



**University of Hail
Laboratory
Industrial Engineering Department
Practical Exercise and Procedures of using 3D Scanner**



Laboratory 3

Introduction

This course will demonstrate how to use 3D printing software to create digital designs that can be turned into physical objects. It will also demonstrate how 3D scanners work to turn physical objects into digital designs. This course is hands-on in nature and will provide step-by-step instructions to guide you how to use the portable 3D Go Scanner. Learners who complete this course will be able to use 3D software to design a wide variety of objects for both personal and professional use.

Goal and contents

Students are given training in:

Use a structured approach, to utilize the full range of functions available in a modern CAD system to create robust CAD models of parts and products with complex shapes and structures.

Adapt and prepare CAD models to make them suitable for manufacturing in a Rapid Prototyping machine

Concepts covered:

Advanced solid modeling operations and modeling of parts with complex shapes and freeform surfaces;

- Point cloud
- Meshes, Polygons
- NURBS
- Solids
- Understand when and why these 3D-format are used
- The different modeling paths available to maximize modeling efficiency.

Some different 3D-measuring technologies as:

- Laser scanning
- Structured light scanning
- Photo "scanning"
- Measuring arm

Knowledge of the software and its applications in the rapid prototyping process

- The importance of constructing, tolerance and linear units.
- Clean exporting of your model for prototype making.
- Understand the process of data transfer as it relates to their designs to other CAD systems.
An overview of the merits and limitations of various file transfer formats (i.e.: IGES, STEP, STL, OBJ etc.), tips and traps will be provided
- Prepare models for successful rapid prototyping output

Practical Exercise

Practical exercise is in the form of lectures and practical training under the supervision of tutor. In the computer lab, exercises will be carried out under the guidance of authorized teacher. All sections in the course are obligatory.

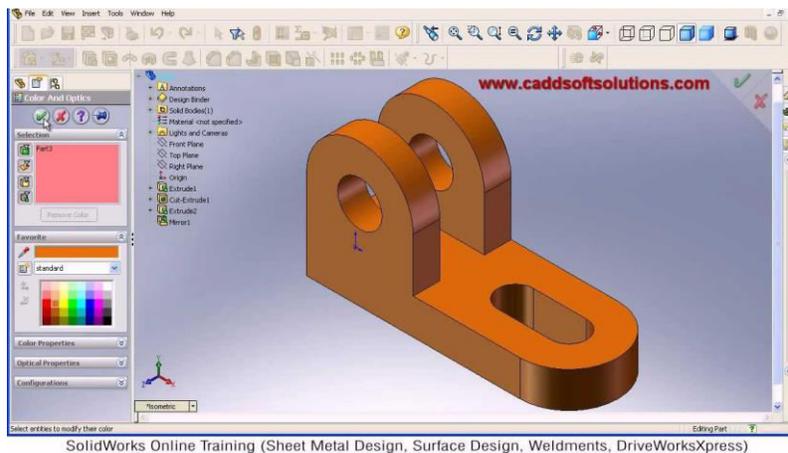
STEP 1

Preparation of files in SolidWorks

- Make a **SIMPLE** 3D-model. With maximum size **110x80 Height 40 mm**
- One **STEP** file
- One **IGES** file
- One **picture** (max 5Mb)

Tool diameter 8 mm

Space between parts about 9 mm.



