting if a tool has previously been connected and activated.

3D Creator Menu and Options

Connecting tools

When the 3D Creator digitizer is connected to Rhino 3, the **3D Creator** menu selection will appear in the Rhino menu bar.

The 3D Creator menu enables connecting and activating instruments to the digitizer and for setting digitizer operating parameters. Tools (instruments) can be either measuring probes or DRFs (dynamic reference frames). Probe names begin with the letter 'P' and DRF names begin with the letter 'D'. The 3D Creator digitizer provides ports A, B, C, and D for connecting wired tools such as the DRF, and ports M and N for connecting wireless tools such as the probe. Typically, Control Units have 2 wired ports on the front for connection of DRF's. The wireless port M and N are virtual ports and are always available, N is used for your wireless probe.

To "connect" a probe or DRF to a port, select the **3D Creator** menu item, and then move the cursor down to the desired port. Expand the port selection to display the tool list and select the desired probe or DRF. Only wired probes/DRFs are displayed for wired ports and only wireless probes/DRFs are displayed for wireless ports. If more than one tool number appears in the list, you MUST select the number that corresponds with the serial number of the probe or DRF that you are using.

After selecting the port/tool combination, a checkmark appears next to the port name and next to the tool name. The tools is now connected but not activated. To activate, select the **3D Creator** menu item again and select **Active** at the top of the tool list.

Only probes are used to measure 3-D coordinates. DRFs are used to establish coordinate systems when attached to large objects being measured. Their use is optional. By connecting and activating a DRF, a coordinate system relative to the DRF is established – if the DRF is rigidly attached to an object, the object or the Sensor may be moved with respect to the other and the coordinate system is preserved.

To deactivate a tool, select the **3D Creator** menu item, and select **Active** again. To disconnect (and deactivate) a tool from the port, select the **3D Creator** menu item, and select the tool name.

Options Dialog

The Options dialog is displayed when **Options…** is selected in the **3D Creator** menu. The Options dialog provides digitizer configuration capability:

- Units of measure
- Geometry tolerance
- Digitizing modes

Units of measure can be set to millimeters, inches, or user defined units (number of units per meter). If the units of measure are changed, the 3D Creator digitizer must be disconnected and reconnected so that Rhino 3 enables the new units.

Geometry tolerance specifies how accurately a tool's LEDs (emitters) must be measured by the Sensor in order to be considered a successful measurement. The lower the value, the more accurate the measurement required. The default value of 1.0 (mm) should be sufficient for most applications and should not be changed.

Digitizing modes specify how the digitizer measures and delivers data to Rhino through the plug-in.

- Single Point mode with data averaging delivers the highest accuracy when individual point measurement is needed
- Continuous mode with Simulated Button delivers a continuous stream of data points when the simulated button is ON. The simulated button is used when the probe used does not have a button.
- Continuous mode with button down and no movement filtering delivers a continuous stream of data points when a button on the probe is pressed
- Continuous mode with button down and movement filtering delivers a continuous stream of data points when a button on the probe is pressed and the probe has moved a specified minimum distance since the last data point. The minimum distance is specified in the current units of measure.

The appropriate digitizing mode should be determined for each application. All tool connections and activations in the 3D Creator menu and all setting in the Options dialog are saved and restored when the 3D Creator digitizer is reconnected to Rhino.

Taking Data points

To take data points with the 3D Creator, remove the probe from its charging cradle. Select either the 5 mm "ruby" tip or the pointed tip. Thread the selected tip into the appropriate extension (use the adapter if needed) and tighten using a tool such as an unfolded paper clip or a pin in the tightening holes of the tip and the extension. The extension, adapter and tip should give you a total tip length of 50mm.

Confirm that the total tip length is set to 50mm. To do this, go to the 3D Creator pull down menu. GO down to Wireless port N. The tip length shows up in the box to the side. It should show 50.000. If not, click on the Probe Length text and a dialog box will open. Change the tip length within that dialog box to 50.000 (or something else if you are using a different extension length) and click OK.

