

CP123957

From Photos to Solid Geometry – Converting Photogrammetry to Viable Solid Models

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Learning Objectives

- Explore the steps necessary to generate a quality photo scan utilizing ReCap360
- Discover methods of cleaning up the scan with Autodesk ReCap Photo
- Learn how to convert a mesh to a solid model with Fusion 360
- Discuss the potential capabilities of the photo-to-solid workflow

Description

It may seem like science fiction, but the ability to create a 3D solid model from a series of photographs is now possible—and it's easier to do than you might think. Join us as we walk through and explore all the steps necessary for this new amazing workflow. We'll start at the beginning with the initial photo scan of an object utilizing ReCap software, and then we'll clean up the scan with ReCap Photo. The clean scan goes over to Fusion 360 software for conversion, and finally into Inventor software to complete the workflow. After we discuss each step in detail, we'll look at the incredible potential of this photo-to-solid workflow.

Speaker(s)

Rusty Belcher is a manufacturing application expert working with IMAGINiT Technologies. Rusty provides implementation, training, and support services at every level for all Autodesk, Inc., manufacturing products. His specialty involves the integration of 3D design practices into manufacturing production environments. He is an instructor and mentor, and IMAGINiT regularly receives outstanding reviews of his impact to their organization. Belcher started his career as a structural steel fitter at Newport News Shipbuilding. He is a graduate of the Newport News Shipbuilding Apprentice School, and he worked in the shipyard's Mold Loft Engineering Division. Over the past several years Belcher has worked directly with Autodesk to develop and author the current Factory Design Suite software training courseware, and he has also developed and recorded many of the tips and tutorial videos available on the Factory Design Suite software's YouTube channel.

Section 1

Explore the steps necessary to generate a quality photo scan utilizing ReCap360

Good Scans Start with Good Photos

This entire process starts with taking numerous photos of the desired object. The quality and coverage of these photos will greatly impact the overall success of the final scan and resulting solid model.

The Pictures

The process starts off by taking many pictures of the object from all directions and angles. It is important to include the entire subject in every picture and to take pictures from high and low angles. Every scan will be different, but in general it will require about 60+ pictures to produce a decent scan. Some subjects will require more, some less. There are several other criteria to keep in mind when photographing the machine:

- Pictures from all Angles – Take pictures every 5 to 10 degrees as you circle the machine. Use a ladder to obtain images from higher positions as you circle the machine again.
- Avoid Reflections or Glare – Reflective Surfaces are very difficult to stitch in the final scan.
- Color Contrast – The subject should contrast with the surrounding background.
- Consistent Light Source – The light source should remain constant in a single position (No Flash).
- Textured Surfaces are Preferred – Textured Surfaces are much easier to stitch in the final scan.

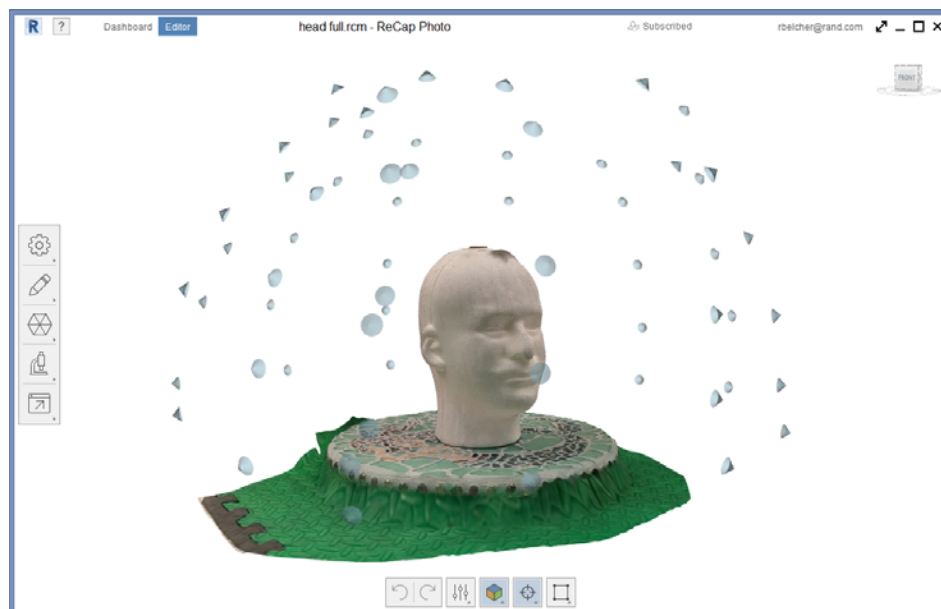


Image of Camera Locations for Skull Scan

Methods for Getting Better Scans

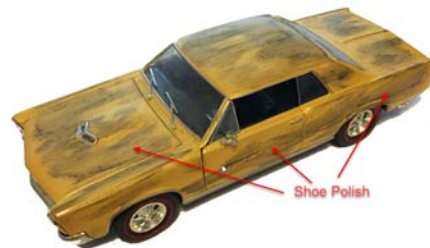
As stated above, there are several circumstances that can prevent you from collecting a quality photogrammetry scan. But, there are some things you can do to improve your scanning results. These tips are not necessarily universal, but you never know when one of them may come in handy.