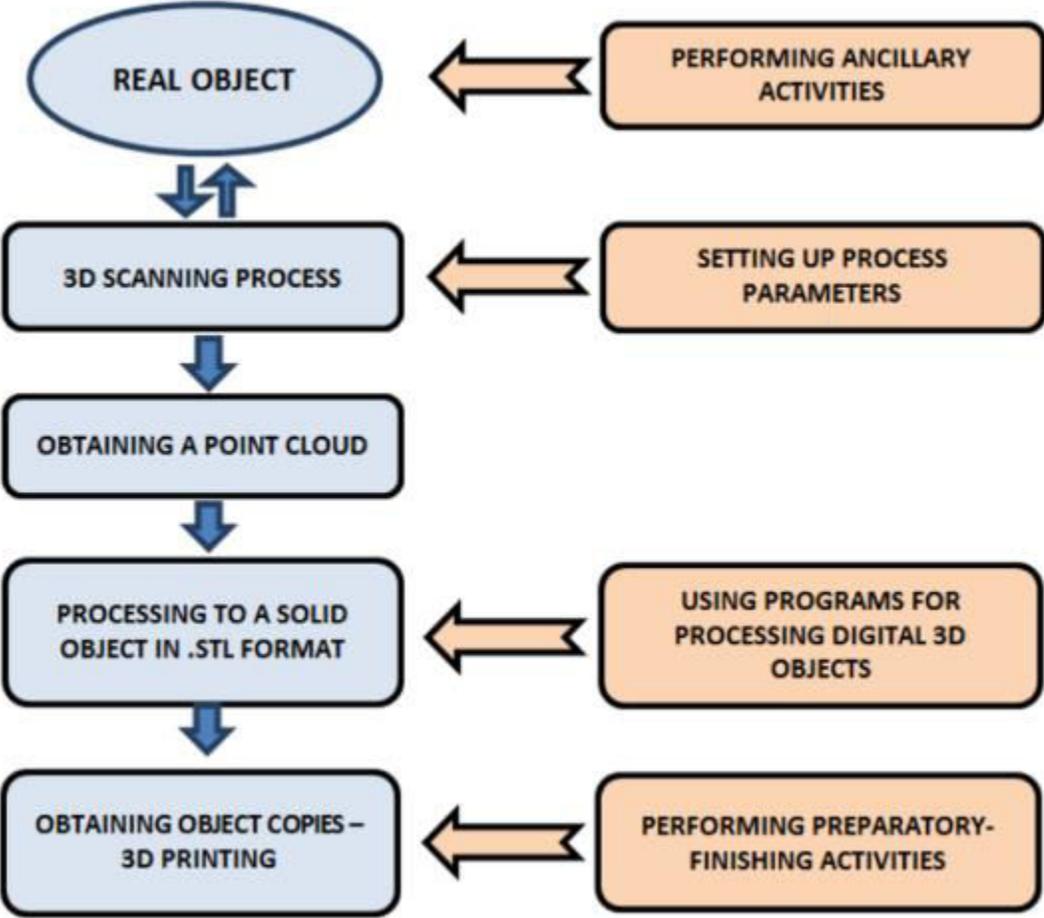
STEP 2

Export file, STL or IGES-format, to the Rapid Prototyping machine

- Use a SIMPLE 3D-model. With maximum size 110x80 Height 40 mm
- Use the SRP-player_ to make the milling paths.
- One STL file or IGES. Yes STL-format is alright
STL is usually only for Rapid Prototyping
- One picture. A screen dump from the Roland software SRP-player (max 5Mb).
The milling paths should be visible!

Exporting to the STL format for 3D printing

<https://www.youtube.com/watch?v=yuwJ89OgpWE>



Procedural scheme of obtaining copies of a real object using reverse engineering and rapid prototyping

Connecting the Scanner

Once the scanner and accessories have been unboxed, the first step is to connect the scanner to your computer by following the connecting instructions in the Set-up Manual or the following:

1. Plug the USB Type A connector end into the computer;
2. Plug the USB Type B connector end into the scanner;
3. Connect the power cable to the scanner and plug the power cable into a surge protector;
4. Download the software from www.matterandform.net/download. Important: Make sure to download the appropriate software for your computer;
5. Follow the setup wizard and complete the install process;
6. Open the scanner by gently depressing the release button on the top of the scanner and swing it open, revealing the scanner head and the turntable. Turn the handle 90° until it locks in place as the scanner leg.
7. Power the scanner on.
8. Open the software. The software will search and detect the scanner. Once it does, you're ready to start! Before you perform your first scan, you must calibrate your scanner. Go to "Calibrating the Scanner" for step-by-step instructions and "The Importance of Calibration" (p.) for more detail on how this process works.

Calibrating the Scanner

The Importance of Calibration

In order to maximize the scanner's precision and accuracy, it's highly recommended users devote time to calibration whenever the scanner has been moved. Every scanner will have tiny, unique differences as a result of the manufacturing process, temperature fluctuations and physical placement, so it is necessary to allow the software to properly measure and compensate for such differences (i.e., calibration). Calibrating is especially important after a scanner is moved. All data captured by the scanner are in relation to the dead center of the turntable. Because the turntable can shift up to 1 mm, any potential shift can affect what the camera, lasers and software consider to be the dead center of the turntable when constructing a point cloud. Throughout the calibration process the scanner's camera,

lasers and software are developing reference points in an XYZ coordinate system based on the geometries and angles of the calibration box and its checkered squares. Upon completion, the software and firmware will save these reference points when scanning all subsequent objects until calibration is completed again and new reference points are saved.

Calibrating the scanner may be the single most important step to take in order to get good results. Calibrating your scanner on a regular basis ensures that you get the most accurate results from your scan. To calibrate:

1. Make sure your scanner is connected to your computer and powered on.
2. Open the Matter and Form scanner software.
3. There are three options on the left on the start screen. Click "Calibrate" to start the calibration process

The scanner will rotate the calibration card (or box) left and right on the turntable, firing its lasers and collecting a range of data. Please be patient. This process can take several minutes.

The scanner will rotate and fire its lasers again. Be patient and avoid moving the calibration device

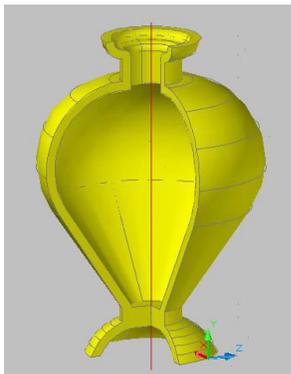
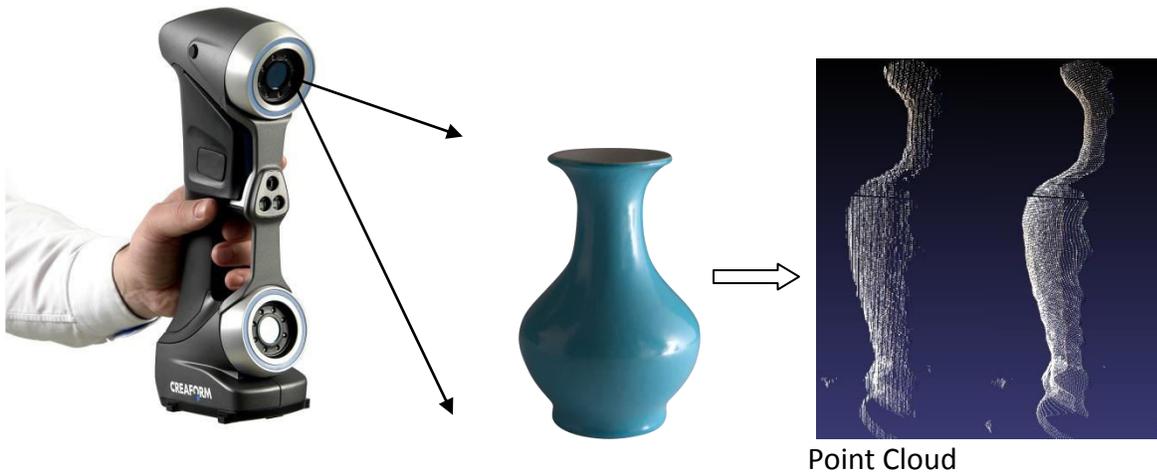
If your calibration is interrupted or fails, an error message should appear. Here are a few examples of the possible error messages

If you receive any of the above Calibration Failed messages, try the action suggested in the message and try to calibrate again.

