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ISDN 2400: Physical Prototyping 24-25 Spring
3D Scanning Lab

3D SCANNING

LAB **OBJECTIVE**

TABLE OF CONTENT

3D SCANNING

3D scanning is the process of analyzing a real-world object or environment to collect three dimensional data of its shape and possibly its appearance (e.g. color, texture). The collected data can then be used to construct digital 3D models.

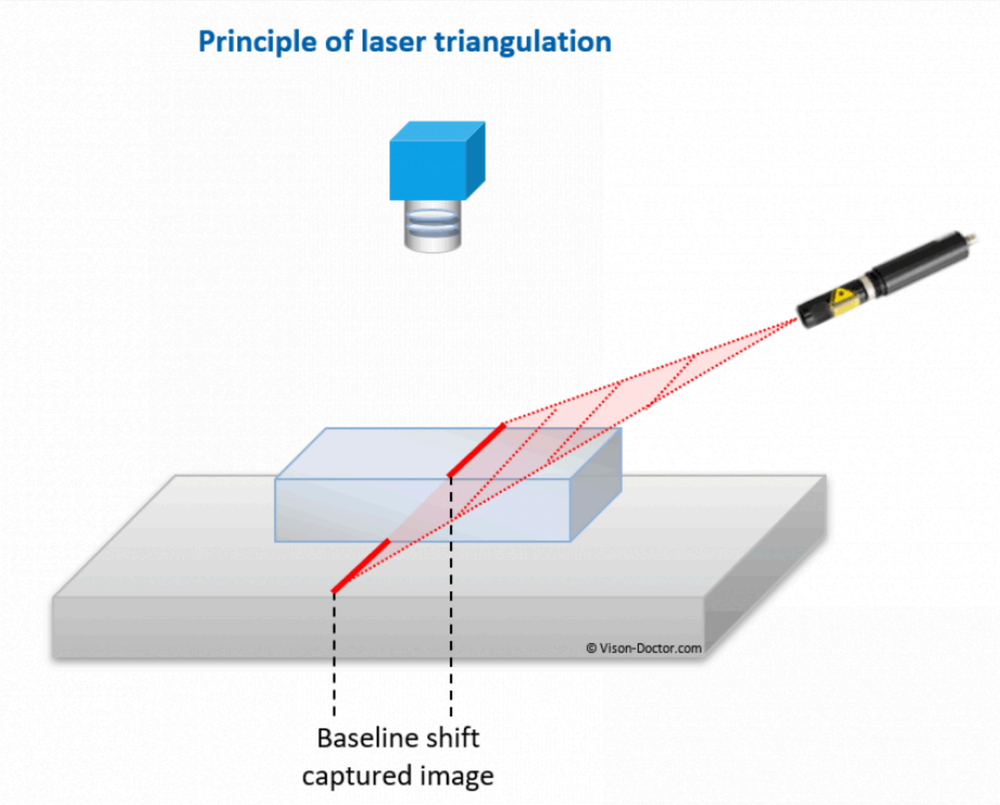
Ref: https://blog.prusa3d.com/photogrammetry-3d-scanning-just-phone-camera_7811/

DIFFERENT TYPE OF 3D SCANNING

WHAT IS THE SCALE / RANGE

DIFFERENT TYPE OF 3D SCANNING

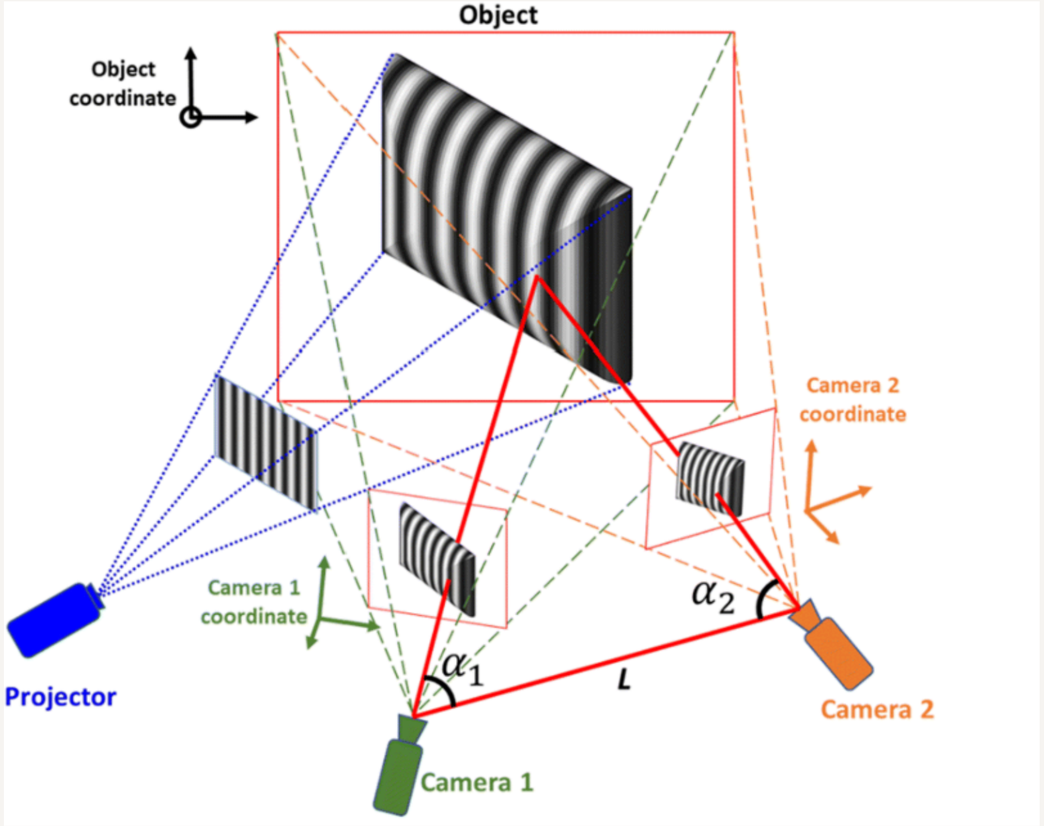
SCANNING AN OBJECT (SHORT RANGE) Laser Triangulation