Adding Texture to a Plane Surface



Shoe Polish

Sounds Crazy, but adding a few passes of shoe polish can provide a stitch-able texture to an otherwise featureless surface



Dulling Reflective Surfaces



Dry Shampoo / Scanning Spray

There are various "Scanning Sprays" on the market that work to dull reflective surfaces. A simple coat of Dry Shampoo also works.



Scanning Base

Because stitching is so important to scanning results, it is often necessary to add additional texture to your base. Placing your target on a sheet of newspaper coupons is a simple solution for this issue.



Note: It is a good idea to keep the colors in the Base and the colors in the subject separate. Having the same colors in the base and the subject may cause “feature bleed” in the stitching.

Scanning Setup

For smaller objects, it helps to have a scanning area with proper lighting and platforms setup. Your scanning area should allow for full access around the target subject.

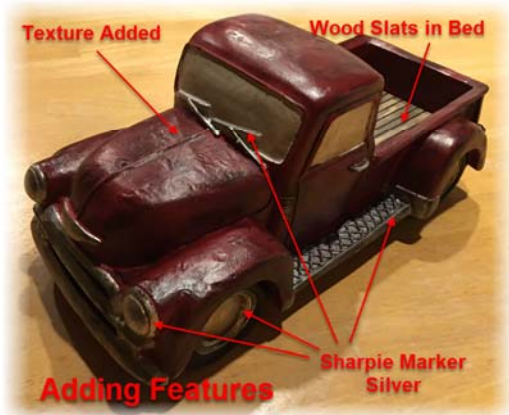


Recent Scanning Project

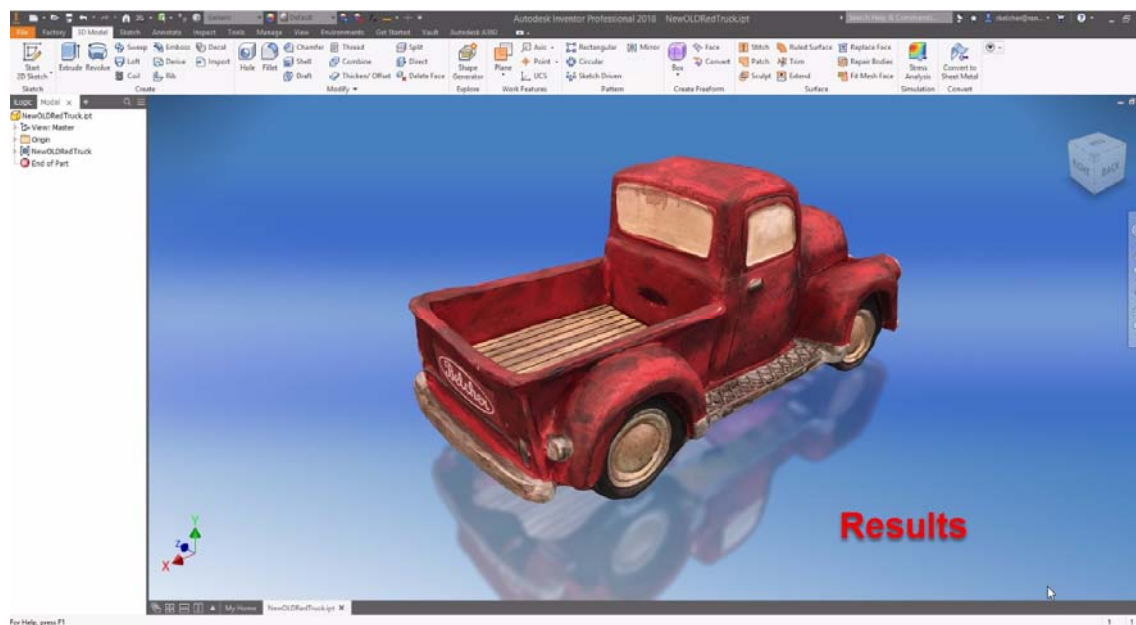
Original



Original Tree and Lights Removed



Scanning Setup



Results

Image – Recent Scanning Project – Old Red Truck

ReCap Photo / ReCap360.autodesk.com

Taking the pictures is the hard part. Once you have the pictures, generating the point cloud is very easy. Simply login to ReCap360.autodesk.com, then proceed to start a new project and upload the pictures. You will be notified via e-mail when the scan is complete. When your scan is finished you can download it in various mesh and point cloud formats. For this example we will download the .rcm (ReCap Mesh) and open it with Autodesk ReCap Photo.