If it's successful, you'll see the following message:

Congratulations! You are now ready to start scanning!

STEP 1



Scan an object

Click on "New Scan" to begin.

Use the Laser scanner 3D Scanner Go Scan

- Make sure there are enough features to track.
- Always keep surface in the middle of the screen during scanning.
- Look only at the screen, not at the object.
- Monitor the distance meter at all times.
- Always aim to keep scanner at medium distance.
- Point scanner at the object from different angles, always moves your wrist.

Most users will find that the automatic settings of the scanner are more than adequate for their scanning purposes. For very complex objects or lighting conditions, or for specialized results, users can select the advanced button to access tools to manually adjust scanner settings

Rotating, Zooming In and Panning Users can rotate, zoom in or move the scan on the screen (i.e. pan) to get a better view. These controls are available anytime and do not affect the scan in progress.

To SPIN your model: Click and drag anywhere in the view window to rotate your model.

To ZOOM in: Use the mouse wheel, or scroll, to zoom in and out of your model.

To PAN: Hold the Control button while clicking and dragging to pan your model on the screen.

Saving and Exporting a Scan Once the scan has completed, users will be prompted to save the finished, rough scan.

What happens during a Scan The scanner uses two lasers to scan small to medium sized objects placed on its rotating bed. One rotation provides 360° coverage of an object. For some small objects, one full rotation (or pass) is enough to scan the whole thing. In order to capture larger objects, the scanner's head rises and automatically detects whether there is more of the object to scan. Like building a virtual layer cake, the scanner continues additional passes until the full height of the object is captured. 43 During the scan, the bed will rotate forward, but will also sometimes rotate back. This is by design and is called Adaptive Scanning. Its purpose is to capture as much of the object as is physically possible. As new sets of points are captured, the distance between them and the previously-captured set of points is calculated. If too much distance has been detected between the last recorded point, the scanner "backs-up" and re-scans the areas between the two sets of points in an attempt to fill in that distance with additional data.

Single-Color vs. Multi-Color Scanning

The difference between the Single- and Multi-Colored scanning options is in the number of camera exposures used to detect the lasers. Single-Colored scans use one camera exposure for laser detection, whereas Multi-Colored scans use two camera exposures. To choose the best option for the object you want to scan, determine if your object's colors are contrasting, or if they are close to the same spectrum. This can be accomplished by looking at the Single-Color or Multi-Color?.

Single- and Multi-Color scanning options are intended to make scanning objects easy. However, as you get more comfortable with scanning, you'll come to realize that the choice can be a little less black and white. For example, objects that have colors on both sides of the wheel, but are very light, can often be successfully scanned with the Single-Color option. The closer a color gets to white the more it starts to have in common with other colors which are also close to white, and the fact that they're on opposite sides of the wheel matters less. The same holds true for colors that are very dark

Problem Materials and Surfaces

There are some materials that laser scanners have trouble scanning. Because the scanner works by capturing the data that is made by the laser hitting the surface of the object, any material that makes it difficult for the camera to record where the laser is hitting it will not scan well.

- Objects with surfaces that are too shiny (i.e. shiny metal, jewels, mirrors, patent leather etc.) - will reflect or bounce the laser away from the object. If your scan looks like it has a halo of cotton candy spinning around it, that's a sign that the object is too shiny.
- Objects that are clear or translucent (i.e. glass, Lucite, clear plastic, flower petals, etc.) - will let the laser light pass right through the surface of the object instead of being stopped by the surface. Your scan will look like there's nothing solid where the laser light passes through.
- Objects that are too dark and absorb too much light (i.e. black velvet, fur) - will also absorb the laser light causing an inaccurate scan. The software won't be able to determine where the surface of the object is. So how do you scan objects with the above features? Pre-treat them with matte paint, anti-reflection sprays or powder (i.e. baby or talcum powder). Users have also had luck with water soluble colored hairspray which is safe for most non-porous material and can be washed away with water. This may not be appropriate for all objects, however. Also, if you want to capture color data, be aware that the treatment may alter the color as it appears in the final scan.

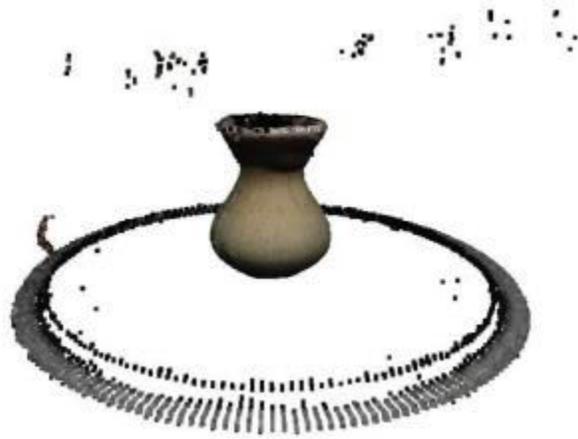
Industrial Engineering Laboratory

Step 2

Improving the Scan Quality

During scanning, the scanner can sometimes pick up and add unintended points to the scan. The cause of these points can be reflections off the surface of the object or captured background movement, objects or reflections, amongst other things. In response, we developed cleaning tools to help remove those unwanted points. It is critical that you clean prior to meshing.

Below is an example of a raw scan of a small, handmade vase. Note the visible scanner bed and what appear to be spots floating in mid-air.



To get rid of these unwanted points, the software has a “Clean” function

Click the "Clean" button on the tool bar.

Clean tools will appear in the area on the right. There are three major options: Crop Points, Brush Cleaning and Fuzzy Points/Auto Clean. There is also an “Undo” button to restore points that you have cleaned.