Ref: https://www.phil-vision.com/en/products/3d-laser-triangulation

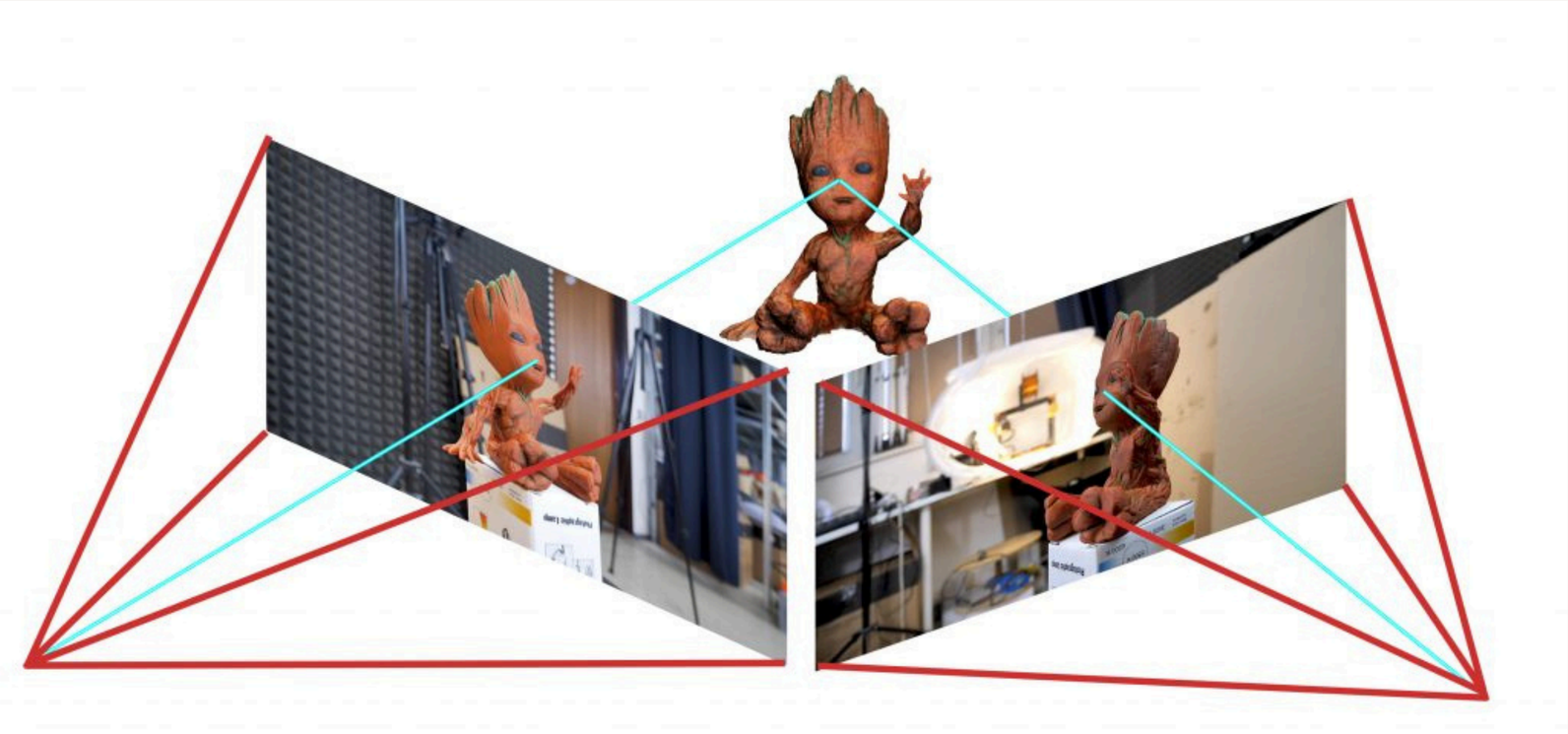
DIFFERENT TYPE OF 3D SCANNING

SCANNING AN OBJECT (SHORT RANGE) Structured Light



DIFFERENT TYPE OF 3D SCANNING

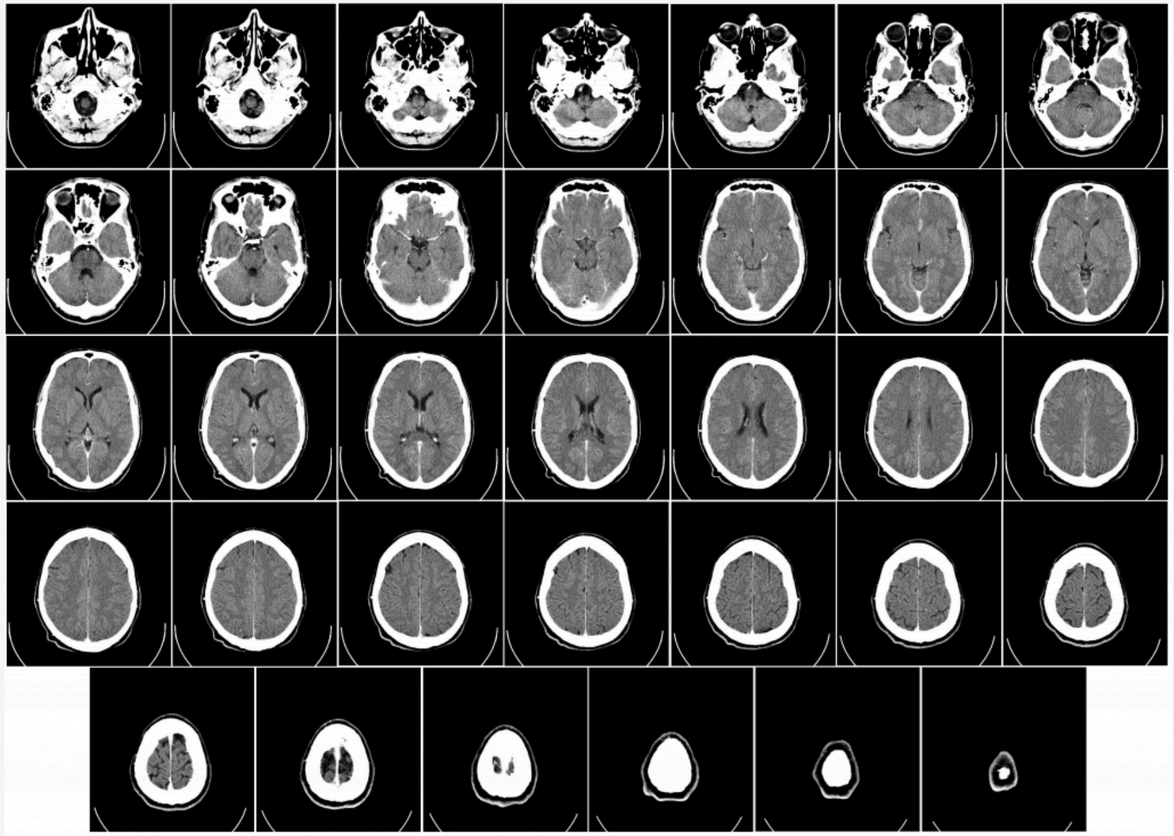
SCANNING AN OBJECT (SHORT RANGE) Photogrammetry



Ref: https://blog.prusa3d.com/photogrammetry-3d-scanning-just-phone-camera_7811/

DIFFERENT TYPE OF 3D SCANNING

SCANNING AN OBJECT (SHORT RANGE) Computerized Tomography (CT)

