Additive Manufacturing (A.M.):

Creates 3D objects by iteratively depositing material layer-upon-layer; builds objects from ground up.

- Utilizes CAD model to slice obj. into horizontal cross-sections
- Mat. deposited / solidified in controlled manner
- Layers accumulate

Framework:

CAD (min. wall thickness, exported in STL format), Slicing (cuts into horiz. layers, creating G-node), G-code (positions printhead / deposition / temp).

Advantages:

Design freedom, fast prototyping speed, possible mass customization, lightweight, mat. efficient, pull-style inventory,

Disadvantages:

slower for high vols., mat. selection limited vs traditional methods, may need post-processing, may be costly.

Classification of AM:

Classification by Material State:

Power bed fusion (PBF)

- employs laser/electron beam to melt & fuse powder mat. to form layers.
- high accuracy, excellent surface finish, intricate geometries

Material Extrusion (MEX):

- extrudes a heated filament mat. through a nozzle to create layers

Vat Photopolymerization (VPP):

- utilizes a vat of liquid photopolymer resin cured layer-by-layer using light to solidify mat.

Classified by Energy Source:

Directed Energy Deposition (DED):

- a focused energy source melts / deposits mat. directly onto platform, metal AM.

Binder Jetting (BJ):

- binders are selectively deposited onto a powder bed to bind parts together, then infiltration process to strengthen the part.

Selective Laser Sintering (SLS):

Heat mat. just below its M.P., creating a strong bond btwn particles.

- Works w/ nylon, polyamide, & polystyrene
- High accuracy & resolution / complex geom.
- Good mechanical strength / thermal prop.

Direct Metal Laser Sintering (DMLS):

AKA Selective Laser Melting (SLM) is another PBF technique

- Metal powders → complex metallic parts
- Like SLS: high-powered laser beam to selectively fuse metal powder particles