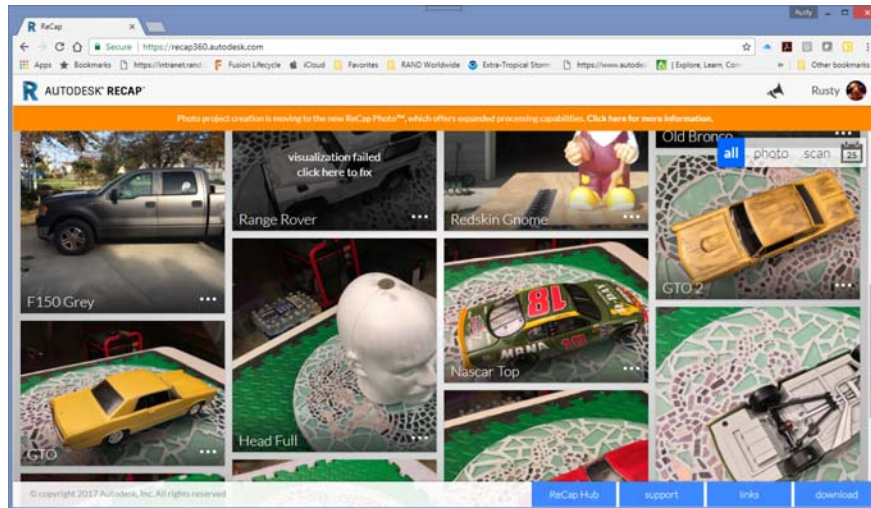


Image – ReCap360.autodesk.com

Section 2

Discover methods of cleaning up the scan with Autodesk ReCap Photo

Cleaning up the Mesh is Essential

Photogrammetry is not an exact process. The mesh generated from the pictures will seldom, if ever, be perfect. Typically, some cleanup is required to make the mesh suitable for subsequent steps.

ReCap Photo – Formally Autodesk Remake

The application we use to clean up the mesh is ReCap Photo. ReCap Photo (formally Autodesk Remake) is a fully functional photogrammetry application that can generate the original scan from photos and cleanup the resulting mesh as well.



Reorient the Mesh

Usually the first thing you address with the mesh is Orientation. ReCap photo allows you to adjust your mesh to any desired orientation.

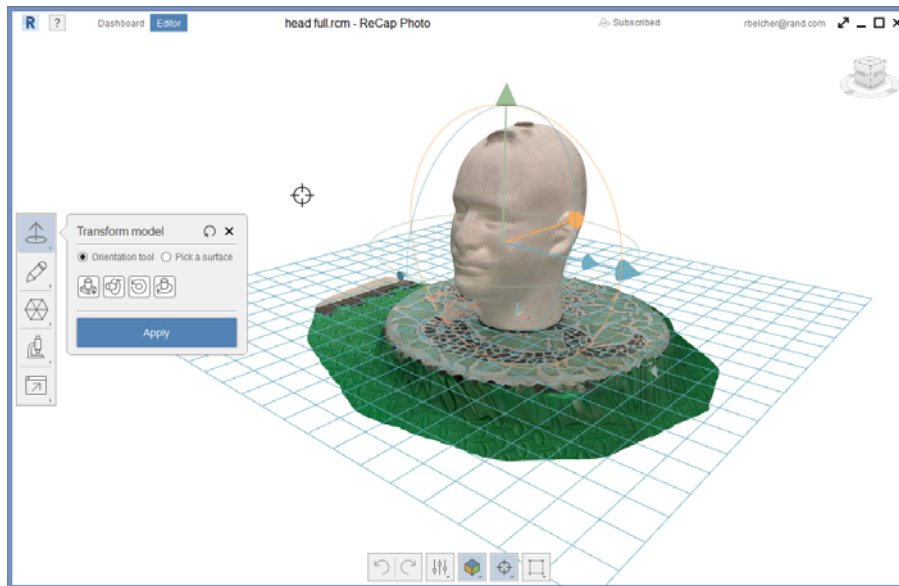


Image – ReCap Photo – Transform Orientation

Remove Unnecessary Data

The original scan will inevitably include unwanted surface data. Use ReCap Photo to simply highlight and delete unnecessary surfaces. Using the Slice and Fill command makes it easy to preserve the desired portion of the mesh while ensuring a watertight result.

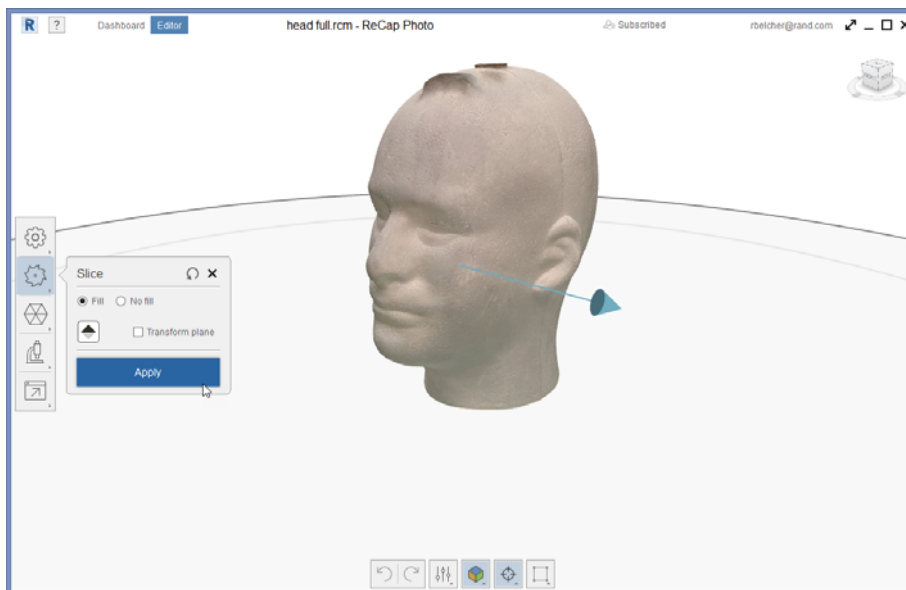


Image – ReCap Photo – Slice and Fill

Smooth the Mesh

Imperfections in the mesh should be expected. ReCap Photo had numerous tools that allow you to smooth or sculpt the mesh. In extreme situations you can remove unwanted bumps and patch the missing mesh data.

