Using a Shining 3D® EinScan-SP™ 3D Scanner

Located in AT 141, Ball State University

http://techweb.bsu.edu/jcflowers1/rlo/einscansp.htm

updated 10/26/2018

Objectives:

By the end of this lesson, you should be able to:

Image Source: www.einscan.com

1. Explain what reverse engineering is, and how 3D scanning is just one of the tools used for reverse engineering.
2. Identify ways to safeguard human health and equipment during scanning.
3. Differentiate between good and bad candidates for scanning with this technology.
4. Prepare the scanner.
5. Scan an object.
6. Align scansets.
7. Post-process scans.

Introduction

Reverse engineering refers to processes and technologies that allow us to start with an object or product and to determine the design or code that could be used better understand it, and possibly to recreate it. Software can be reverse engineered, and this is sometimes done illegally where programmers intend to steal the intellectual property from its owner by writing new code that mimics what the owner's code does. Physical objects can also be reverse engineered, both for legal and illegal purposes.

There are several techniques and technologies that can be used to reverse engineer a physical object. For example, an object can be physically measured, possibly leading to the creation of a drawing based on those measurments. We can also digitize the surface of the object using contact digitizers, where a stylus is placed against a point on the surface of the object and the location of the stylus is then read, or non-contact digitizers, such as laser scanners, scanners that use structured light, CT-scans, MRI scans, ultrasound scans, and more.

Scanning the surface of an object using light tyically results in a virtual object that has holes in it. By repositioning an object after a set of scans is complete, it may be possible to scan areas of the surface that were hidden during the first set of scans. With some scanning software, there is a need to align individual scans into a scan family or set, and then to align one set with another set scanned after the object had been repositioned.

Editing is often needed to eliminate data points that are not actually on the surface of the object, such as mounting clay. Holes may need to be filled, and surfaces smoothed somewhat. The resulting virtual object is typically a high-polygon mesh file that can be saved in a variety of formats for 3D visualization, rendering, 3D printing, simulations, advertising, extracting working drawings, changing the design of an object, and more. Somtimes the object file is too large to be easily and quickly manipulated, as often happens when those new to scanning use too high a resolution.

Safety

While 3D scanning may seem harmless (and mostly is), there are still safety concerns related to working with the machine. Always be sure that you are wearing eye safety while in the lab, but also consider the following:

1. Never look directly into the lights from the 3D scanner. These lights can be very bright and damage the eyes. This should also include any observers while you are using the machinery. Be mindful of others so that they are also not harmed during the process.

2. Do not use the equipment without a prior demonstration by an instructor or lab supervisor.

3. Do not put fingers, hands, or any other part of the body near the turntable while the equipment is running.

4. Do not touch the areas where light enters the scanner, which could dirty the lens or cover.

5. Make sure that during scanning nothing will fall or get damaged. Scanners move all by themselves, and if poorly positioned, either part of the scanner or the object being scanned can become damaged.

For more information:

View and listen to an introductory youtube video:

https://www.youtube.com/watch?v=nnU-WNGqDRI

This non-contact 3D digitizer (i.e., scanner) is manufactured by Shining 3D. Their page on this scanner can be seen at:

https://www.einscan.com/einscan-se-sp

The manufacturer has a small guidbook at the following location. Please reawd through its brief sections called *How to Get a Successful Scan* and Our Scan Process:

https://docs.wixstatic.com/ugd/981f44_fd4e14c42d2b49f2a04473b488f565e9.pdf

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Procedure

A. Select an Object to Scan

A1. Before coming to the lab to do a scan, please select an apprpriate object to scan. Use the following checklist to select an object that meets the following criteria:

A good object for scanning is likely:

- ☐ 1. Not smaller than 1.2 x 1.2 x 1.2 inches
- ☐ 2. Not larger than 38 x 38 x 38 inches (much smaller is better)
- ☐ 3. Not heavier than 11 pounds (much lighter is better)
- ☐ 4. Not symmetrical, which would make alignment difficult (like a golf ball)
- ☐ 5. Not transparent (like clear plastic or glass)
- ☐ 6. Not very shiny or reflective (like shiny plastic, glass, or metal); not oily (like okra)
- ☐ 7. Not very dark (like a piece of coal)
- ☐ 8. Not fuzzy or hairy (like a peach or a doll with hair)
- ☐ 9. Not so floppy that it will not maintain its shape when repositioned (like a rag doll)
- ☐ 10. Not with internal areas that cannot be scanned (lik a chambered Nautilus)
- ☐ 11. Not having very thin features (as does a scallop seashell)