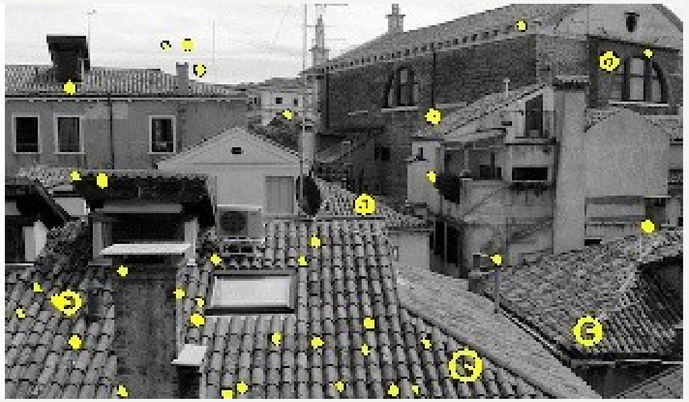


https://bitfab.io/blog/types-of-3d-scanning/

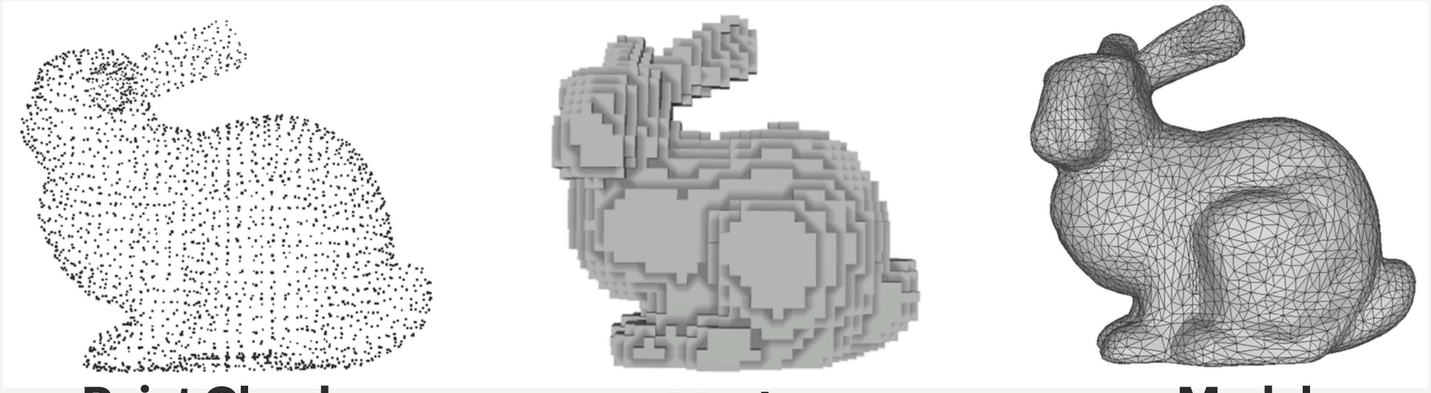
ROUGH THEORIES BEHIND 3D SCANNING

Photogrammetry

Images and Poses



Key Features

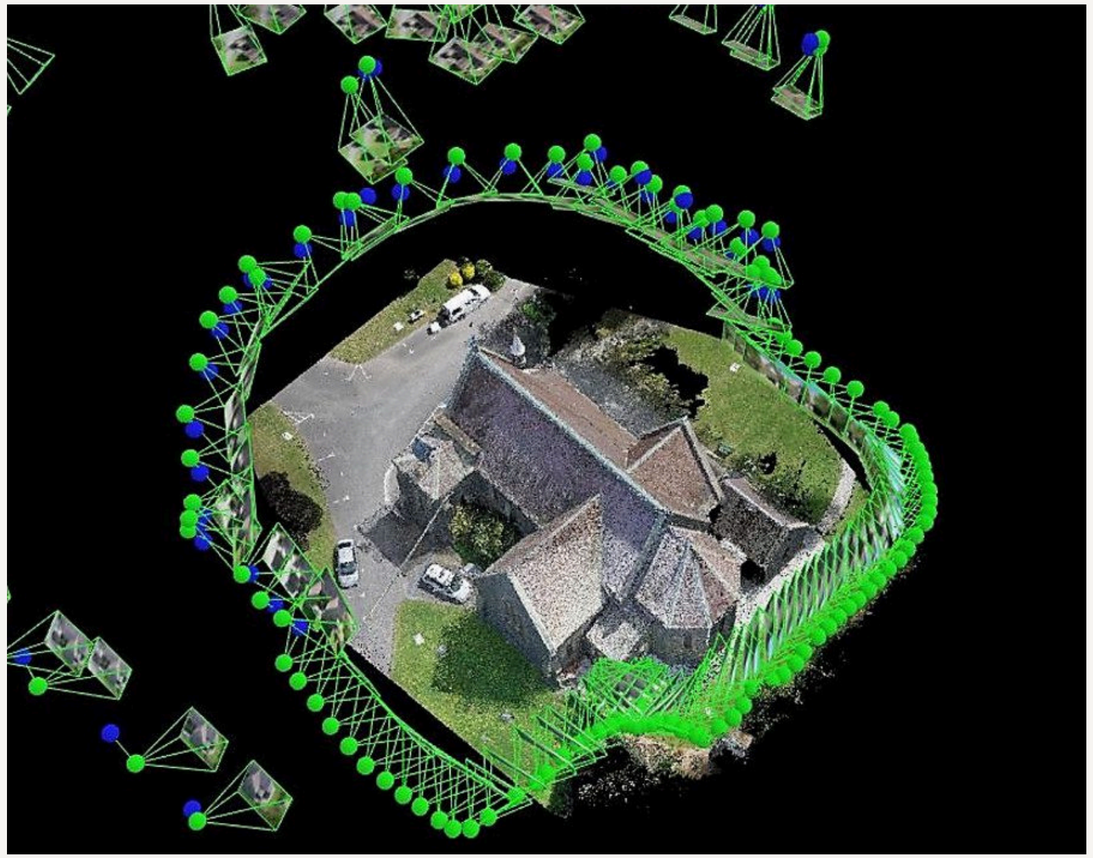


Point Cloud **Mesh** **Model**

- **Image → Features:**
  - Algorithms detect and match key points.
- **Features → Point Cloud:**
  - Depth estimation generates 3D points.
- **Point Cloud → Mesh:**
  - Surface reconstruction creates a connected mesh.
- **Mesh → Model:**
  - Refinement and export make it usable.

DIFFERENT TYPE OF 3D SCANNING

SCANNING AN OBJECT (LONG RANGE) Photogrammetry



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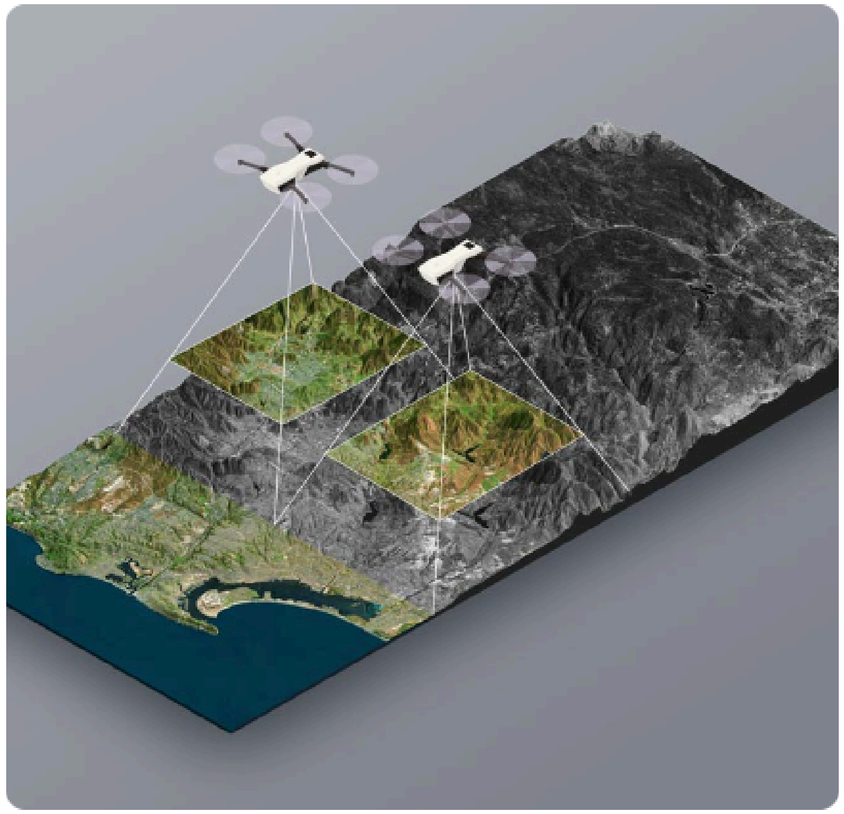
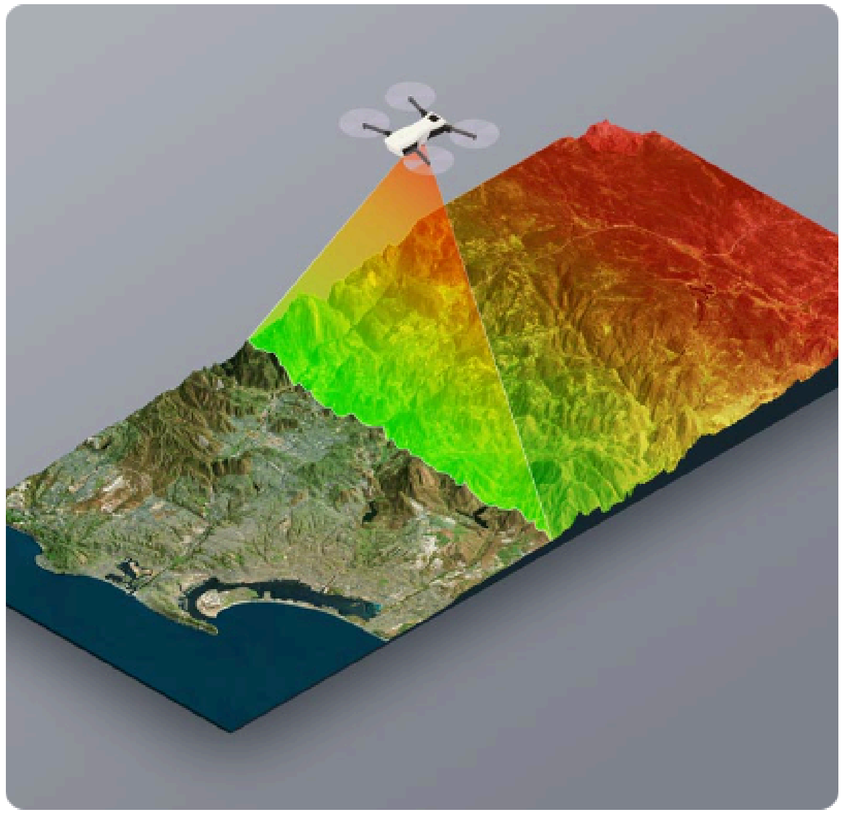
WHY START FROM 2D IMAGES?