Cropping removes all points outside an area you specify. Use the sliders (click and drag or use your arrow buttons) to control how much of the image you want to crop out. Points will highlight in red when they are in the cut off area. The first slider removes points from the bottom up.

Use the second slider to crop points away from the center.



Points to be removed are highlighted in red.



Slider has been moved to crop points outside the “cage” surrounding the vase.



Zooming into the vase, we can see that there are still a few unwanted points. The Brush Cleaning feature can remove these individual points.

Zoom in close to remove even more points.



Before: Note the points near the outer left surface.



After: Points have been deleted.



Light cleaning – errant points still remain on the scanner bed and around the bumper.



Medium cleaning – a few more points have been cleaned away.



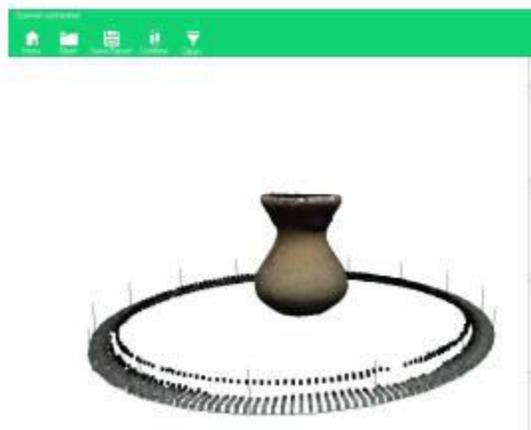
Heavy cleaning – errant points on the scanner bed are gone but so are some good points around the front wheel.

All points can be removed including good points. Highlighting a section will remove all points in the path of the highlighted section. Rotate the model to make sure only unwanted points are highlighted.

Another option is to use “Auto Clean”. The software automatically "cleans" what it determines are outlier points. Radius refers to the number of points surrounding each evaluated point in a scan. Threshold refers to the minimum distance, in millimetres, from the surrounding radius points that a potential outlier point must be for it to be cleaned/discarded. The lower the numbers, the more points are erased.



Before Auto Clean



After Auto Clean

Once cleaning has been finished, click the green “x” next to Clean and Crop to close out of “Clean”. A new message window will appear:



Congratulations! You have a cleaned scan.

If you get no result, or a very fragmented surface, the following are probably wrong:
Distance from scanner

- Make sure your object is in the centre of the turntable (by eye) and the centre of the turntable is 430mm (17in) from the scanner for a 'wide' scan. For a close up scan, (macro) this distance should be 265mm (11in).

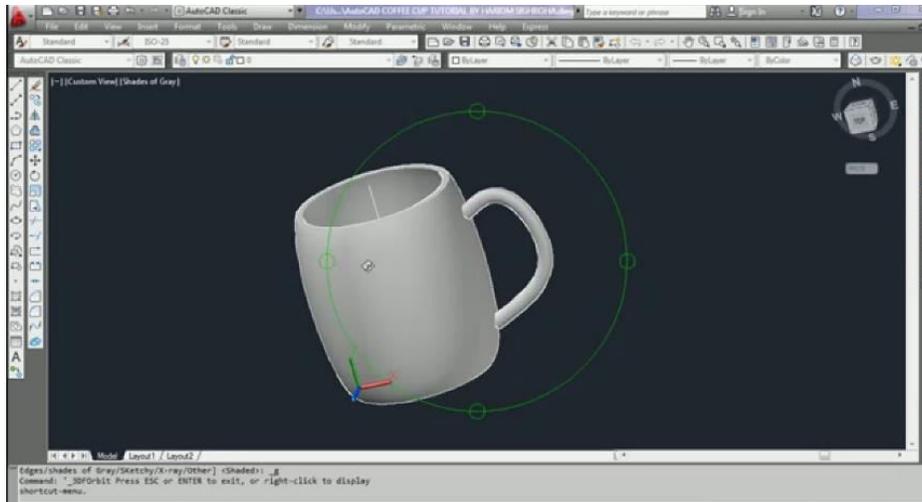
Surface of the object is too reflective

- Try treating the surface of the object by applying the chalk powder in the powder pen in the accessories box. Alternatively, you could spray paint your object a neutral matt medium grey color. Pure white may reflect too much light back to the scanner, and black may not reflect enough.

Scanner is not level

- Ensure that the scanner is parallel with the axis of the turntable. This is easy if the scanner and turntable are on the same surface.

STEP 3



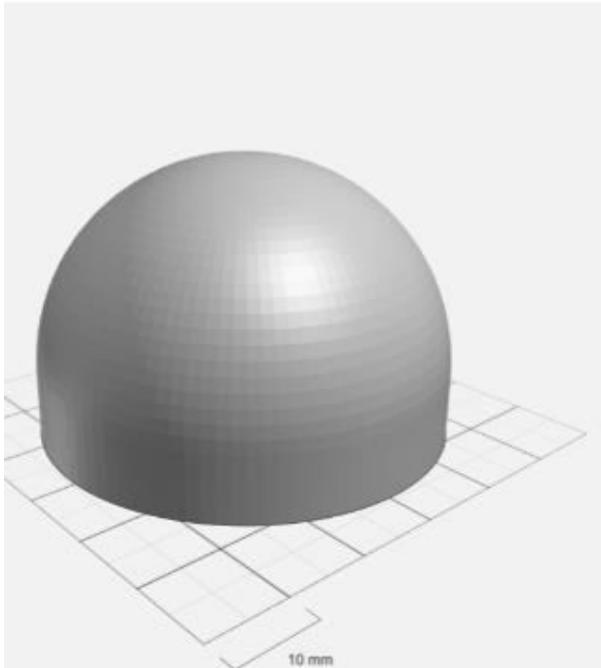
Trim Scans

- The scanner will inevitably pick up some geometry of the hardware restraining your object. You can easily delete this.
- Click 'Trim' in the main toolbar.
- Select the areas of the mesh to trim. You can do this using the tools in the main toolbar
- Square/circle brush - use these to draw over the geometry to be trimmed
- Draw rectangle - use this to draw a rectangle over the areas to be trimmed
- Draw polygon - ditto for polygons
- All - select all
- +/- - add to or subtract from the selection
- It is very hard to see what has been selected so it is best just to be very careful and sure of what you are doing. You can always undo.
- Click 'trim' in the main toolbar. The selected geometry will disappear from every scan in the scan family. Repeat as necessary.
- Click 'back' when done.