- ☐ 12. Not a simple object (like a cube or sphere) that would be easier and cleaner to draw rather than to scan
- ☐ 13. Not an object that another person has scanned in this lab
- ☐ 14. Not an object that came from the Rapid Prototyping Lab (like one of the objects in the display window or a tool or piece of material from the room)
- ☐ 15. Not the intellectual property of a corporation or a person from whom you have not received written permission for this scanning (as are a host of manufactured objects)

B. Prepare the EinScan SP scanner

Note: The procedure below will guide you through the most common usage of the EinScan-SP scanner in our lab. Be ware that there is sometimes a need to make alternative choices, such as selecting to calibrate the scanner.

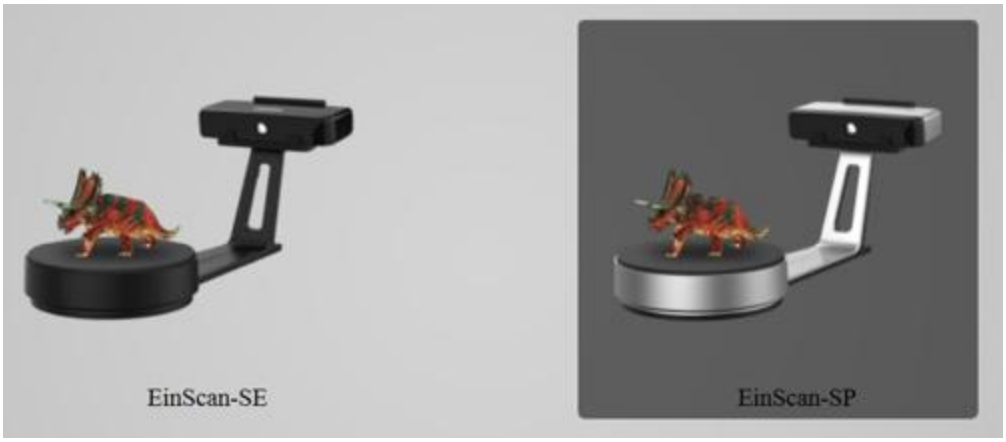
B1. Turn on and log into the scanner's computer.

B2. Position the scanner for scanning.

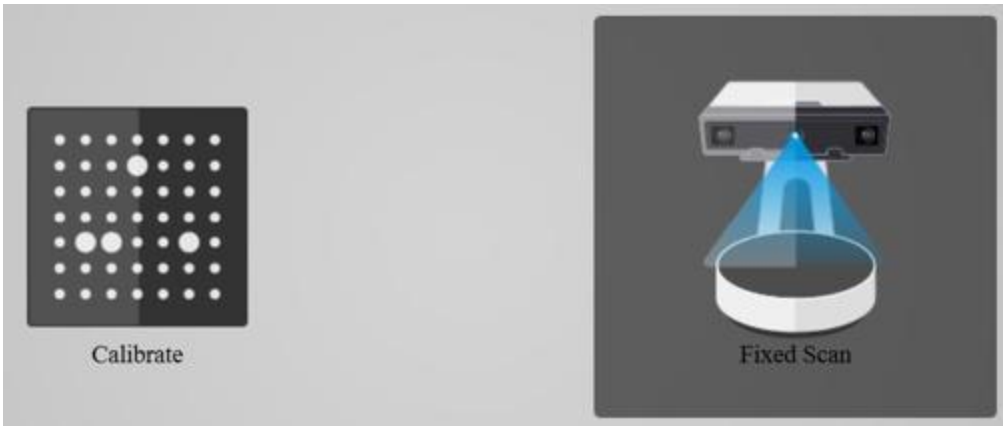
B3. Since we typically turn off the scanner by unplugging the power cord, plug it in.

B4. After a moment, open the EinScan-S program on the computer.

B5. From the *Select Device Type* screen, choose **EinScan-SP** and click **Next**.



B6. From the *Choose Working Mode* screen, choose **Fixed Scan** and click **Next**.