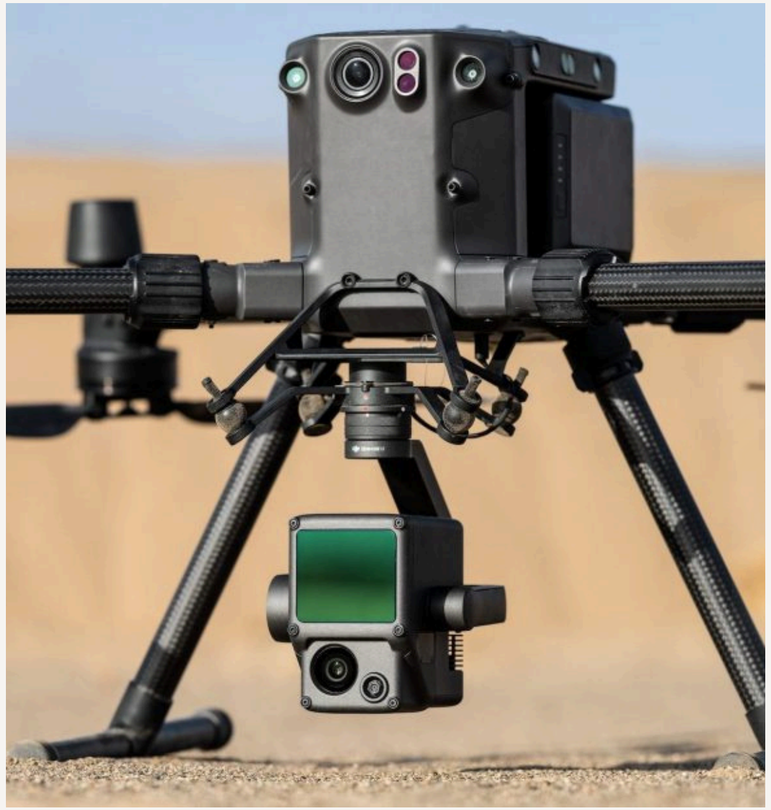


Photogrammetry principle



LiDAR principle

WHY START FROM 2D IMAGES?



WHY START FROM 2D IMAGES?

Short-range LIDAR

With the continuous development of the airport, the possibility of turbulence arising from buildings near the runway has gained attention. To address this issue, the Observatory developed alerting technology based on the short-range LIDAR (SRL), and installed a unit of SRL (**Figure 1**) close to the Centre Runway near to AsiaWorld-Expo. With its finer and more frequent scans, the SRL can help capture turbulence features, which are of smaller spatial and temporal scales, induced by buildings nearby. The SRL has commenced operational use since the middle of 2019 as an enhancement of the Observatory's Windshear and Turbulence Warning System.

In addition, the Observatory installed a unit of SRL at each end of the airport's new North Runway in the middle of 2022, and two units of SRL close to South Runway in early 2024 to support the detection and research of aircraft wake turbulence. In latter part of 2024, three more SRL units were installed onn the airport and its vicinity to enhance the support for the study of building induced turbulence as well as aircraft wake turbulence.

Figure 1 The short-range LIDAR in operation.

WHY START FROM 2D IMAGES?

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Short Range Lidar

$150.00

- Input power voltage: 4.5V-5.5V
- Scan frequency: 5-13Hz
- Minimum detection distance: 0.02m
- Maximum detection distance: 5-12m
- (Detection range is surface dependent – detections up to 5 meters are reliable, with detections beyond 5 meters dependent on the reflectivity of the surface)
- Cabling: Serial with USB – serial converter
- Scan angle: 360 degree
- Ranging method: TOF flight time ranging
- Connectivity: Internet