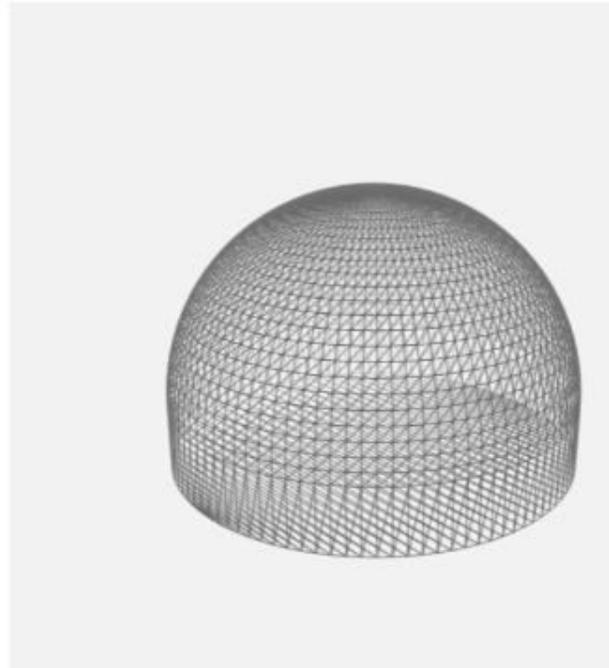
STEP 4

Create an STL file

STL model in Solid View



STL model in Wireframe View



STL file with boundary edges

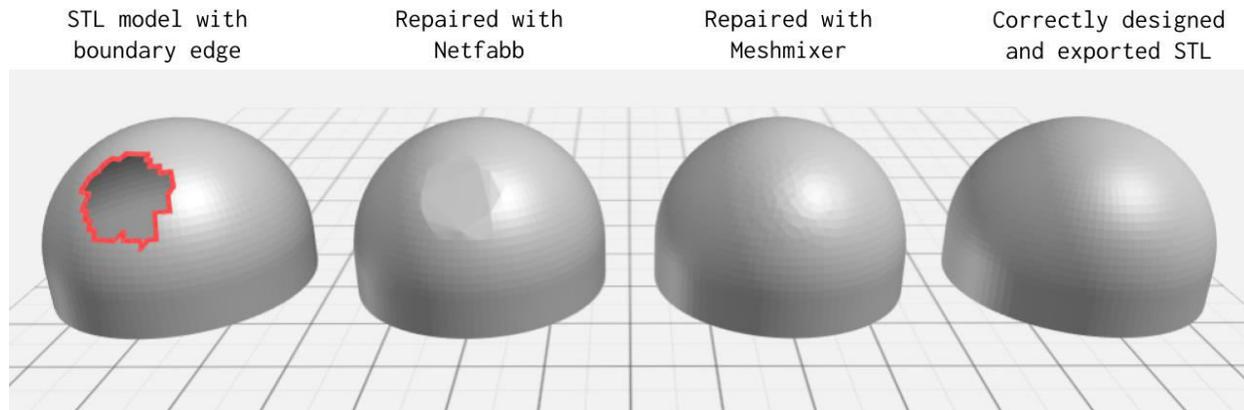
Virtually all 3D Rapid Prototyping machines and 3D Printers use the STL file format for input.

Almost all CAD programs have a way to save or export to the STL file format. Below follow detailed instructions for most common CAD programs.

What to consider while creating STL file:

Generating STL files is usually a fairly simple process. But every CAD system uses different terms and parameters for defining the STL file resolution. It's not necessary to understand all those parameters to produce useful STL file. Following is brief checklist which can help to produce good STL file:

- 1) As a typical example mesh with triangles approximately the size between 0.02mm (.001") to 0.05 mm (.002") will produce a good quality STL file. Please keep in mind if you reduce mesh tolerance further down doesn't mean prototype accuracy will be improved. As a thumb rule parts with many contoured or curved surfaces need to have fine tolerance than straight geometric parts.
- 2) STL files are always preferred to be saved in Binary format than Ascii mode.
- 3) If you are using Solid CAD modeling package to create 3D model, there are less chances of having any error in STL file. For surface model please stitch/sew all surfaces together to make a single water tight model before exporting STL file. You may be still able to produce STL file from untrimmed or corrupt surfaces but will never get a clean STL file and its much harder to fix STL file than native CAD file.
- 4) Generally STL file has no UNITS attached to it so its always good practice to send overall part sizes along with your STL file otherwise we wouldn't know your part dimensions. Most common units are MM or Inches.
- 5) Some CAD systems will generate error messages during STL conversion showing that some part geometry is outside of the positive X, Y, Z quadrant or is in negative space. These warning messages can be ignored.
- 6) Make sure to join all the solid model pieces to single entity which you want to see in a single prototype. Otherwise all those bits & pieces will end up separately in STL file and we'll have to spend time to join them together, unless you want them to be separately made.



STL file with non-manifold edges shared by more than one bodies

How to repair your STL files

We recommend these two options for repairing your STL files:

- **Repair your STL file using a dedicated 3D printing software:** Many software solutions exist dedicated to the preparation of STL files for 3D printing and they can repair most STL errors. Popular (and free) examples include Netfabb (using the Repair command) and Meshmixer (using the Inspector command). For quick repairs, 3D Builder is an easy-to-use software for visualizing and repairing STL files and a free online STL repair tool.