B7. Select **New Project**, then navigate to the appropriate folder on the D:\ drive for your class. Create a new folder with your last then first name as the folder name, so mine would be flowersjim, and give your file an appropriate name.

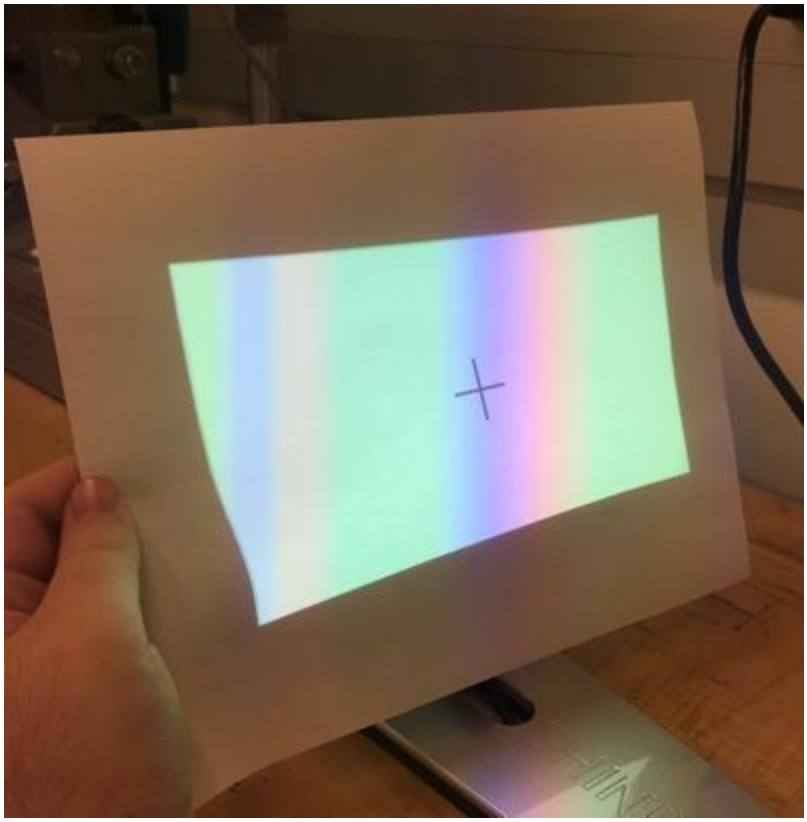
B8. Will you be doing a monochrome scan, or also capturing the color pattern of the object's surface? If you are scanning in full color, select **Texture Scan**. If not, select **Non-Texture Scan**, thrn click **Apply**.

For Texture (color) Scans Only:

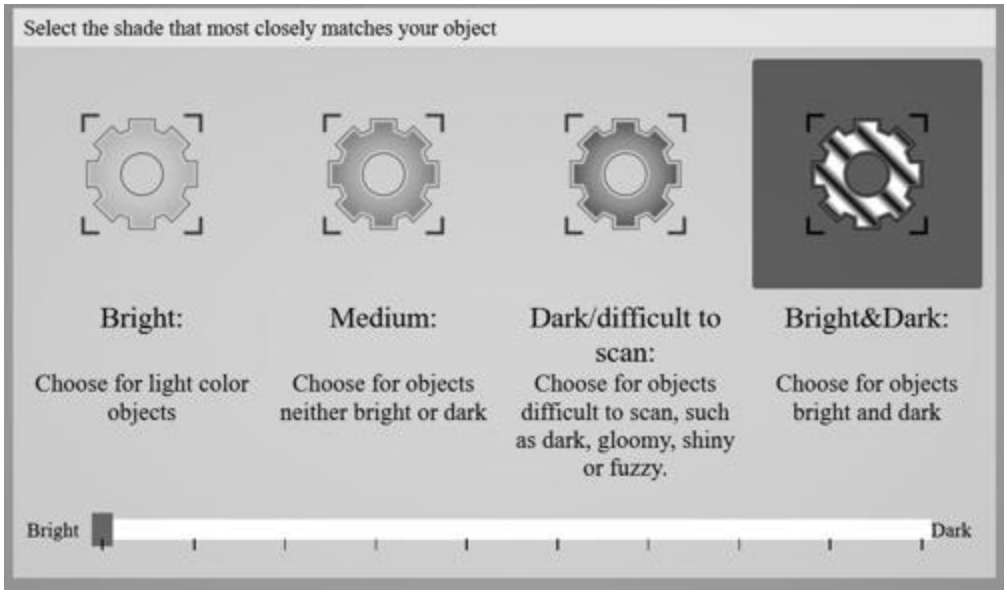
B8a. Here, you will see a dialog box which says ‘Restarting white balance’. Choose ‘Yes.