Note: Alternate tip lengths can be used to reach into otherwise difficult or impossible to reach locations, but they require setting the system to the appropriate tip length AND they impact the overall system accuracy.

Turn the probe on by sliding the small slide switch at the front of the probe (near where the extension was threaded in). The green LED on the probe will come on momentarily and then turn off.

Position the probe in the field of view of the sensor. The green LED on the probe should again com on, indicating that it is receiving a signal from the sensor array.

NOTE: this does NOT mean that it can transmit a signal back to the array, fingers can be blocking any of the 4 transmitting LED's (prohibiting a successful measurement) and the green LED will still be on!!

Measuring in Rhino 3 with the 3D Creator

The following describes methods of entering commands into Rhino to take data points and analyze them.

Note that each time you take a data point, the 3D Creator will beep.

-Taking Points-

Curve menu: Point Object > Multiple Points
Or
On the **Command line**: Type "Points"

To draw multiple point objects

1 At the 'Location of point object' prompt, start taking points with probe.
2 Press Enter when you are done creating points.

-Making Curves-

You can either select the points you created and run the 'curvethroughpt' command

OR

Draw a curve by interpolating points (This creates the points and draws a curve along the points).

Either
Curve menu: Free-Form > Interpolate Points
Or
On the **Command line**: Type “InterpCrv”

To draw a curve by interpolating points

1 At the prompt “Start of curve (Degree=3 Knots=Chord StartTangent), start taking points with the probe.

2 Press enter when done. At the ‘Degree=3 Knots=Chord EndTangent Close Sharp=Yes Undo’ prompt, you can use the Close or Sharp=Yes option to close the curve.

3 To end the curve, press Enter.

-Creating Surfaces-

1. Create a surface by lofting curves.

Either
Surface menu: Loft
Or
In the **Command line**: Type “Loft”

To loft a surface

At the prompt “Select curves to loft”, select the curves by clicking on them in the order that the surface should pass through them.

Options

Style:

Normal
Uses chord-length parameterization in the loft direction.

Loose

The surface is allowed to move away from the original curves to make a smoother surface. The surface control points are created at the same locations as the control points of the loft input curves.

Tight
The surface sticks closely to the original curves.
Uses square root of chord-length parameterization in the loft direction.

Straight sections
The sections between the curves are straight. This is also known as a ruled surface.

Developable
Creates a separate developable surface or polysurface from each pair of curves. A separate developable surface is created from each pair of curves

Closed loft
Creates a closed surface, continuing the surface past the last curve around to the first curve. Available when you have selected three shape curves.

Match start tangent

If the start curve is a surface edge, maintains tangency with the adjacent surface. You must use at least three curves to activate this option.

Match end tangent

If the end curve is a surface edge, maintains tangency with the adjacent surface. You must use at least three curves to activate this option.

Cross-section curve options

Do not simplify
Rebuild with control points
Rebuilds the shape curves before lofting.
Refit within
Refits the shape curves to the specified tolerance value.

Click preview to preview the loft.

When you are done adjusting the connections, press Enter.

2. Create a surface from a network of curves.

Either
Surface menu: Curve Network

Or
On the **Command line**: Type “NetworkSrf”

NetworkSrf creates a surface from a network of smooth curves. You can select a group of curves and Rhino sorts them out automatically. Rhino also handles curves that do not touch exactly.

To create a surface from a curve network

At the Select curves in network (NoAutoSort) prompt, select the curves.

The surface will be created.

If the automatic curve sorter cannot figure out which curves go in which direction, you will be prompted to select the curves manually.

If you want to select the curves individually, you can turn the automatic sorter off.

Options

Tolerances

Edge Curves
Sets the tolerance for the edge curves. The edges of the surface will be within this value from the edge curves. The default is the system tolerance.

Interior Curves
Sets the tolerance for the interior curves. The interior of the surface will be within this value from the interior curves. The default is the system tolerance x 10.
If the curves themselves are farther apart from each other than the tolerance values, the best guess is made at the surface.