Repair the error in the native CAD software before exporting to STL: In most cases, best results will be achieved when the STL file is correctly designed and exported in the first place and is always the recommended option.

If you have any issues with repairing your STL files yourself, our highly experienced 3D printing service providers could help you solve them. It is the responsibility of the customer though to provide the correct models, so good and clear communication with your hub is always recommended.

STL export guidelines from some of common CAD systems

SolidWorks

1. File > Save As...
2. Set type to STL(*.stl)
3. Click Options...
 1. Output as: check Binary
 2. Unit: > Millimeters or Inches
 3. Resolution > Fine
 4. OK
4. Enter Filename
5. Save

STEP 5

Export Rapid Prototyping (STL)

- Combine the scanned object with something you model
- Scale it to fit in a Rapid Prototyping machine
- Leakage free! Fill all holes
- Quick fix Use the Make Solid tool in Meshmixer
- Smooth! Too few polygons make it rough. Export with more polygons (heavier mesh).
- Non silly file size! 1-10mb is usually enough.
- One STL file

3D Scanner Terms

File Format Information

project file	File format that is the quickest and easiest format to use while utilizing Matter and Form's software. Third party software, however, doesn't recognize this file format so scans must be saved in XYZ, PLY, OBJ, or STL format if you want to view and edit your scans with other software, such as MeshMixer, MeshLab, Blender, AutoDesk 3D, etc
XYZ (point cloud) The most basic point cloud format	saving your scan as an XYZ file will simply store all of the points without color on a Cartesian coordinate system with X
PLY(point cloud) Also called the Stanford Triangle Format	it supports a relatively simple description of a single object as a list of nominally flat polygons. A variety of properties can be stored including color and transparency
OBJ (meshed)	An OBJ is another type of 3D model file. It is also used by a number of 3D modeling programs and meshes the point cloud, but is used for 3D printing less often than STL. Unlike STLs, where every facet of your 3D model is a triangle, an OBJ can contain both triangles and other polygons. Due to innate properties associated with our MFCX software, our scanner's camera takes 12 photos during each 360° turntable rotation while simultaneously capturing the point cloud. These photos are then layered onto the meshed point cloud while exporting/saving to OBJ format. In 3D computer graphics (CGI), one of the most common geometry interchange file formats is the OBJ because it captures texture so well. There are a few 3D p
STL (meshed)	An STL is a widely-used type of 3D model file. It consists of surfaces made up of triangles. Each triangle has an inner side and an outer side. The outer side is called the "normal." In a well-formed STL, all the normals face outward and the surface is continuous, with no holes. When a model meets these standards, we refer to this as a "watertight mesh." This watertight-ness is typically mandatory for 3D printing

Point Cloud Basics A point cloud is a set of data points in a coordinate system. In a three-dimensional coordinate system, these points represent the external surface of an object and are usually defined by X, Y, and Z coordinates.

There are five essential terms that are used to describe elements of a given point cloud: vertices, edges, faces, polygons and surfaces.

Vertices



A vertex is a position. It includes additional information such as color, normal vector, and texture coordinates.

Edges



A connection (i.e. a line) between two vertices is an edge.

Faces



A face is a closed set of edges. It can be categorized as a triangle face (three edges) or a quad face (four edges).

Polygons



If a collection of faces all exist on a single geometric plane, this one collection of faces is labeled as a polygon.

Note: Polygons and faces are equivalent in software platforms that support multi-sided faces. However, most rendering systems support only 3- or 4-sided faces. So polygons are represented as multiple faces.

Surfaces



Surfaces connect neighbouring polygons together. Also called smoothing groups.

Advanced Scanning

Introduction

Advanced scanning grew out of the research and development we conducted when we were building the scanner software. We needed a way to control the fundamental aspects of the scanner and visualize the results, so we could understand what worked and what didn't. The

main screen scanning options - “Single-Colored” and “Multi-Colored” - both codify and encapsulate the knowledge we gained through using the advanced features. These have improved with each release, and now they’ve reached a point where their results are often as good as those you’d get in Advanced. But to understand what they’re doing and why, the best way to explain is to take you through Advanced scanning, so you can have a similar journey to the one we’ve had – learning what are the fundamental aspects of the scanner and how they affect the end result. Understanding these things and using the Advanced features is surprisingly easy, especially when you give them a try in the software.

Example 1: Picking the best exposure for color

Here are three examples of color capture adjustments. As you can see in the images below, the second one is the best choice. It’s bright, but not so bright that it’s white



The color capture on a scan with this exposure will result in a fairly dark object. White looks grey.



This is a good choice for color.



This is overexposed.

Example 2: When the choice isn't clear

Sometimes you might find that the difference between two exposures doesn't give you a strong impression about which is the better choice for color. There isn't necessarily a wrong choice in

this instance, either one will probably be OK. We recommend that a good way to help decide is to look at the white area of the scanner that holds the scanner bed (seen at the bottom of the Feed screen). In which of the exposures does it appear clearest? Choose that one.



The scanner bed casing is overly bright and slightly blurred.



The scanner bed casing is well-defined and clear. This is probably your better choice.

