



Reverse Engineering & Rapid Prototyping



Dr. Yogesh Kumar

Assistant Professor

Mechanical Engineering Department
National Institute of Technology Patna

Bihar - 800 005, India

yogesh.me@nitp.ac.in

Lecture No 3

Additive Manufacturing Process chain

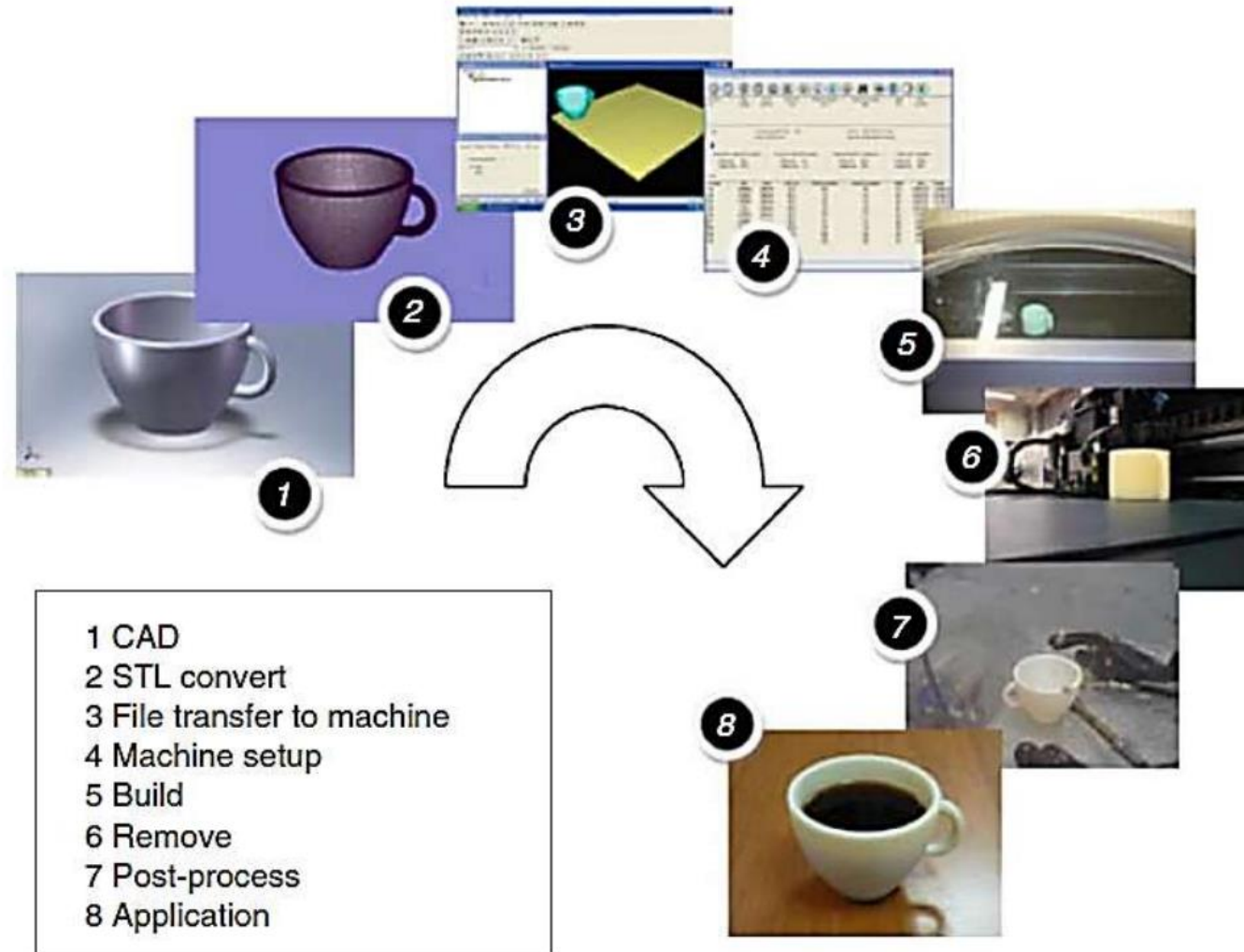
Additive Manufacturing Process chain



The Eight Steps in Additive Manufacture

1. Conceptualization and CAD
2. Conversion to STL
3. Transfer and manipulation of STL file on AM machine
4. Machine setup
5. Build
6. Part removal and clean-up
7. Post-processing of part
8. Application