B8b. The program will ask you to ‘Place a white paper to do white balance testing. This means that you will need to hold a blank piece of white printer paper in front of the scanner such that the full projection is only on the paper, as seen in the picture below. Click ‘Start white balance’. The white balance test will run, and the screen will change when complete

B8c. The program will ask you to ‘Place a white paper to do white balance testing. This means that you will need to hold a blank piece of white printer paper in front of the scanner such that the full projection is only on the paper, as seen in the picture below. Click ‘Start white balance’. The white balance test will run, and the screen will change when complete.



B9. Whether you chose a texture scan or a monochrome scan, you will see a dialog box which asks you to select the shade that most closely matches your object. If your object is white or a color which is light in shade, choose **Bright**. If your object is a mid-tone color, choose **Medium**. If your object is a dark or black color, or if your object is shiny or fuzzy, choose **Dark/difficult to scan**. If your object is a combination of light colors and dark colors, choose **Bright & Dark**. Click **Apply**.



Note: On the left side of the screen is a group of settings for your scan. These will control the quality, time, and file size of your scan mounting clay.

Right Camera – this only affects whether or not both input cameras are seen on the screen. It is purely cosmetic and will not affect your scan, but can be used to make sure that your object can be seen by both cameras.

HDR – this will change whether the scan uses High Dynamic Range (HDR). This can improve the quality of your scan, but can increase scan time as well as file size.

Turntable Steps – this setting will change how many steps the turntable takes to complete its full 360 degree rotation. With 8 as the setting, the turntable will turn 45 degrees 8 times to complete the scan. The higher this number is, the smaller the turns, the longer the scan time, and the higher the scan quality.

With Turntable – This should be kept checked unless otherwise instructed so long as the turntable is being used.

Align Mode – Unless otherwise instructed by a lab supervisor or instructor, this should be kept as Turntable. This setting affects how the alignment of the model is completed after scanning.

B10. After reviewing what each of the settings does, please choose the settings apporopriate for your scanning job.

B11. Place the object to be scanned onto the turntable if you are using turntable or turntable coded targets alingment mode. If the object will tend to move on the turntable, you might need to use a tiny amount of dark clay to hold it to the turntable.

C. Scan the object:

C1. Select the "**Start Scan**" button on the far right of the window. It looks like a triangle facing the right side of the screen.

C2. **Wait for the scan to complete.** Depending on your settings, this could take some time. Be patient and do not move the model or the scanner during this process. At this time, the system makes several individual scans that are aligned into a scanset or scan family.

C3. Once complete, look at the finished scanset to find whether the geometry is complete. The scanning software will indicate areas without geometry with yellow.

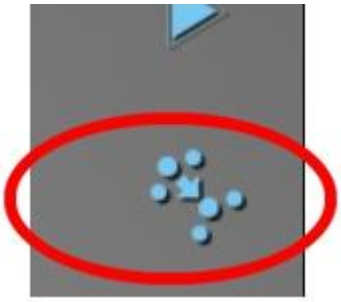
C4. As necessary, reorient the object and run a second set of scans. (Return to 6.a for instructions on starting another scan.)