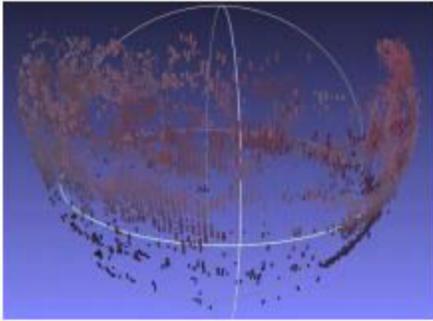
Troubleshooting

Introduction

We will say this upfront... bad scans can happen. Anyone who has spent time scanning objects with a 3D scanner knows the frustration of setting up a scan, waiting for it to finish and then coming back when it's done only to find that there are giant holes of missing data or the object has fallen over mid scan. These setbacks can be overcome, however, if we keep in mind a few key principles. To demonstrate how quick and easy it is to get exceptional results with the scanner, we thought we'd showcase a few indisputably bad scans, discuss the root causes, and highlight the best practices we employed to subsequently produce better scans of the same object. Topics covered are Lighting, Calibration, Missing Points, Errant Points, Strange scans, Missing scans, and Wrinkled Meshes.

Bad Lighting Proper lighting plays a key role in producing quality scans. Insufficient or improper lighting directly affects the data that the scanner picks up from the object. To illustrate this point, we scanned a Red Delicious apple under different lighting conditions.

Scan Result

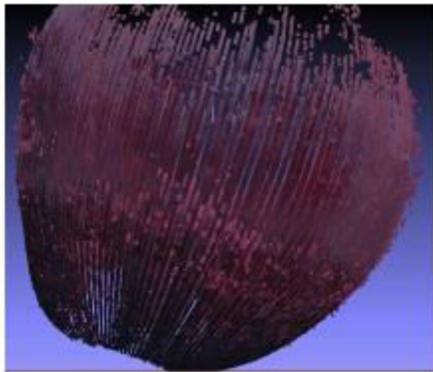


Lighting Condition

Too Bright

12" from a window on a bright, sunny day

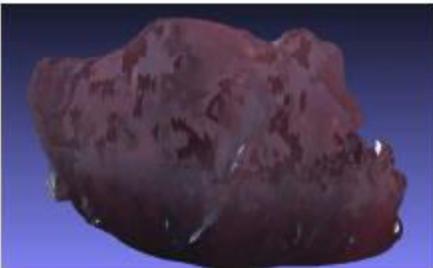
Note the gaps in the surface of the scan. The sunlight is overpowering the brightness of the lasers.



Too Dark

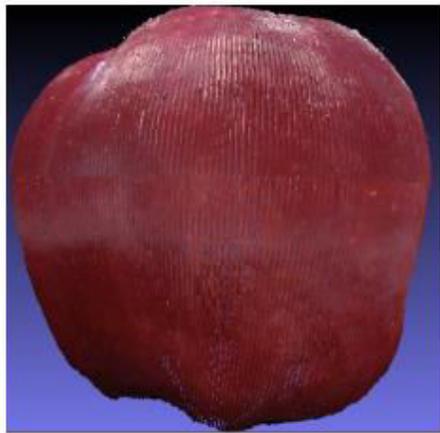
Dim overhead lighting

Note how dark the apple appears to be. The bottom of the apple appears black.



Bad Lighting Final Outcome
Meshed OBJ File Format
(from too bright scan, above)

By keeping in mind the optimal lighting condition discussed in The Importance of Lighting, we can produce much better scans of the exact same object, as seen on the next page



Proper Lighting
Point Cloud PLY File Format

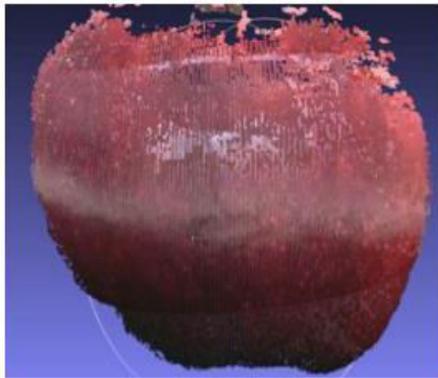


Proper Lighting Final Outcome
Meshed OBJ File Format

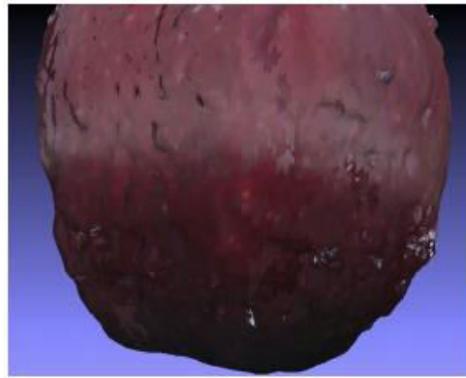
Calibration

Ensuring your scanner is properly calibrated has a tremendous impact on your scan's geometric accuracy. Failure to calibrate directly impairs the accuracy of the scanned object's point cloud as it is

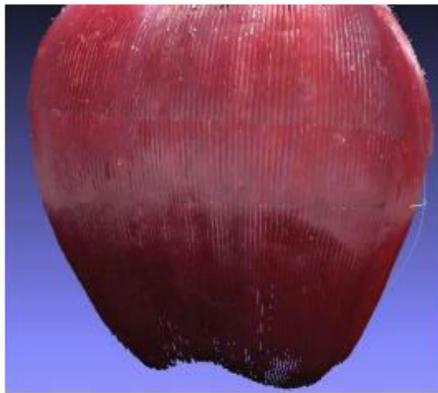
being constructed, distorting the final scan. The solution is to calibrate and recalibrate as needed. Even a small movement in the scanner's placement can affect its calibration and, consequently, its precision. Another good practice is to calibrate each time before starting to scan a very small object.