Quantity 1

Add to cart

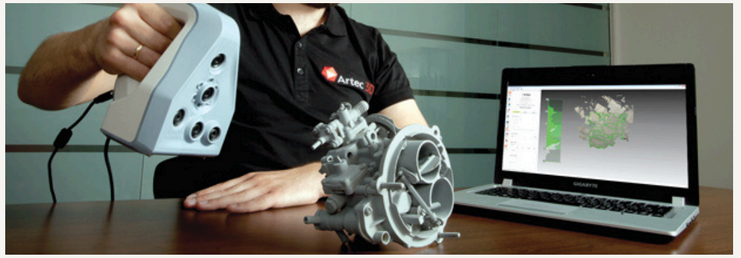
SKU SRL00001

Category: LIDARs

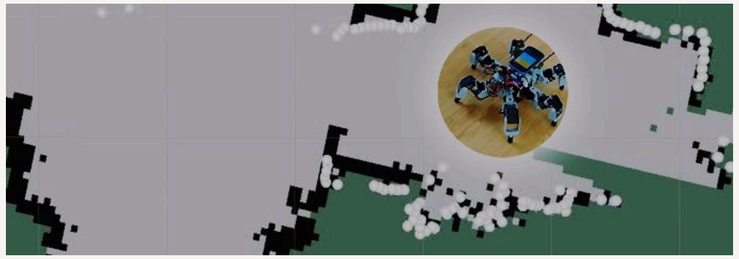
3D SCANNING APPLICATION

3D Reconstruction

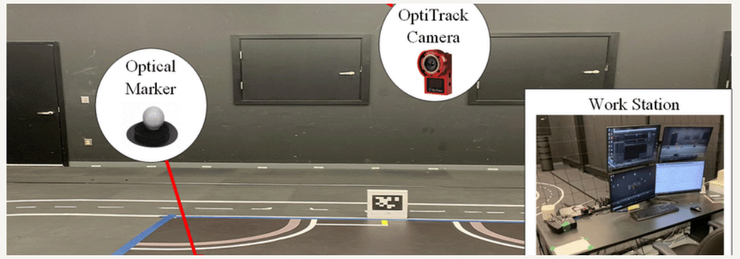
Digital Heritage



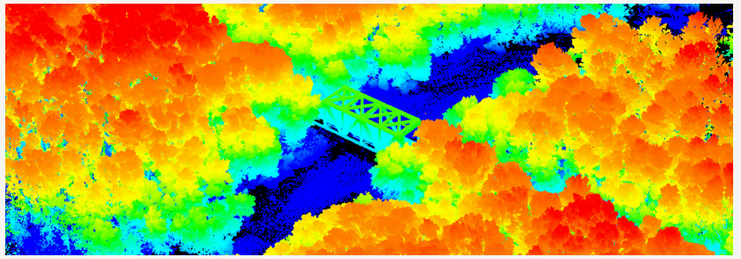
Reverse Engineering



Robot Navigation

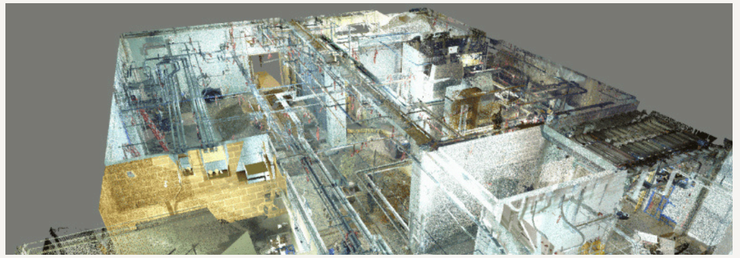


Motion Tracking

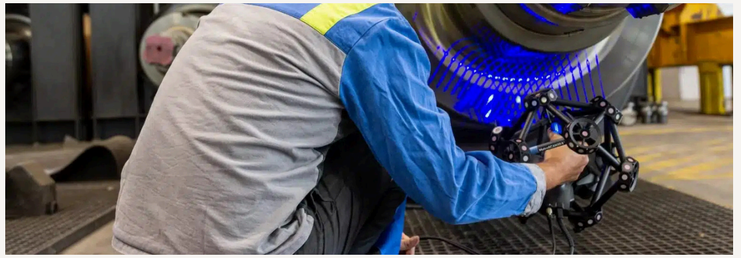


Surveying and Terrain Study

Gaming



Architecture and Construction



Quality Control

3D SCANS FILE FORMAT

POLYGON FILE

A polygon file is a mesh file consisting of 3 sided triangles and a normal vector.

Polygon files are the first step in the scanning process. The final polygon file will be “watertight’ and the mesh optimized.

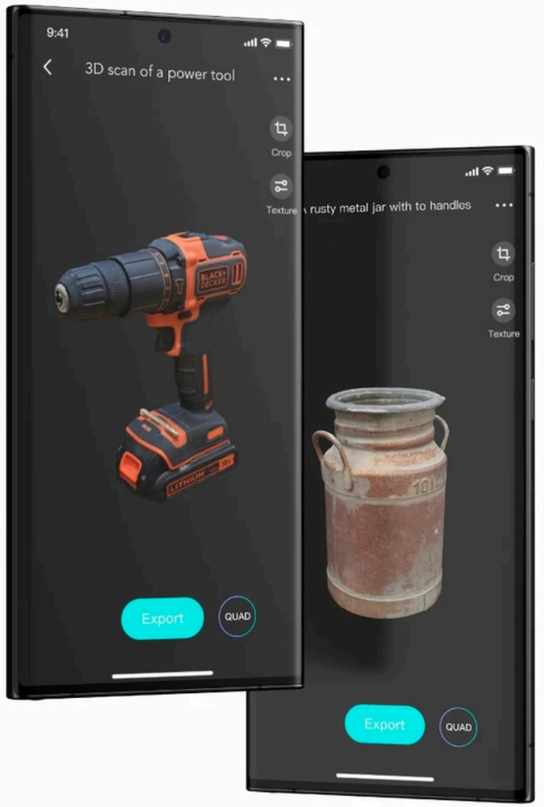
Most mechanical CAD systems can NOT work with polygon files to make changes to the model.

- **.STL (Stereolithography File)**
  - STL is a file format native to the stereolithography CAD software created by 3D Systems.
- **.OBJ (Object File)**
  - OBJ (or . OBJ) is a geometry definition file format first developed by Wavefront Technologies for The Advanced Visualizer animation package. It is an open file format and has been adopted by other 3D computer graphics application vendors.
- **.PLY (Polygon File)**
  - PLY is a computer file format known as the Polygon File Format or the Stanford Triangle Format. It was principally designed to store three-dimensional data from 3D scanners.
- **.WRL (VRML: Virtual Reality Modeling Language)**
  - VRML is a standard file format for representing 3-dimensional (3D) interactive vector graphics, designed particularly with the World Wide Web in mind.