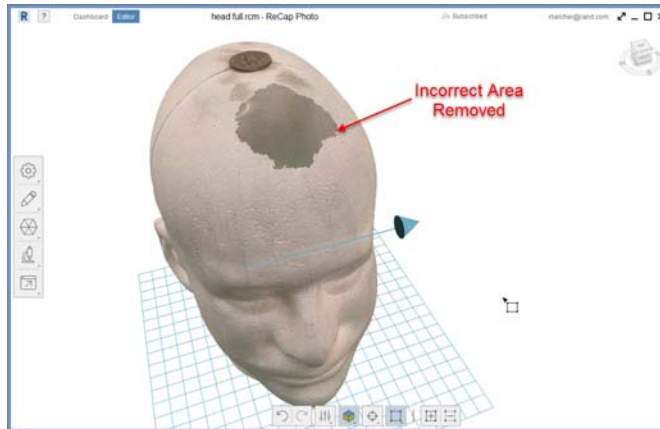


Image – ReCap Photo – Incorrect Mesh Removed

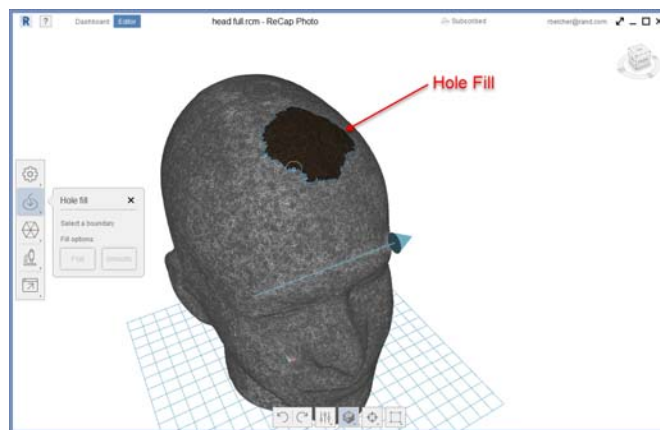


Image – ReCap Photo – Hole Fill

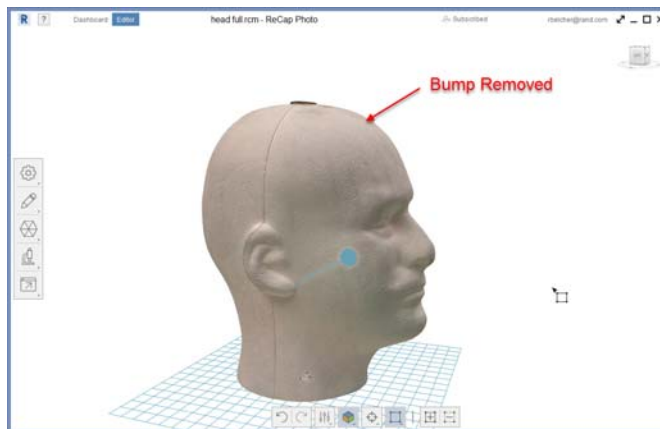


Image – ReCap Photo – Bump Removed

Decimate the Mesh

The more triangles you use to represent the mesh, the more computer power you will need downstream to work with it. It is usually advisable to decimate the mesh to a manageable amount.

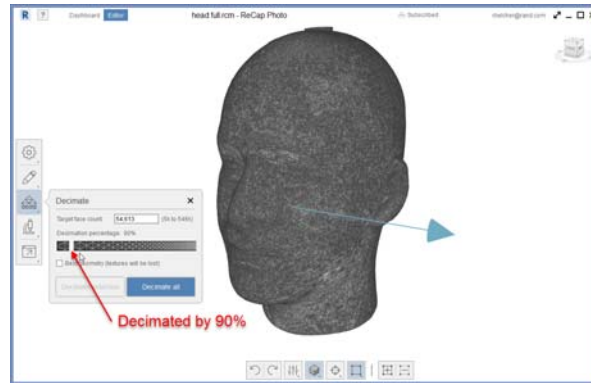


Image – ReCap Photo – Decimate Mesh

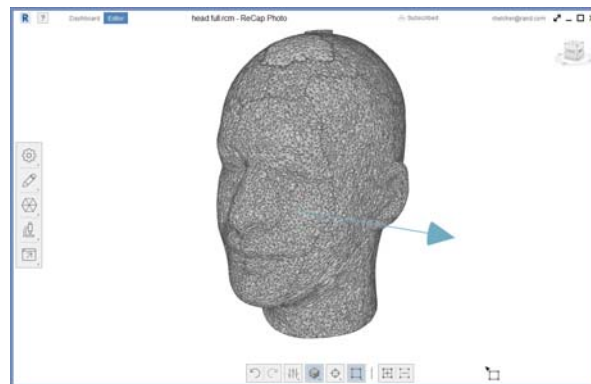


Image – ReCap Photo – Decimation Result

Watertight Mesh – Detect and Fix

The overall goal of mesh cleanup is to generate a completely watertight “surface” with no holes. Use Detect and Fix Model Issues to address the remaining watertight issues.