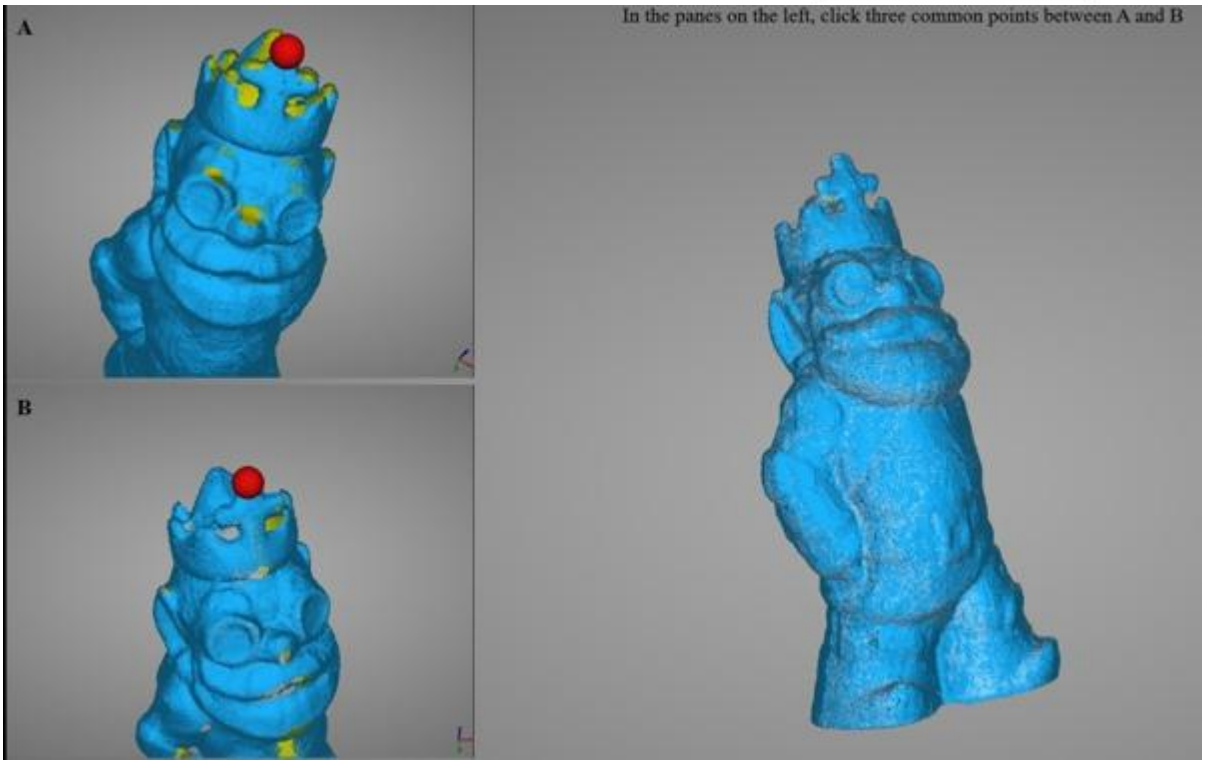
D. Align scansets:

D1. After a second scanset has finished scanning, EinScan-S should attempt to align the geometry automatically. Check the geometry to see if the alignment is correct. If the alignment is correct, skip to section E1 on Post-Processing.

D2. If the alignment is incorrect, you will have to manually align the scansets. To begin this, **press the Align button** on the far right of the window. (This button is a set of 6 dots with an arrow between)

D3. Find three areas of the model which have shared geometry within the two scans and select them using Shift+Left Mouse Button. The shared areas will be identified using colored spheres. Once you have selected these three points, the program will align the scans using the supplied information.



