Introduction to 3D Printing

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scu.edu/engineering/makerlab

Overview

- History of 3D Printing *(Video: 0:18-0:53)*
- Three Common Types of 3D Printing *(Video: 0:54-2:28)*
- Uses of 3D Printing *(Video: 2:29-3:32)*
- Prusa FFF 3D Printer *(Video: 3:33-4:36)*
- Software for Creating Models *(Video: 4:37-6:24)*
- Software for Preparing Models to Print *(Video: 6:25-10:43)*
- Running a Print Video *(Video: 10:44-15:12)*

History of 3D printing

3D printing is making an object by adding material layer by layer often referred to as additive manufacturing.

In the 80s processes for 3D printing plastics were beginning to be developed.

In the 90s processes for metal printing were starting development along with medical applications of 3D printing.

In 2009, Fused Deposition Modeling (FDM) printing patents expired.

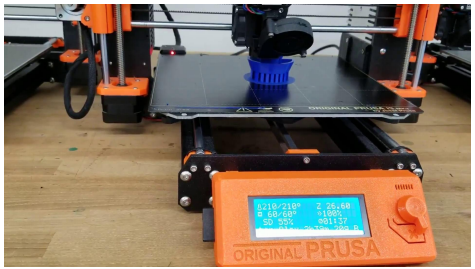
In 2000s to present day, there are continued advancements in the types of materials that can be used and the ability to create more detailed 3D prints. The cost of 3D printers has decreased making the technology more widely available.

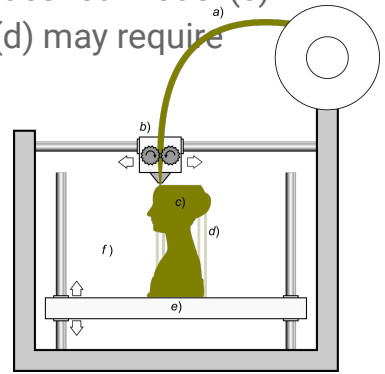
From Redshift by Autodesk and Wikipedia

Three Common Types of 3D Printing

Fused Filament Fabrication (FFF)
Fused Deposition Modeling (FDM)

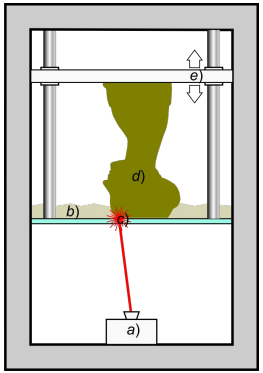
Solid material/filament (a) is heated and fed through the extruder (b). Motors move the extruder (b) and build plate (e) to allow motion in 3 directions in the build space (f) to create the desired model (c). Parts of the model that overhand (d) may require support material.





Stereolithography (SLA)

A light emitting device (a) is directed through a transparent tray (c) to cure/harden the liquid resin (b) in order to create the desired model (d). The build plate (e) raises the model out of the resin layer by layer.

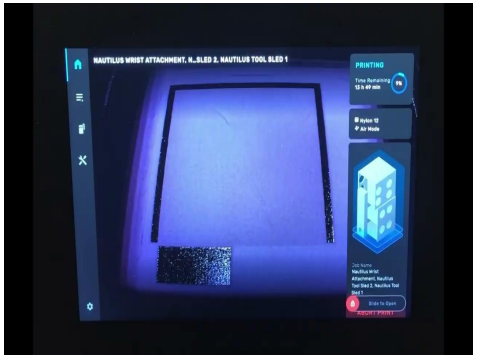


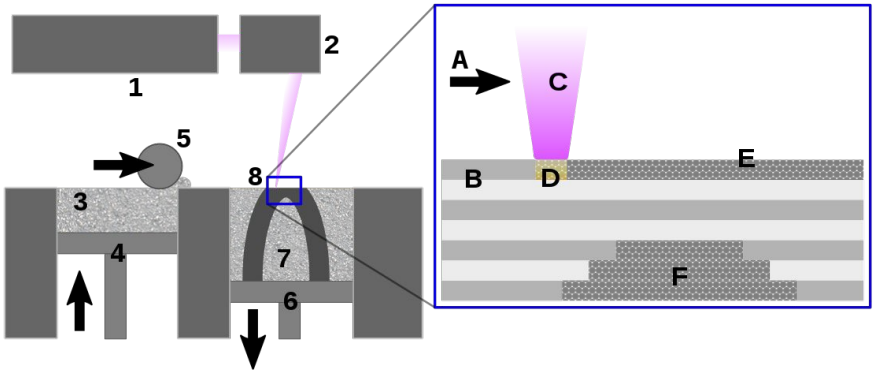
Images from Wikipedia

Three Common Types of 3D Printing (cont'd)