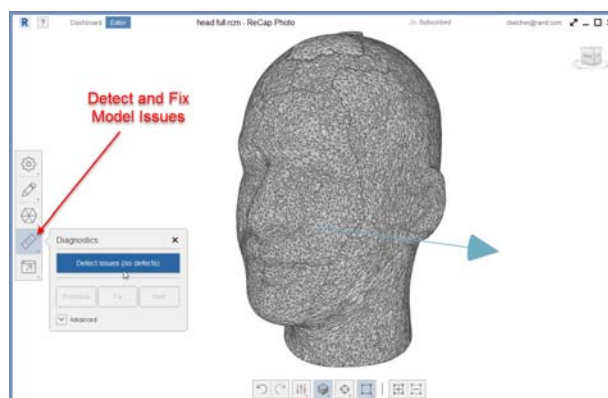


Image – ReCap Photo – Detect and Fix Model Issues

Export Mesh as OBJ(Quads)

The final step in ReCap Photo is to export the mesh as OBJ(Quads). Traditional meshes are made up of triangles. The Quad mesh is made up of four sided patches. These “square” patches will stitch together much easier in future steps.

Note: This export can take some time to accomplish. The more you decimate the mesh, the faster your translation will occur.

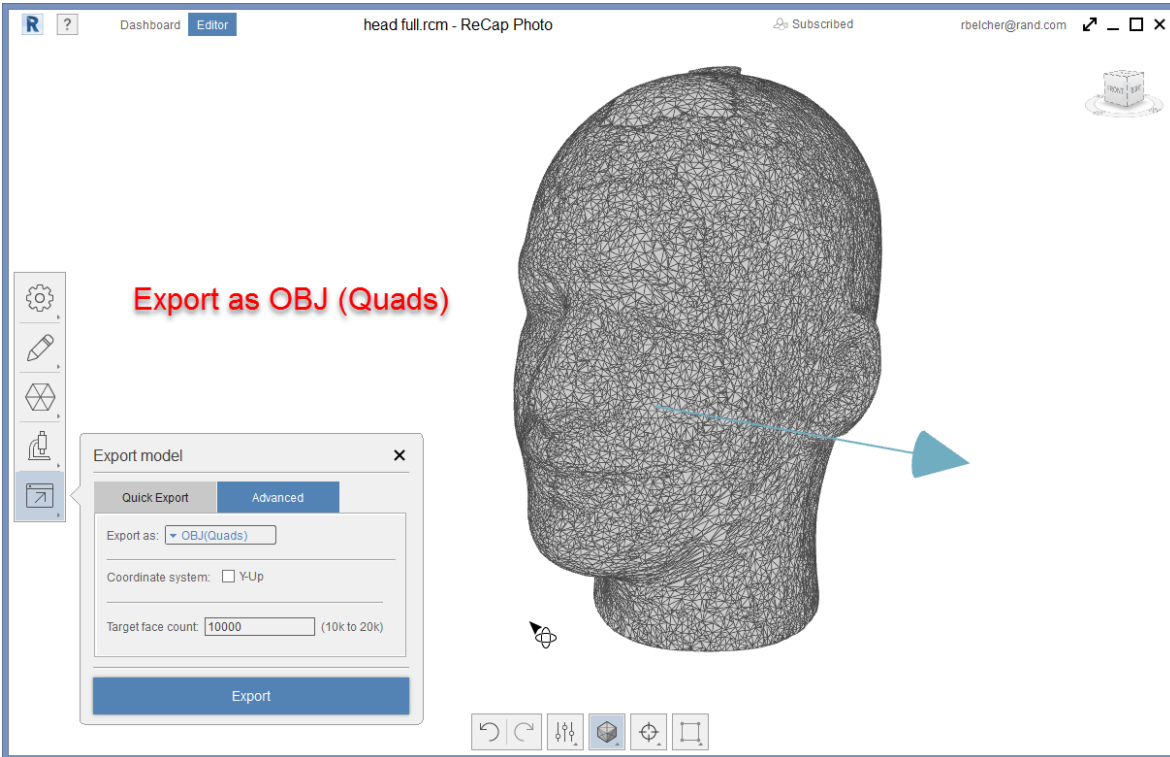


Image – ReCap Photo – Export as OBJ Quads

Section 3

Learn how to convert a mesh to a solid model with Fusion 360

Converting the Mesh to Solid Occurs in Fusion 360

The OBJ(Quads) export is opened in Autodesk Fusion 360. Fusion has unique tools that allow the Quad Mesh to be converted to a T-Spline form. During the T-Spline edit session, you can make additional edits to the mesh if necessary. When you finish the T-Spline edit session the mesh will be translated to a solid body.

Insert the Mesh

Use the Mesh insert options to import the file created in the previous step. Make sure to center the mesh and orient it as needed.