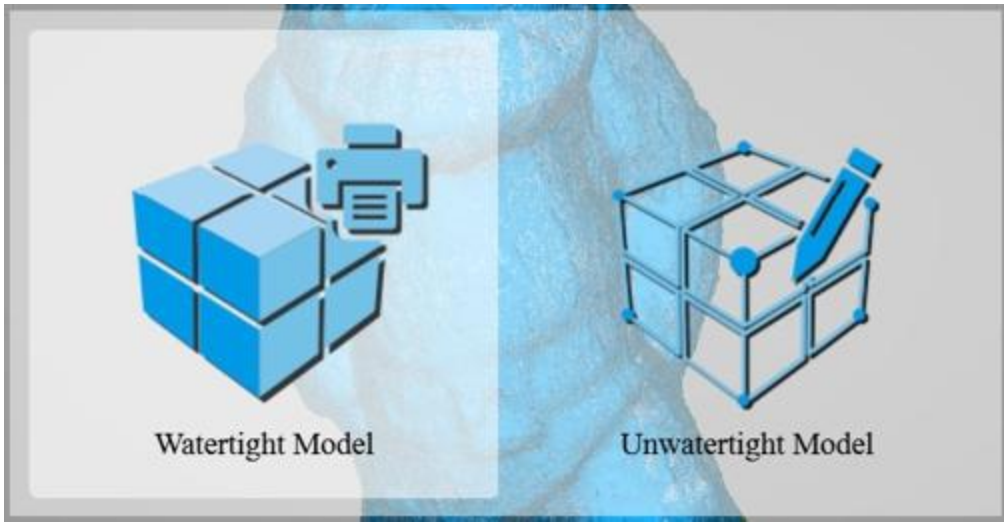


E. Post-Processing:

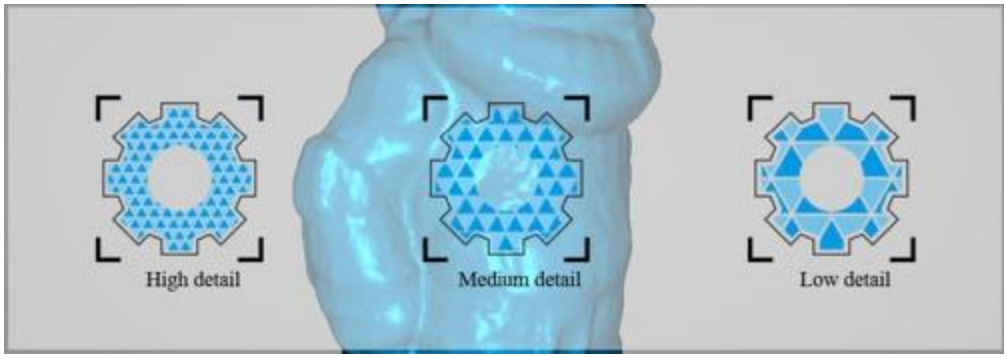
E1. After alignment, **save your work**. To do this, select the Save Your Scan button in the far right of the window. This looks like a floppy disk. Be sure that you are saving in the correct folder and giving the file an appropriate name for ease-of-retrieval later. You would be wise to make a backup of your work on removable media, like a thumbdrive, and take it with you.

E2. Convert the 3D scan into a mesh. click on the Mesh button in the far right of the window. This button looks like a triangle with a curved arrow next to it.

E3. Select **Watertight Model.** It is customary to make sure the virtual model is a solid rather than just a series of planes that may have holes between the model's outside and inside. It is especially important that models used for 3D printing do not have holes. These are referred to as *watertight* virtual models, even though after 3D printing the physical model might not hold water without leaking.



E4. Select the appropriate level of detail. In most cases, this would be **Low Detail**. In rare instances, it would be more approriate to select medium or high detail, depending on the nature of the geometry in the model and the intended use of the result. d) If you are intending to 3D print the object or to modify the object in 3D modeling sE4oftware, you will select Watertight Model in the next dialog box



E5. Select and record the final processing pamaters:

Original Size – the size of the file before any simplification

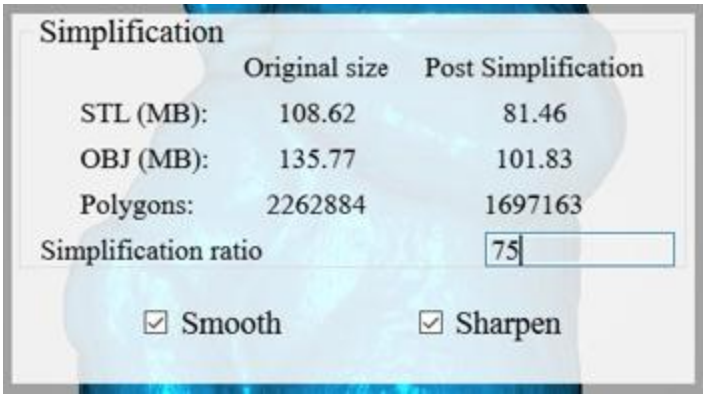
Post Simplification – the size of the file once the simplification process is completed

STL (MB) – This refers to the Original size and the Post Simplification size (in MB) if the file is exported from the program as a stereolithography (.STL) file.

OBJ (MB) – This refers to the Original size and the Post Simplification size (in MB) if the file is exported from the program as an object (.OBJ) file.

Polygons – the number of faces on the model before and after simplification. A higher number will result in a larger, more complex file.