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Step 1: Conceptualization and CAD

- The generic AM process start with 3D CAD information.
- There may be a many of ways as to how the 3D source data can be created.
- The model description could be generated by a computer.
- Most 3D CAD systems are solid modeling systems with some surface modeling components.

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Step 2: Conversion to STL

- The term STL was derived from **STereoLithography**.
- STL is a simple way of describing a **CAD** model in terms of its geometry alone.
- It works by removing any construction data, modeling history, etc., and approximating the surfaces of the model with a series of triangular facets.
- The minimum size of these triangles can be set within most CAD software and the objective is to ensure the models created do not show any obvious triangles on the surface.

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Step 2: Conversion to STL

- The process of converting to **STL** is automatic within most **CAD** systems.
- **STL file repair software** is used when there are problems with the file generated by the CAD system that may prevent the part from being built correctly.
- **With complex geometries**, it may be difficult to detect such problems while inspecting the CAD or the subsequently generated STL data.
- **If the errors are small then they may even go unnoticed** until after the part has been built.

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Step 2: Conversion to STL

- STL is essentially a surface description, the corresponding triangles in the files must be pointing in the correct direction; (in other words, the surface normal vector associated with the triangle must indicate which side of the triangle is outside vs. inside the part).
- While most errors can be detected and rectified automatically, there may also be a requirement for manual intervention.

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Step 3: Transfer to AM Machine and STL File Manipulation

- Once the STL file has been created, it can be sent directly to the target AM machine.
- Ideally, it should be possible to press a “print” button and the machine should build the part straight away.
- However there may be a number of actions required prior to building the part.
- The first task would be to verify that the part is correct.
- AM system software normally has a visualization tool that allows the user to view and manipulate the part.

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Step 3: Transfer to AM Machine and STL File Manipulation

- The user may wish to reposition the part or even change the orientation to allow it to be built at a specific location within the machine.
- It is quite common to build more than one part in an AM machine at a time.
- This may be multiples of the same part (thus requiring a copy function) or completely different STL files.

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Step 4: Machine Setup

- All AM machines will have at least some setup parameters that are specific to that machine or process.
- Some machines are only designed to run perhaps one or two different materials and with no variation in layer thickness or other build parameters.
- In the more complex cases to have default settings or save files from previously defined setups to help speed up the machine setup process and to prevent mistakes.
- Normally, an incorrect setup procedure will still result in a part being built.

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Step 5: Build Setup

- The first few stages of the AM process are semi-automated tasks that may require considerable manual control, interaction, and decision making.
- Once these steps are completed, the process switches to the computer controlled building phase.
- All AM machines will have a similar sequence of layer control, using a height adjustable platform, material deposition, and layer cross-section formation.
- All machines will repeat the process until either the build is complete or there is no source material remaining.

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Step 6: Removal and Cleanup

- The output from the AM machine should be ready for use.
- More often the parts still require a **significant amount of manual finishing** before they are ready for use.
- The part must be either **separated from a build platform** on which the part was produced or removed from excess build material surrounding the part.
- Some AM processes **use additional material** other than that used to make the part itself (secondary support materials).

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Step 7: Post Process

- Post-processing refers to the (usually manual) stages of finishing the parts for application purposes.
- This may involve abrasive finishing, like polishing and sandpapering, or application of coatings.

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Step 8: Application

- Following post-processing, parts are ready for use.
- Although parts may be made from similar materials to those available from other manufacturing processes (like molding and casting), parts may not behave according to standard material specifications.
- Some AM processes create parts with small voids or bubbles trapped inside them, which could be the source for part failure under mechanical stress.
- Some processes may cause the material to degrade during build or for materials not to bond, link, or crystallize in an optimum way.



Thanks