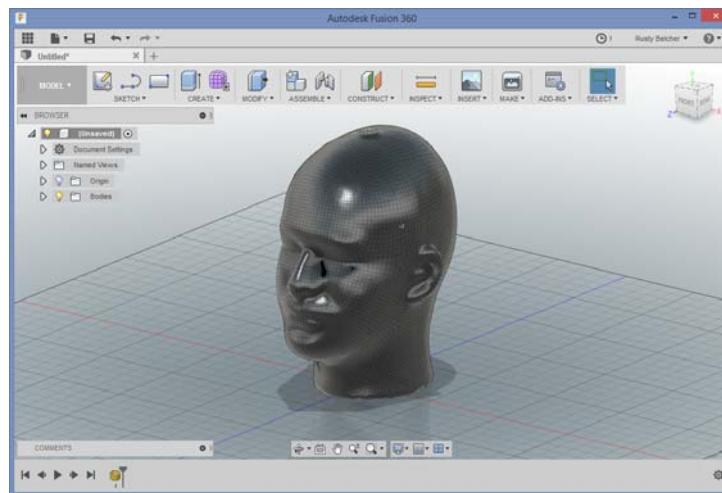


Image – Fusion 360 – Insert Mesh

The Sculpt Environment

The Sculpt Environment is where the “magic” happens. Enter the Sculpt environment and then convert the mesh to a sculpt form.

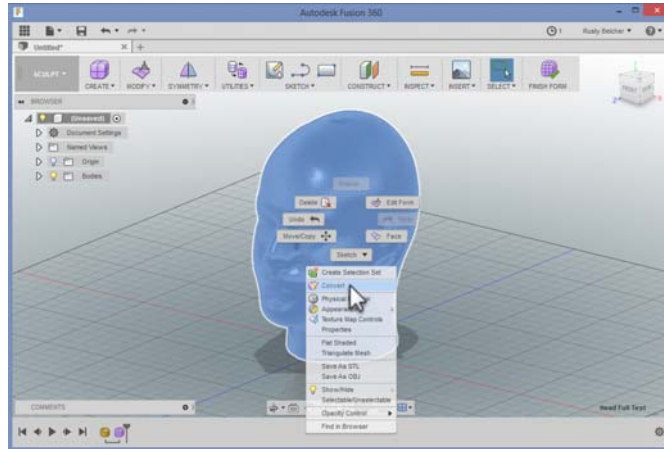


Image – Fusion 360 – Sculpt / Convert

Repair Body

Use the Repair Body command to locate any trouble spots. Usually the Auto Repair options are enough to fix any issues.

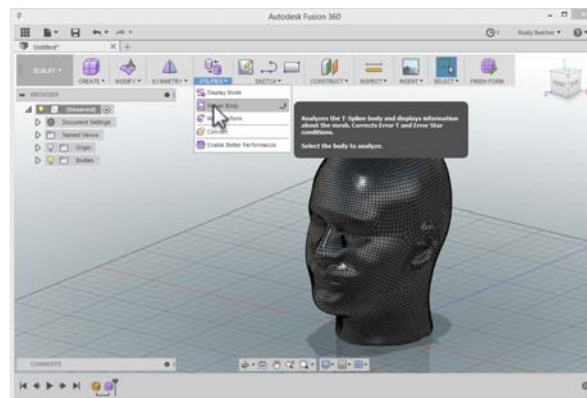


Image – Fusion 360 – Utilities / Repair Body

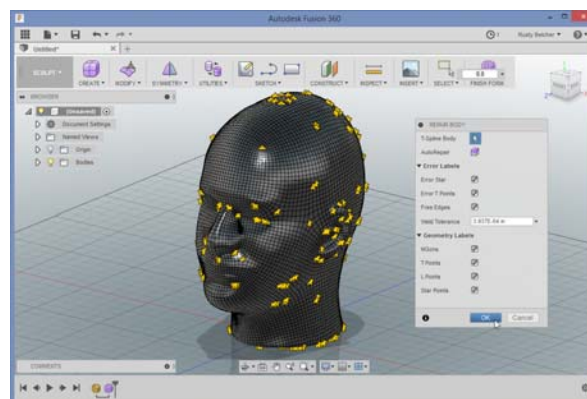


Image – Fusion 360 – Utilities / Repair Body

Finish Form

Use the Finish Form command to return to the modeling environment. When you execute the Finish Form, the Quad Mesh will be stitched together to form a solid part.

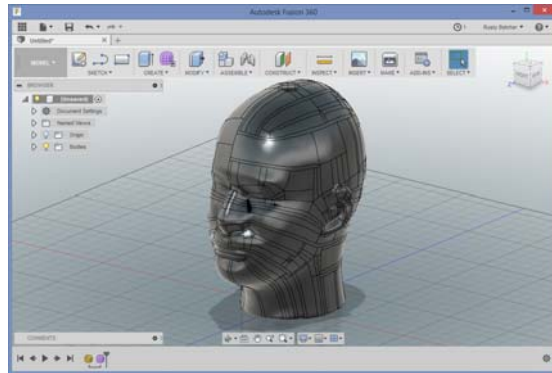


Image – Fusion 360 – Finish Form

Export Model

If you want to utilize this model in Fusion 360 simply carry on with your traditional modeling tasks. If you want to use the model in Inventor, simply export the file as an .SAT.