Selective Laser Sintering (SLS)

Powder from delivery system (3) is moved (5) into place (7). A laser (1) and scanning system (2) heats the powder to melting point to create the part (8). The build plate (6) lowers to allow more powder to be added to build the part up layer by layer.
Laser direction (A), Sintered powder particles (B), Laser beam (C), Laser sintering (D), Pre-placed powder bed (E), Unsintered material in previous layers (F)



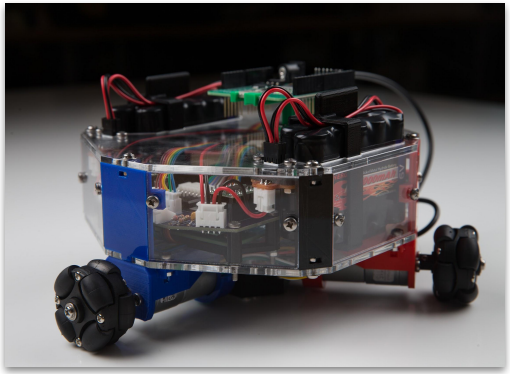


Images from Wikipedia

Examples of Uses of 3D printing

- Prototyping and Manufacturing
  - Design iteration
  - Final components
- Medical/Dental
  - Joint replacements
  - Bioprinting tissues
  - Crowns/fillings
- Industrial
  - Automotive
  - Aerospace
- Food
  - Piping/decorating
- Arts/Crafts/Hobbies
  - Jewelry
  - Scale models

Mass produced 3D printed parts for face shields for medical personnel



Custom motor mounts and components printed for a robotics research project

Prusa MK4 (FFF)

Print Size: 250x210x220mm (approx. 9.8x8.3x8.6 inches)

Input Format: STL, 3MF, OBJ

Approved Materials: PLA (Polyactic acid), PETG (Polyethylene terephthalate glycol), ASA (Acrylonitrile styrene acrylate), ABS (Acrylonitrile butadiene styrene), Flex PP, Ninjaflex, Nylon, and more

Pros: Great printer for a variety of projects, wide range of supported materials, good size workspace, easy maintenance

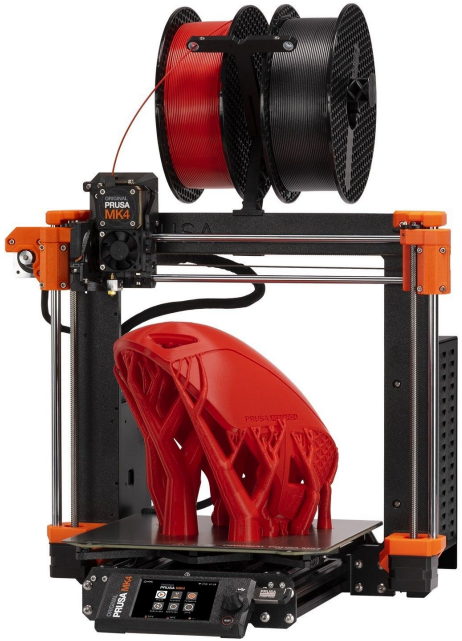


Image from prusa3d.com

Software for Creating Models

- TinkerCAD
  - Free/web-based (no downloads)
  - Good for beginners
  - Built-in tutorials
- Fusion 360
  - Free for personal/education
  - Good for intermediate/advanced
  - Tutorials available through AutoDesk site
- SolidWorks
  - License required
  - Good for intermediate/advanced
  - Tutorials available through SolidWorks site
- Other Modeling Software
  - Many other options available for create models
- Other Options
  - Scanning/photographing an object to create the 3D model
  - Downloading models created by others

