Faculty Name	:	**Dr.M.Subramanian, Prof & Head/ Aerospace**	Academic Year	:	**2024-2025 (Odd)**
Year & Branch	:	**IV Aerospace**	Semester	:	**VII**
Course	:	**19ASZ401-3D Printing for Space Components**			

Unit II

DESIGN FOR ADDITIVE MANUFACTURING

Tool Path Generation

Definition

Tool Path Generation is the process of creating a precise path that a cutting tool follows during a machining operation. This path is defined using computer-aided design (CAD) and computer-aided manufacturing (CAM) software, ensuring that the tool moves accurately to produce the desired shape or feature on the workpiece

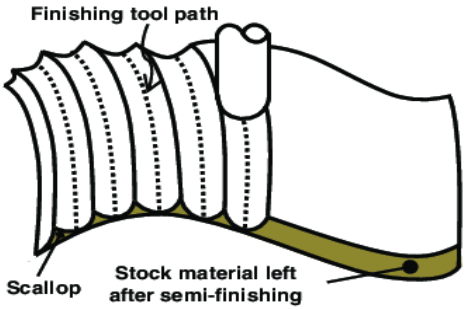
Detailed Explanation

1. **Process**:

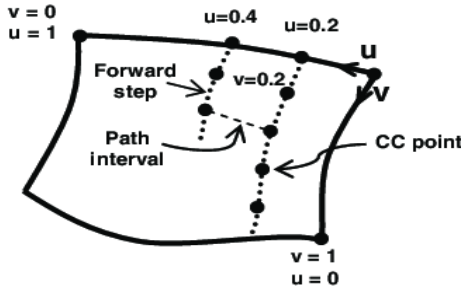
- **Design Input**: The process begins with a 3D model of the part, which is imported into CAM software.
- **Path Planning**: The software calculates the optimal path for the cutting tool, considering factors like tool type, material properties, and desired surface finish.
- **G-code Generation**: The tool path is converted into G-code, a language that CNC machines understand. This code includes instructions for tool movement, speed, and other parameters

2. **Types of Tool Paths**:

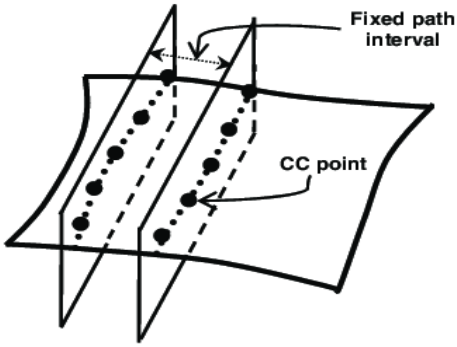
- **Linear**: Straight-line movements, often used for simple cuts.
- **Contour**: Follows the outline of the part, ideal for complex shapes.
- **Zigzag**: Moves back and forth in a zigzag pattern, useful for clearing large areas.
- **Spiral**: Moves in a spiral pattern, often used for circular features



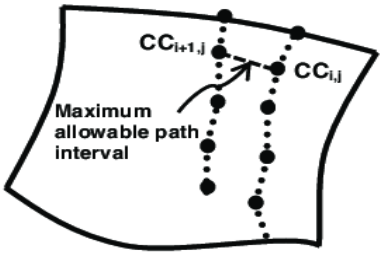
(a) Surface geometry during generation of finishing tool paths.



(b) Iso-parametric tool path generation.



(c) Iso-planar tool path generation.



(d) Iso-scallop tool path generation.

Advantages

- **Precision**: Ensures high accuracy and repeatability in machining operations.
- **Efficiency**: Optimizes tool movements to reduce machining time and material waste.
- **Flexibility**: Can be adapted for various materials and machining processes.
- **Automation**: Reduces the need for manual intervention, minimizing human error

Disadvantages

- **Complexity**: Requires skilled operators and sophisticated software to generate effective tool paths.
- **Cost**: High initial investment in CAD/CAM software and training.
- **Dependency**: Over-reliance on software can lead to issues if the software malfunctions or is not properly configured

Applications

- **Aerospace**: Used for machining complex components with high precision.
- **Automotive**: Essential for producing engine parts, body panels, and other components.
- **Medical**: Used to create intricate surgical instruments and implants.
- **Manufacturing**: Widely used in various industries for producing parts and prototypes