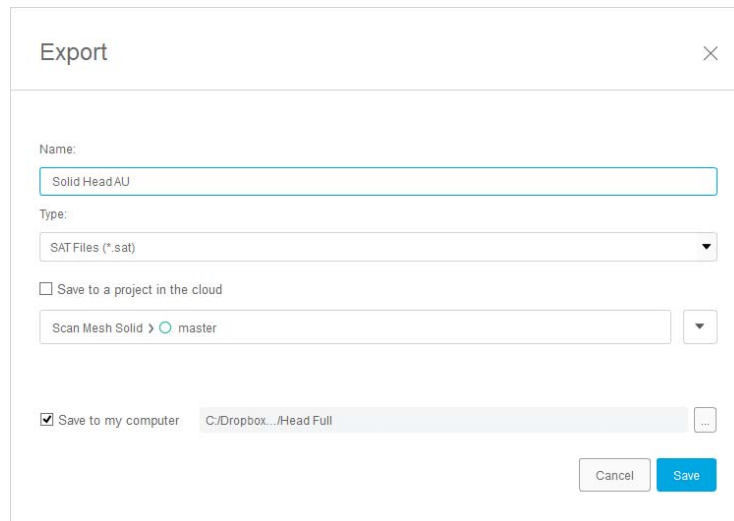


Image – Fusion 360 – Export Solid as .SAT

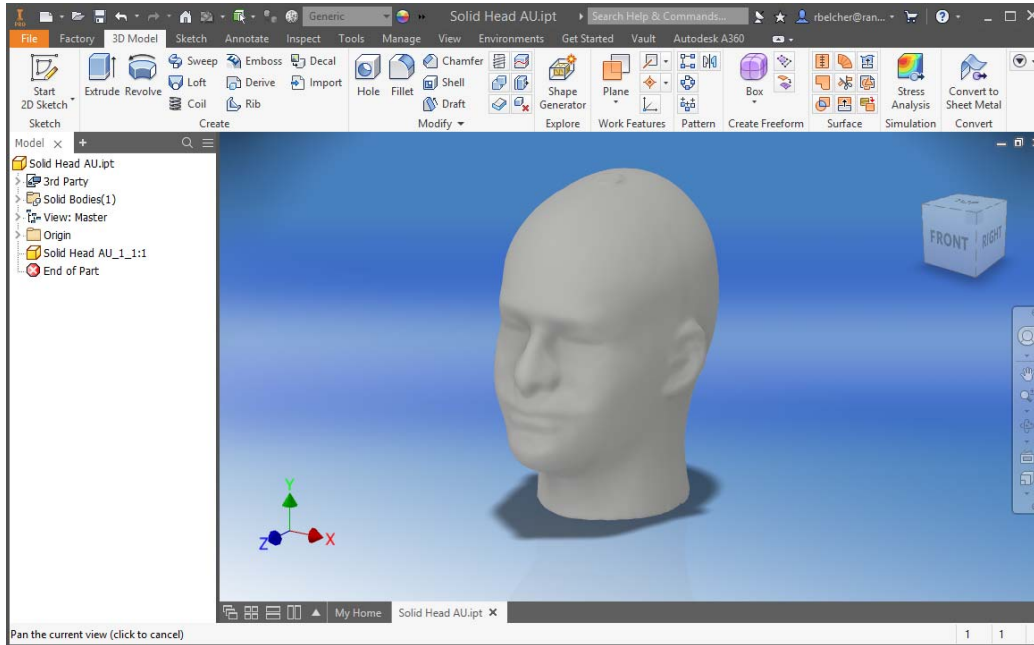


Image – Inventor – Solid Model from Photos in Autodesk Inventor

Section 4

Discuss the potential capabilities of the photo-to-solid workflow

New Manufacturing Options

The capability of generating solid model geometry based on photogrammetry scans opens many new and exciting opportunities and manufacturing workflows. In the example we have been working through, a human head was translated from photographs to a viable solid model in Inventor. Now we can utilize this component to design a wide array of consumer products based on the interaction and contour of human facial features.

Working with Complex Forms and Shapes

Inventor and Fusion are great modeling platforms capable of generating extremely complex shapes and forms, but they both fall short when it comes to producing an ergonomic, natural shape based on a human form. With this process you will be working on files that are simply impossible to create with traditional Inventor / Fusion modeling techniques.