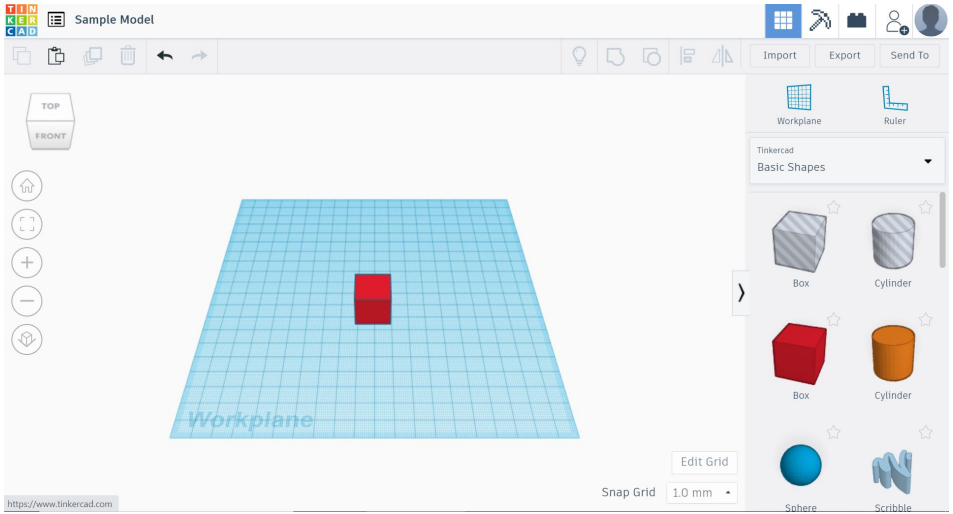
TinkerCAD

Go to TinkerCAD.com

Select Join Now to create an account. If you already have an account with AutoDesk, you can select Sign In to log into your account.

Once logged in, you can go through the lessons, create a new design, or modify (tinker) a design you already started.

You can invite people to collaborate on the design with you (icon in top right corner).

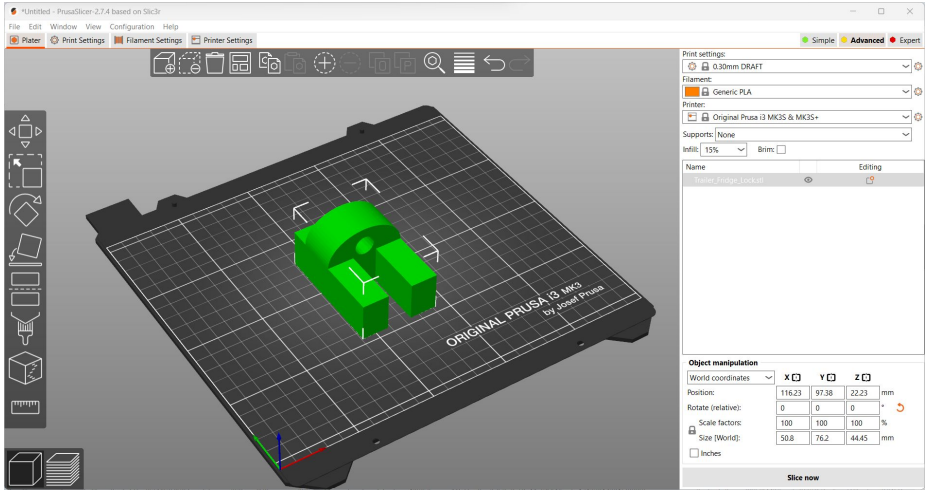


Software for Preparing Models to Print PrusaSlicer

Each printer manufacturer may have their own software, referred to as Slicer software, to generate the code to tell the printer how to make the part- speed, temperature, motor control, etc.

PrusaSlicer works will all Prusa printers as well as select other printers.

In PrusaSlicer, you can move, scale, and rotate your model. You can also cut it if you only want to print a section of it. These features only impact the model loaded in the software and not the original file (stl).



Settings for FFF prints

Material: PLA, ABS, PETG, and others (Typically PLA or PETG)

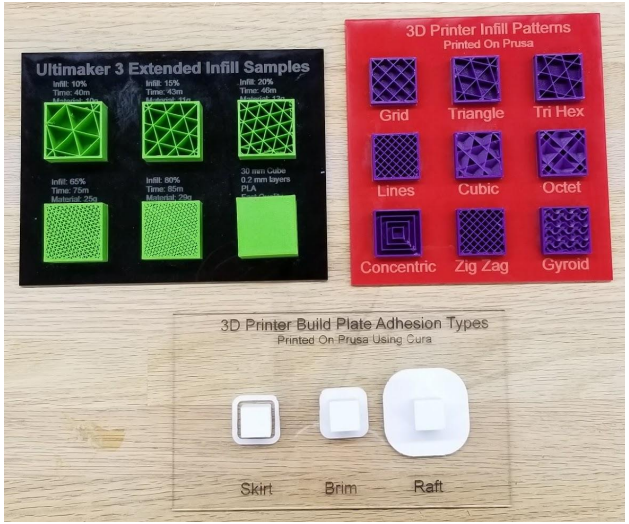
Layer Height: 0.1-0.3 mm (Typically 0.2 mm)

Infill Density: 0-100% (Typically 10-20%)

Infill Pattern: Grid, Cubic, and others (Typically Grid)

Build Plate Adhesion: Skirt, Brim, or Raft (Varies)

Support Material: Yes or No (Varies)



	Pro	Con
PLA	Print tiny or large parts, eco-friendly	Brittle, low temperature-resistance
ABS	Strong, heat resistant	Prone to warping
PETG	Tough, humidity and heat resistant	Stringing, bonds to print surface

Pro/Con from prusa3d

Running a print (on Prusa MK3s)