No Calibration
Point Cloud PLY File Format



No Calibration Final Outcome
Meshed OBJ File Format



Proper Calibration
Point Cloud PLY File Format



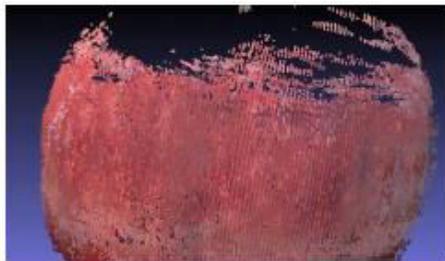
Proper Calibration Final Outcome
Meshed OBJ File Format

Inadequate Exposure and/or Missing Points

Objects that have stark, contrasting colors necessitate different camera exposures and might prove difficult during automatic "tuning." Tuning is the process by which the software determines the best

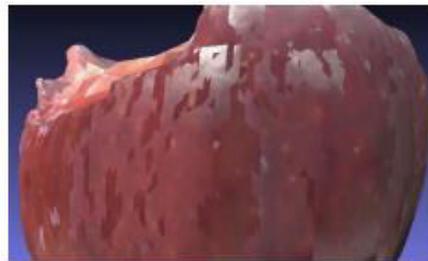
camera exposure for capturing the color of the object and the best exposure for capturing where the laser is hitting the object. Repositioning the object on the turntable so the camera can tune to a different side of the object might resolve this problem. A second option is to utilize the “High Contrast Scanning” function under the Advanced Scanning menu. Some objects that have intertwined high contrasting colors can’t be scanned with one exposure. Dual exposure will yield impressively better results. Spending a few extra minutes manually setting the exposures for objects with stark color contrasts will likely lead to complete point clouds and watertight meshes.

In the following example, an attempt to scan an apple with a very light spot near the stem proved very difficult using automatic tuning



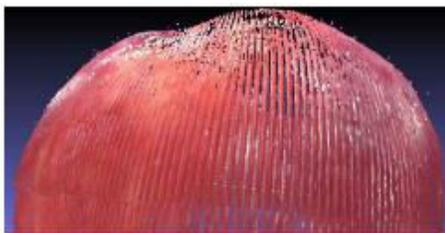
Bad Exposure
Point Cloud PLY File Format

Note the area of the apple where the color was light wasn't captured at all.



Bad Exposure Final Outcome
Meshed OBJ File Format

Note where the missing data led to the apple looking like a bite was taken from it.



Proper Exposure
Point Cloud PLY File Format

Note the light spot on the apple has been captured.



Proper Exposure Final Outcome
Meshed OBJ File Format

Final mesh has better color and more accurate surface detail overall.

Errant Points and/or Background Noise

The scanner was designed with busy workplaces in mind: people walking by workspaces while scanning is underway, conversations happening over desks where scanners are working. A defining component and feature of our scanner is its “cleaning” functions that enable users to erase unwanted point. It’s hard not to overemphasize the importance of cleaning your scans, especially given the fact it can be accomplished in a matter of seconds.

These improved meshes, in turn, produce impressive 3D prints. Consequences of not cleaning before meshing can be seen below:



A Lot of Background Noise and No Cleaning
Point Cloud PLY File Format

Note what looks like orbiting debris surrounding the apple.



A Lot of Background Noise and No Cleaning Final Outcome
Meshed OBJ File Format

Meshing without cleaning has left a foreign body included in the final result.

Proper and regular cleaning produces better meshes as shown below.



Proper Cleaning
Point Cloud PLY File Format



Proper Cleaning Final Outcome
Meshed OBJ File Format

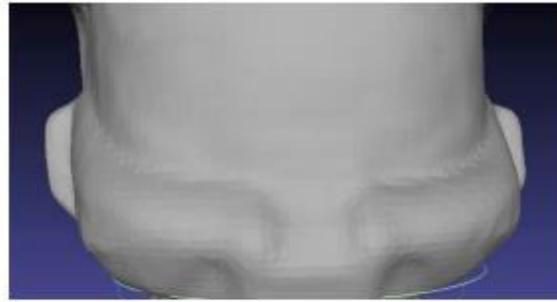
Mesh Appears Wrinkled

After completing a scan and attempting to mesh the point cloud, the vertical strands of points that comprise all point clouds could be visible on the mesh. Or, after meshing, the object might appear wrinkled. This can happen when the octree depth is set too high relative to the quality of scan that was captured. In other words, a low quality scan typically doesn't result in a great mesh, regardless of how high the octree depth is set. As a consequence, it may be better to set the octree depth and/or degree settings lower to yield a mesh with less ripples



Wrinkled Mesh
Octree Depth: 9
Degree: 4

Note the orange peel-like surface.



Smooth Mesh
Octree Depth: 7
Degree: 3

While lacking crisp edges, this mesh is smoother.

Reading Materials

1. Guide to the Ideal 3D Scan, Part I and II
2. FDM OR POLYJET BEST PRACTICE, Converting CAD To STL
3. 3D Printing, Export STL Files From Your CAD Programme
4. Yee Ling Yap , Yong Sheng Edgar Tan , Heang Kuan Joel Tan , Zhen Kai Peh , Xue Yi Low , Wai Yee Yeong , Colin Siang Hui Tan , Augustinus Laude, 3D printed bio-models for medical applications, Rapid Prototyping Journal, Volume: 23 Issue: 2, 2017
5. Jairo Chimento, M. Jason Highsmith, Nathan Crane, 3D printed tooling for thermoforming of medical devices, Rapid Prototyping Journal, Volume: 17 Issue: 5, 2011

You tube

1. How to Create STL Data for 3D Printers
<https://www.youtube.com/watch?v=CLmUYyGhgkU>
2. SolidWorks Loft Copy Paste Trim Surface
<https://www.youtube.com/watch?v=NGUJpi314K8>
3. Filled Surface in SolidWorks
<https://www.youtube.com/watch?v=gBx57K2Kf5A>
4. 3D go scan scanner tutorial
<https://www.youtube.com/watch?v=NsbG-m2hrIM>
<https://www.youtube.com/watch?v=3i-NqPUPVuE&t=2s>
<https://www.youtube.com/watch?v=Rj1LI9BOQbE>
<https://www.aniwaa.com/the-creaform-goscan-3d-a-fast-and-easy-to-use-portable-3d-scanner/>