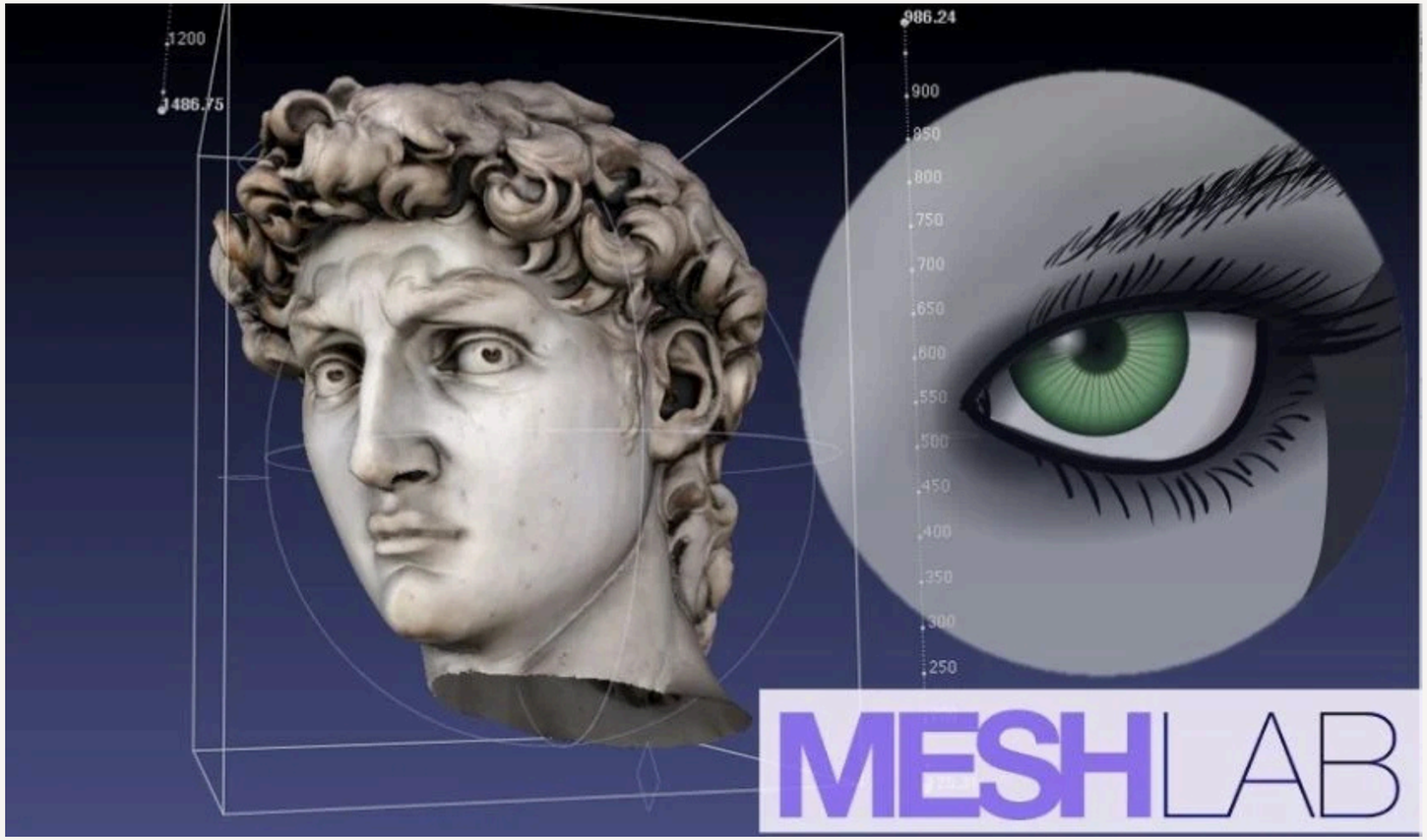
KIRI ENGINE

KIRI Engine

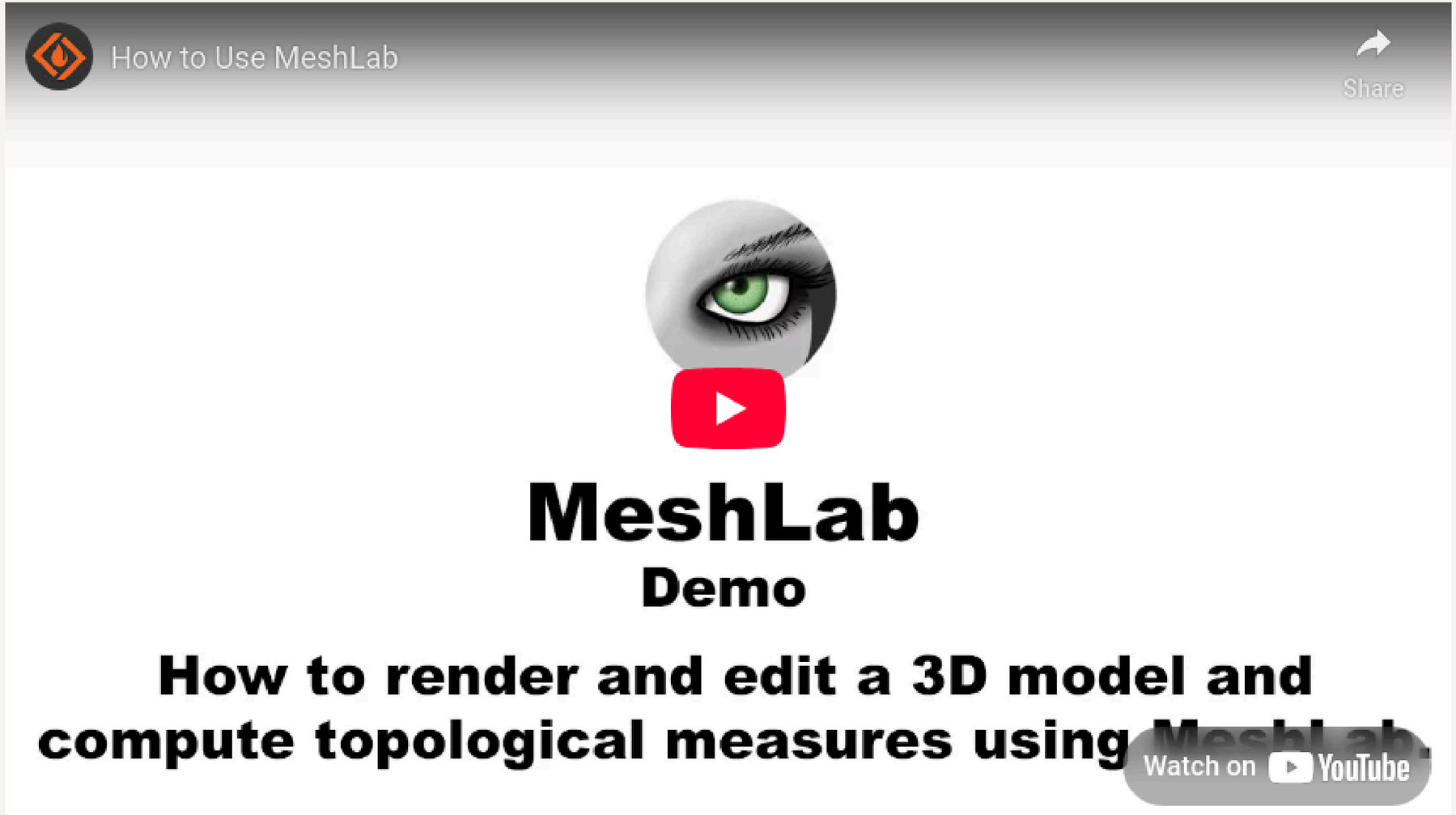
One 3D scanner app to do them all



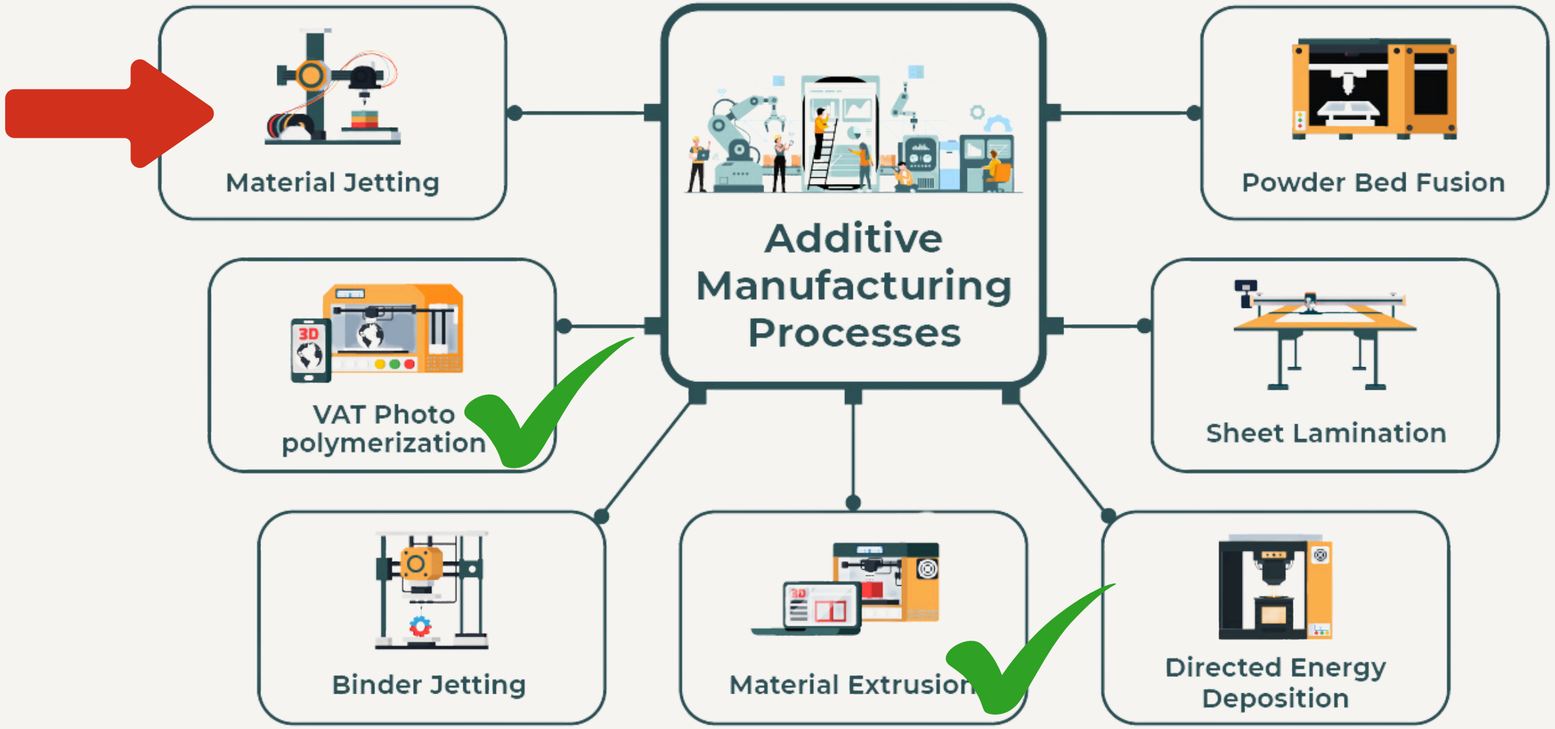
MESH PROCESSING



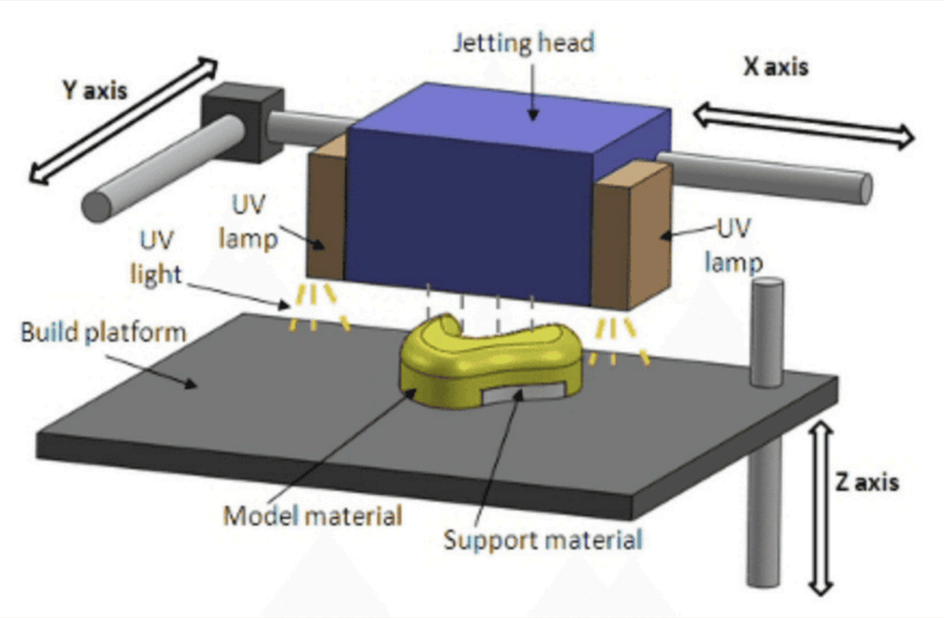
MESH PROCESSING

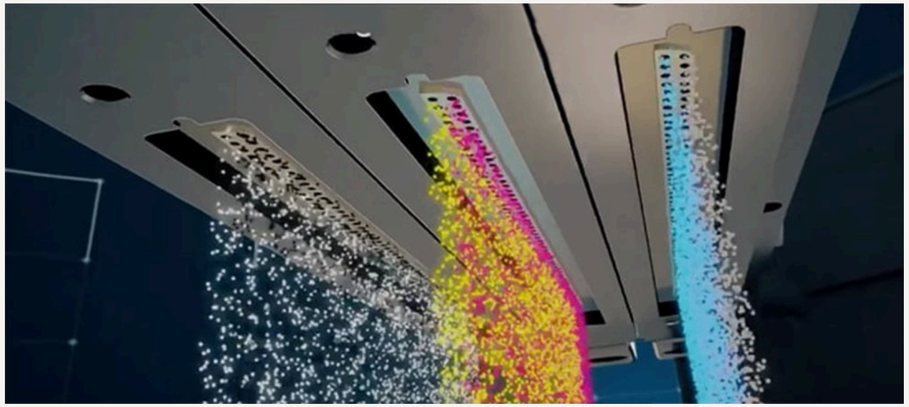


RECAP: MATERIAL JETTING TECHNOLOGY

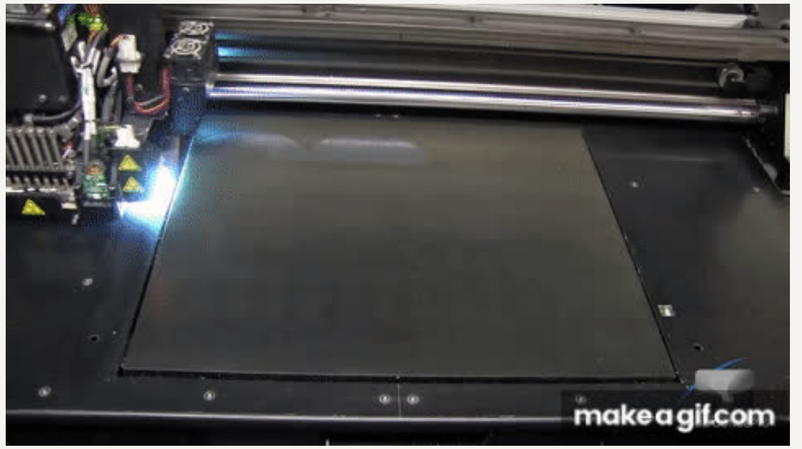


Stratasys PolyJet™ Technology





Stratasys PolyJet™ J850 Prime



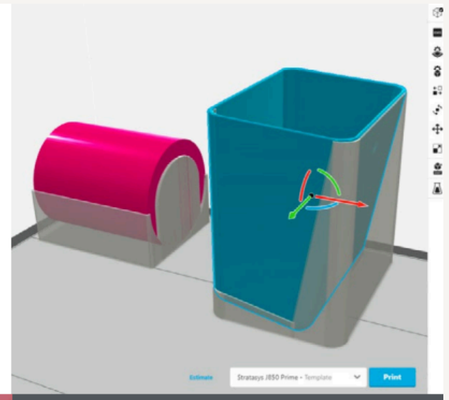
Stratasys Research Package

Pause Print

Pause and resume printing at a specific slice or height to insert electronics or mechanical parts in the model.