Simplification Ratio – the amount of simplification to be performed with respect to the original file size and polygon count. This number is a percentage, so 75% would simplify the file to 75% of its original size.



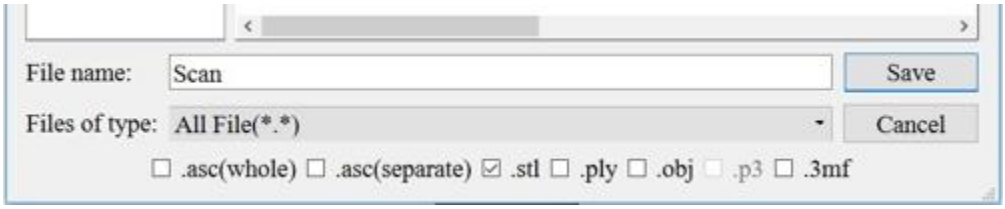
Smooth – whether the program should attempt to smooth out any rough areas of the model during the simplification process.

Sharpen – whether the program should attempt to sharpen any corners or edges of the model during the simplification process.

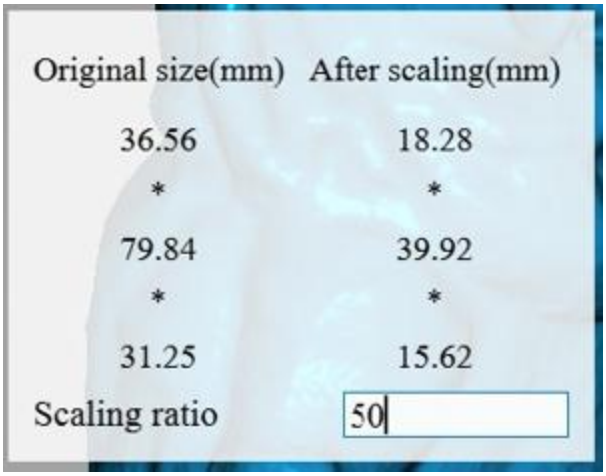
E6. After selecting the simplification ratio and whether you would like the program to smooth or sharpen the model during the process, select **Apply**. This process might take some time as the file runs the simplification process.

E7. Save your work again, with an appropriate filename.

E8. Consider exporting your model into a different file format. The output could be a stereolithography (.STL) file, a polygon (.PLY) file, an object (.OBJ) file, or a 3D Manufacturing Format (.3MF) file. If the scan includes color and you intend to 3D print or modify the file, choose .OBJ. If the scan does not include color and you intend to do a monochromatic 3D print or modify the file, choose .STL.



E9. If you would like to scale the model to a different size at this time, select the appropriate ratio so that the model size (in millimeters) is correct.



E10. Navigate to your file in Windows Explorer and copy it to a removable storage device or other suitable location.

E11. **Fill out your entry in the Machine Log** in the 3-ring binder for your scanning job.

E12. Close the EinScan-S window.

E13. Power off and unplug the EinScan-SP scanner.

E14. Eject and remove any removable storage devices.

E15. Power down the workstation and turn off the monitor.

E16. Remove your model and any clay you might have used. Leave the workstation in good order for the next person.

Appendix: Instructions and Notes for Laboratory Staff

EinScan-SP

S1. Do not allow users to scan manufactured items that are the intellectual property of other people or companies unless the user has written permission.

S2. Over the years, about 95% of the models students first suggest scanning are bad candidates. Please help the students to use the checklist.

S3. Encourage students to create original shapes that are not too flimsy nor with intricate internal geometry out of the lighter colored clay.

S4. If the scanner needs to be calibrated, help the student to do this. Do not do it for the student.

S5. As needed, refer students to the talcum powder and the calibration plate located in the drawer near the scanning station.

S6. When a student is finished, make sure they've logged their job and left the station in good order for the next person, powering down if no one was waiting to use the station.

S7. In rare instances, the tripod in the drawer near the scanning station can be used to hold the scanner. Please don't let the students damage the scanner if they use the tripod.

S8. If any person who is not listed as having been trained on the use of this scanner wishes to use it, refer them to Jim Flowers.

"Using a Shining 3D EinScan-SP 3D Scanner "
All information is subject to change without notification.
Some information provided by Cody Blacksand

Ball State University
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