Angle
If you are matching tangency or curvature, this is the accuracy that is used for matching surface normals.

Edge Matching
After the command is done, the surface will have four edges. Edge matching determines how those edges match the input geometry.

Loose
The surface edge is does not attempt to match the edge to the surface edge within tolerance.
Position
The surface edge is matched within tolerance of the input surface edge.
Tangency

The surface edge is matched tangent (G1) to the surface edge.
Curvature
The surface edge is matched curvature continuous (G2) to the surface edge.

You can choose the type of edge matching you want for each curve or surface edge. You must select surface edges as part of your curve network to match edges. If a curve and surface edge overlap, be sure to select the surface edge. The Choose multiple objects dialog box differentiates between the two.

-Measure distance between two points-

At the very bottom of Rhino window:

-Make sure 'World' and 'Snap' options are selected
-Enable the 'Osnap' dialog bar by clicking on Tools → Object Snap → Persistent Osnap Dialog
-Check boxes 'Near' and 'Point' in the Osnap Dialog bar.
-Now, click on Analyze → Distance
-Select the points you want to measure distance between. The distance between the points is shown above the command input box.

Some commonly used rhino commands with 3D Creator (in alphabetical order)

3View: Three-viewport layout.
4View: Four-viewport layout.
Blend: Blend between two curves.
BlendSrf: Blend two surfaces.
CrvThroughSrfControlPt: Create curves through the control points of a surface.
Curve: Draw a curve by control points.
CurveThroughPolyline: Interpolate a curve through a polyline.
CurveThroughPt: Create a polyline through a group of point objects.
Extend: Extend a curve.
ExtendCrvOnSrf: Extend a curve on a surface.
ExtendSrf: Extend a surface.
ExtrudeCrv: Extrude a curve into a surface or solid.
ExtrudeSrf: Extrude a surface into a surface or solid.
InterpCrvOnSrf: Interpolate a curve on a surface.
Length: Measure the length of a curve.
MergeEdge: Merge two adjacent edges of a surface.
MergeSrf: Merge two untrimmed surfaces.
NetworkSrf: Create a surface from a network of curves.
New: Create a new file.

Offset: Offset a curve.
OffsetSrf: Offsets a surface.
Point: Draw a point object.
Points: Draw multiple point objects.
Sketch: Sketch a curve.
Snap: Toggle snap mode.

Pointers for good measuring success:

Sensor:

Place the sensor array at or slightly above the object to be measured. Typically, the sensor is horizontal, however some measurement situations benefit from orienting the sensor. If it is used in this orientation, it must of course be positioned so that none of the tripod legs block the sensors windows.

Position the sensor to be looking as directly at the object to be measured as possible. Parallel or perpendicular to the object are both good, parallel is better if the object stills fits in the viewable area. The sensor can

The viewable area of the sensor is straight ahead of the sensor and approximately 10 degrees to either side.

Dimmer light in the measuring area is better than bright light. Avoid incandescent lights.

Probe:

Make sure that the "Probe Tip Length" is set correctly. In Rhino, this is under the command "3D Creator > Wireless Port N > Tip Length". The standard tip length is 50mm.

Confirm that the tip extension is fully threaded into the probe body. A loose extension creates errors. Check this tightness periodically during measuring.

Remember to hold the probe in a manner that does not cover the infrared receiver (in the middle of the handle) or any of the 4 infrared transmitters, yet still allows you to actuate the buttons on the side.

Orient the probe so that it has "line of sight" to the sensor array at all times.

The probe can be held in any orientation that allows it to be seen by the sensor and still touch the point to be measured. "Lean" the probe in any direction that you need to in order to get a reading.

The green light on the probe will be illuminated when it is receiving commands from the sensor. While this is an indication of a good probe position for getting commands FROM the sensor, it does not necessarily mean that it is a good position for the sensor to see all of the transmitters on the probe.

If you have additional questions, please call

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