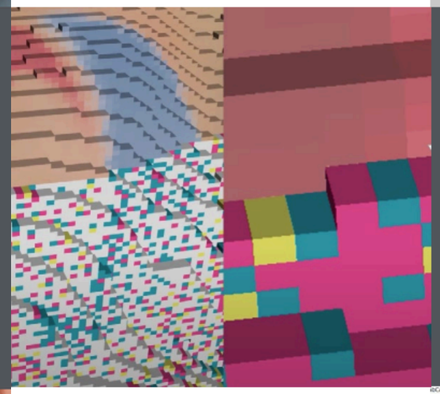
Design Better

Increase your ability to design and produce with the option to visualize your work at every stage of the process



Air Print

Use air as a print material to create voids in which electronics or smart devices can be inserted, manage textures or model weight and create finished surfaces.

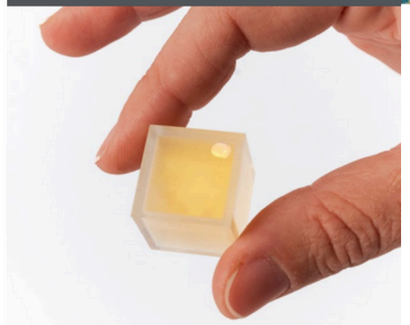


GrabCAD Voxel Print™

Define data volumetrically for each 3D voxel throughout the entire model allowing for an advanced level of control at a microscopic scale, enabling higher resolutions, fine-tuned color placement, and Shore value transitions within one part.

