

Laser Scanning Protocol

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*After opening laser scan tools (icon on desktop), click on the "scan" icon in the upper left corner of the window.

*On the lower row of icons, click "connect". You should see the blue articulated arm and the laser sheet reconstructed in the main window.

* Home the device by putting the red-balled tip into the cone-shaped socket on the back of the articulated arm. Spin the laser head counter-clockwise (looking down at the table) until the scanning head touches the side of the articulated arm, and continue to rotate the base in the same direction until it stops. Hold lightly in this position and push the 'home' button located on the back of the base of the articulated arm. The reconstructed arm in the monitor should now be in the same position as the arm is.

*Under the "navigator" menu, you should see one object. As you accumulate sweeps, they will all be merged into this object.

*To create new objects, click the 'new scan' icon on the lower row of icons. This will not overwrite your previous object, it will only add another. Using multiple objects, one can take multiple separate scans of a specimen (for example, in different orientations) and then register them to one another.

Scan mode

This is the mode you are automatically brought into when the program opens with a new scan. This is the mode where data collection takes place. You can get back to this mode (or any other mode) at any time by clicking on the "sweeps" icon (or the icon of whatever mode you'd like to go to) along the top row of icons. Data collection happens via a series of individual sweeps of the specimen.

To take a sweep, point the laser at your specimen, making sure the rectangular head of the scanner is perpendicular to your specimen. Click (not hold down, just snap) the button on the side of the scanning head. The "status" in the Microscan menu (left side of the screen) will turn from a green-highlighted "ready" to a red-highlighted "scanning". As long as this reads "scanning", the scanning head is collecting data. Sweep across your specimen slowly and steadily, keeping the rectangular portion of the head perpendicular to your specimen. Finish the sweep by clicking the button on the scanning head again. Now the status should read "synching" for a moment, then will automatically go back to "ready". Once it goes back to ready, you can take more sweeps. The black rectangle on the left side of the screen shows what the camera sees. The red dots are where the laser is hitting the specimen and the camera is seeing that intersection. Use this as a guide for understanding the appropriate distance and orientation of the laser.

The Microscan menu also has a toggle between small and large laser. Use the large laser for broader areas and the small laser for hard-to-reach crevices and times when more detail is needed. For each surface (top, front side, back side, left side, right side, etc.) take a sweep, rotate the scanning head 90 degrees about the long axis of the rectangular head and sweep again. Do this two more times. You should now have swept the same surface four times, once in each direction. If this does not give you enough points, or if there is artifact from the scanning orientations (visible in the 'points mode, below), try sweeping diagonally (rotating 45 degrees instead of 90) several times as well. As your sweeps accumulate, you should see your model building up in the large window.

Use the "move" icon on the top row to manipulate your scan. Holding down the left mouse button rotates the object, holding down the middle mouse button allows one to move the object, and holding down the right mouse button allows for rotation about the world origin instead of the centroid of the object. Using the "select" icon, any noise or unwanted parts of the scan can be highlighted and deleted. To deselect something already selected, click the "clear" icon on the lower row of icons. To delete it, click the "cut" icon, or hit the "delete" key on the keyboard. The "raw points" icon on the top row allows for one to see the points of an object, which can be toggled on and off; same with the sweeps. This can be helpful in assessing artifact, density of points in a particular area, or missed regions of the specimen. Note: When creating multiple objects with the intention of merging, both objects can be selected by holding control while clicking them. Once multiple objects are selected, they can be moved together instead of individually. This is possible in any mode.

Sweeps mode.

Click on the "sweeps" icon after you've finished taking sweeps of the specimen. You will be asked if you want to disconnect from the Microscan. The answer is yes. You're now in the "sweeps" mode. This mode allows for registration of multiple scans (pieces of the same specimen) and them merging of those objects. If you only have one object, click on the "point cloud" icon on the lower row of icons to generate a point cloud and move to the points mode. *Registration.* If multiple objects need to be registered together, click on the "register" icon on the top row. You are given up to four points to place on each object needing to be registered to others. Alternate between "register" and "move" to be sure the points are placed correctly. Click on each object individually to place registration points. Once they have been placed on all objects, click the "register" button on the registration menu on the left side of the screen. Note: this is NOT one of the icons in either row. We'll use those in a moment. The program will now try to align those three or four points as well as possible, and you will get a residual based on the error of those four points only. Click on the "register objects" icon in the top row to begin a fitting algorithm. Adjust settings as appropriate for your model. Use multiple iterations to lower your error. This is often best done several times at decreasing search areas. This icon will be present in the following modes as well, and can be used there instead of in "sweeps" mode. Most modelers have the best luck waiting until mesh mode to register, but explore for the best mode to register with the specimen at hand.

Points mode.

Here, you have a point cloud of your data. Use the "detect noise" icon to find abnormal points. Even the strongest noise detection is usually beneficial. After clicking "detect noise", the noise that the program finds will be highlighted. Use the "cut" icon or the delete key of the keyboard to erase these points. Nick often does this twice to detect a greater proportion of the outlying points. The "Sample" icon is used to cut down your point cloud, and can be done based on either a raw percentage of randomly selected points, or based on density of points in a given volume. The "Smooth" icon can be used to both sample and smooth the remaining data. This is one of the most helpful functions in this program, but troubleshooting is typically needed to estimate the best levels for smoothing. Save your work and try several different iterations at different levels to find the appropriate settings for your size and resolution needs. The "triangulate" icon brings your point cloud into a mesh by creating triangles connecting points. This also brings you into Mesh mode.

Mesh mode.

In this mode, the mesh can be edited. If the goal is an exported OBJ, STL, VRML or other file format mesh, the program must be in this mode for the export to work properly. File -> export will allow this action. In this mode, as in previous ones, the "select" tool can be used to select and delete specific portions of the model, and the "move" tool can be used. Select multiple objects to move them simultaneously. "Smooth" in this mode is a similar version of what could be done in points mode. Try different levels to create the desired smoothness. Use "Decimate" to randomly cut down the number of triangles in the mesh. "Detect" can be quite helpful in for selecting triangles that should never have been formed in the first place. It selects abnormal triangles on the basis of edge lengths, areas, or aspect ratios selected by the user. "Fill Holes" is only useful for small, simple holes. Select all or part of an object and then click this icon. Complex holes will not be altered, and simple holes will be filled with as few triangles as possible. "Merge" will combine two or more objects into one object in their current orientation. This was available in other modes, except in this mode, one can decide to join triangles and edges or to keep them separate. The "register" icon on the bottom row runs a fitting algorithm on two selected objects. It begins from the current orientation and optimizes from there. If the algorithm is not fitting the two objects together correctly, try changing the settings, or using the "register" icon on the top row (where points are input onto each object by the user manually, and then registered to each other) first, to start the computer close to the correct orientation.

Bone models can be cleaned up with Geomagic.