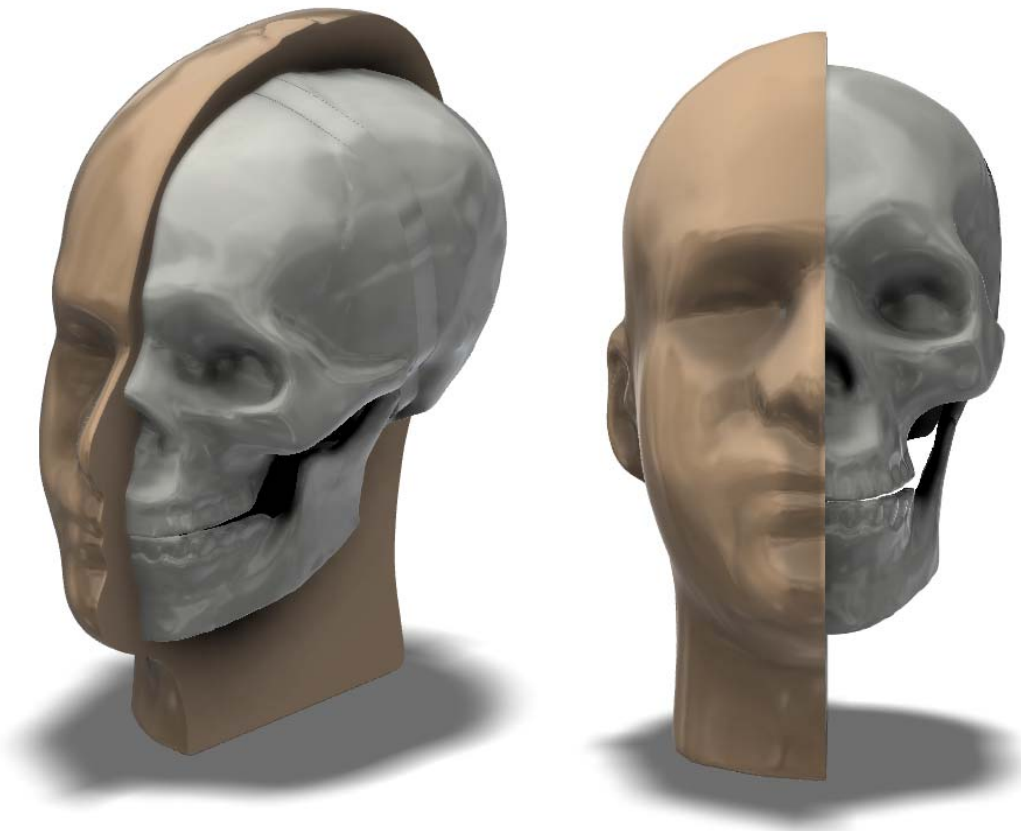


Image – Inventor – Complex Forms and Shapes from Photogrammetry

Customizable Products

Making a disturbance in the marketplace is something we all want to do with our designs. Introducing something new in the competitive world of consumer products is a good way to be profitable. Imagine incorporating facial scans into your design processes generating products custom made to suit an individual's specific facial features.

- Individual Customization
- Market Advantage
- Simple Process for Scanning
- Video Scan to Solid Model
- Repeatable

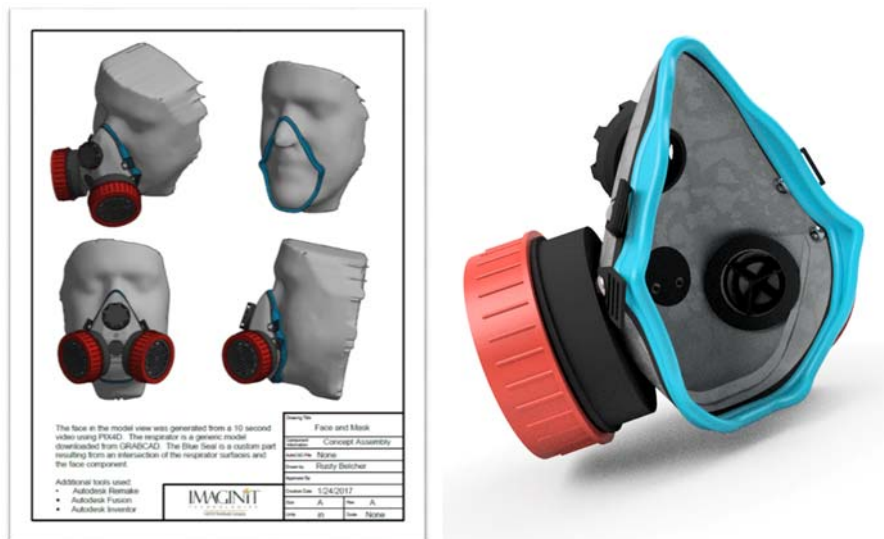


Image – Inventor – Custom Regulator Seal Based on Facial Scan

- Health Care – Respiratory
- Safety Equipment
- Medical Prosthetics
- Sporting Equipment
- Custom Fit
- Asset Collection for VR



Image – Various Consumer Products Developed from Scans

Concerns / Pitfalls

It is extremely important to note that this process is far from perfect. The main issues for concern deal with accuracy and scanning. These important topics need to be addressed and understood before full adoption. Some other tips and best practices are listed below.

- Include a Scalable Object in the Original Scan
- Utilize the Final CAD Software to Address Scale
- Always Take Too Many Pictures for the Original Scan
- ReCap Photo – Subscription / Cloud Credits
- Double Check Accuracy of Final Model
- Keep Up to Date with the Industry and Potential Changes
- Potential to Advance to a Professional Level Scanner
- So Many Possible Workflows

Conclusion

New Tools / New Options

It seems like science fiction when you look at the photogrammetry to solid model process, but believe me when I say, it is already a reality. The workflows discussed in this short class is viable and proven. Of course, it could be more accurate and we all wish there was a “magic” button to make the process more efficient, but don’t let the complexity of the process prevent you from trying it for yourself.