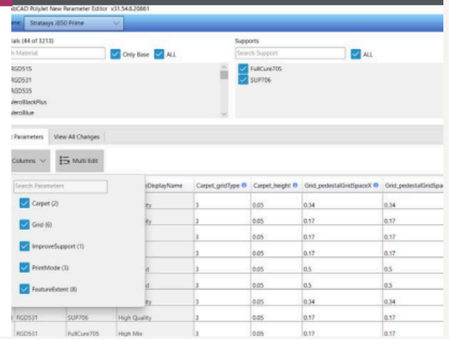
Liquid Print

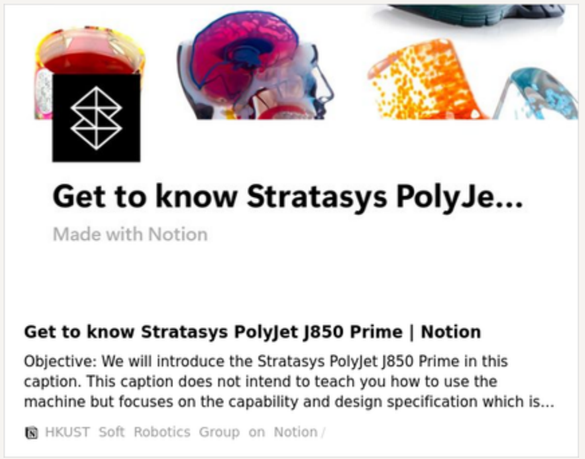
Print liquid materials for soft parts, hydraulics or fluidic models in exquisite detail.



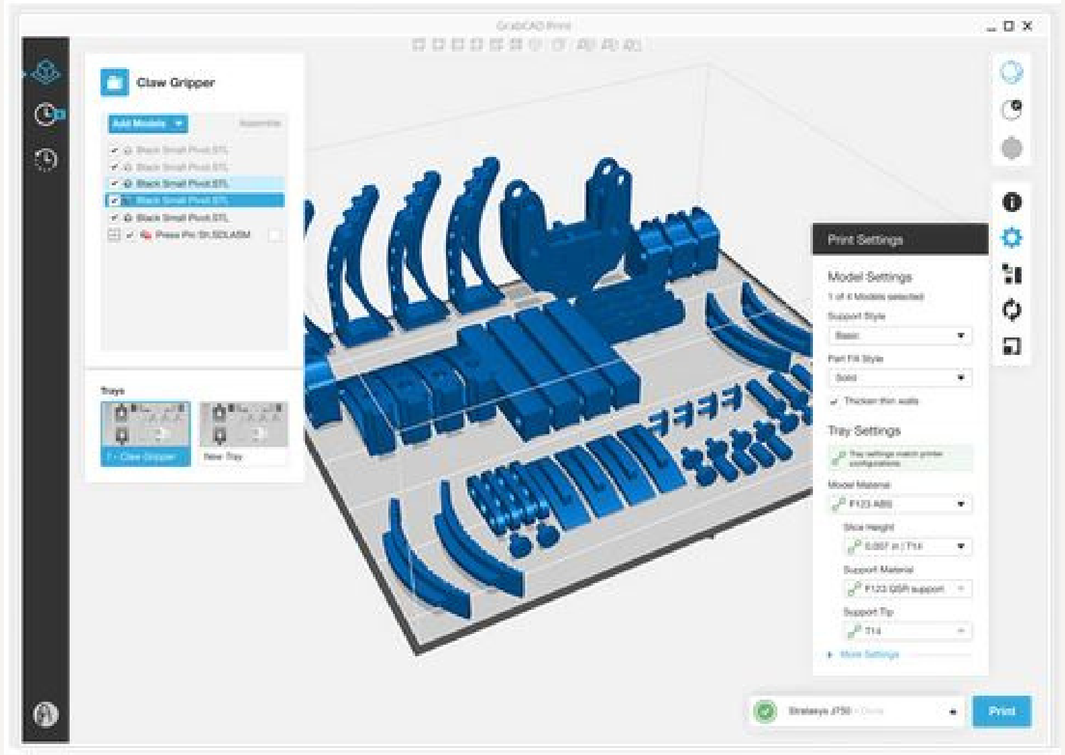
Parameters Editor

Control print parameters such as scale, offset carpet height and pedestal height with GrabCAD™ software.





Stratasys GrabCAD Print



List of Supported File Formats

GrabCAD Print allows you to print from a huge variety of file types. If you're having trouble inserting a file, please make sure that the software and version are in the list below.

	Software	File Extension	Versions Supported	Color and texture data
Autodesk	Inventor	IAM, IPT	up to 2025	Color only
	FBX	FBX	all versions	Color and texture [4]
Dassault Systemes	CATIA V5	CATPART, CATPRODUCT	R4 to V5-6 R2024	Color only
	SOLIDWORKS	SLDASM, SLDPRT	up to 2025	Color and texture [1]
PTC	ProE / Creo	ASM, PRT	Pro/ENGINEER 19.0 to Creo Parametric 11.0	Color only
Siemens	NX	PRT	Unigraphics V11 to v18, NX to NX12, NX1847 Series to NX2312 Series	Color only
	Solid Edge	ASM, PAR	1 to 20, ST1 to ST10, 2019 to 2025	Color only
Neutral	Stereolithography	STL	all versions	None
	IGES	IGES, IGS	5.1, 5.2, 5.3	Color only
	STEP	STP, STEP	AP 203 E1/E2, AP 214, AP 242	Color only
	Siemens	JT	up to V10.9	Color only
	VRML	WRL	V2.0 (also known as 97)	Color and texture [1]
	Wavefront Object	OBJ	all versions	Color and texture [1 2]
	Parasolid	X_T, X_B	up to 37.0	Color only
	3MF	3MF	all versions	Body and face color and texture [3]
Stratasys	CatalystEx / Insight	CMB, CMB.GZ	version 8.9 or later	None

[1] All multi-body files are presented as a single body with one texture, for now. Only GIF, PNG, BMP, and JPEG texture files are supported. Color depth must be 8 bits per channel. For formats that support RGB channels this means a depth of 24 bits per pixel. For formats that support transparency as an Alpha channel (PNG only), the RGBA channels result in 32 bits per pixel. Only triangle meshes are supported (i.e. facets with 4 or more vertices are not supported).

[2] Non-standard OBJ files with long lines wrapping around to the next line using a trailing '\' are supported. MTL material files with displacement / tactile texture information are not supported. To print with such textures, use the texture to physically displace the model geometry. For OBJ files with non-standard per-vertex colors the colors are imported if the RGB color channels are represented as floating point numbers in the range [0.0, 1.0].

[3] Body and face colors and textures are supported for 3MF files exported from SolidWorks and Keyshot. Other CAD systems have not been tested for color and texture support. For specific guidance on printing 3MF models from Keyshot, please see these tutorials.

[4] Texture image files must be stored in the same folder as the FBX file.

Assignment for 3D Scanning and PolyJet

INDIVIDUAL ASSIGNMENT

DUE APR 29TH TUE 23:59

- Choose a object to scan
- Scan the object using any 3D scanning method
- Export and repair the mesh
  - Trim the mesh to appropriate size (the final print will be scaled to within a 30mm^3 box)
  - Make it watertight
- Make sure you zip the final file for PolyJet printing, make sure it is with texture
- Submission a zip file
  - A zip file of your final CAD file for PolyJet Printing
  - A nice, high quality picture of your scanned object (with neutral background)
  - A nice, high quality screenshots (or render) of your scanned mesh / model
  - A paragraph in any document format (doc, txt, md) explaining your choosing of object, what challenge you encounter, any remarks to make and other things you think is worth writing it down.