

CAMufacturing Solutions, Inc.

Additive manufacturing module for **Mastercam**.

- True additive travel paths
- Additive process simulation
- Intuitive graphical interface
- Seamless integration into Mastercam

CAM for hybrid manufacturing



University
of Windsor

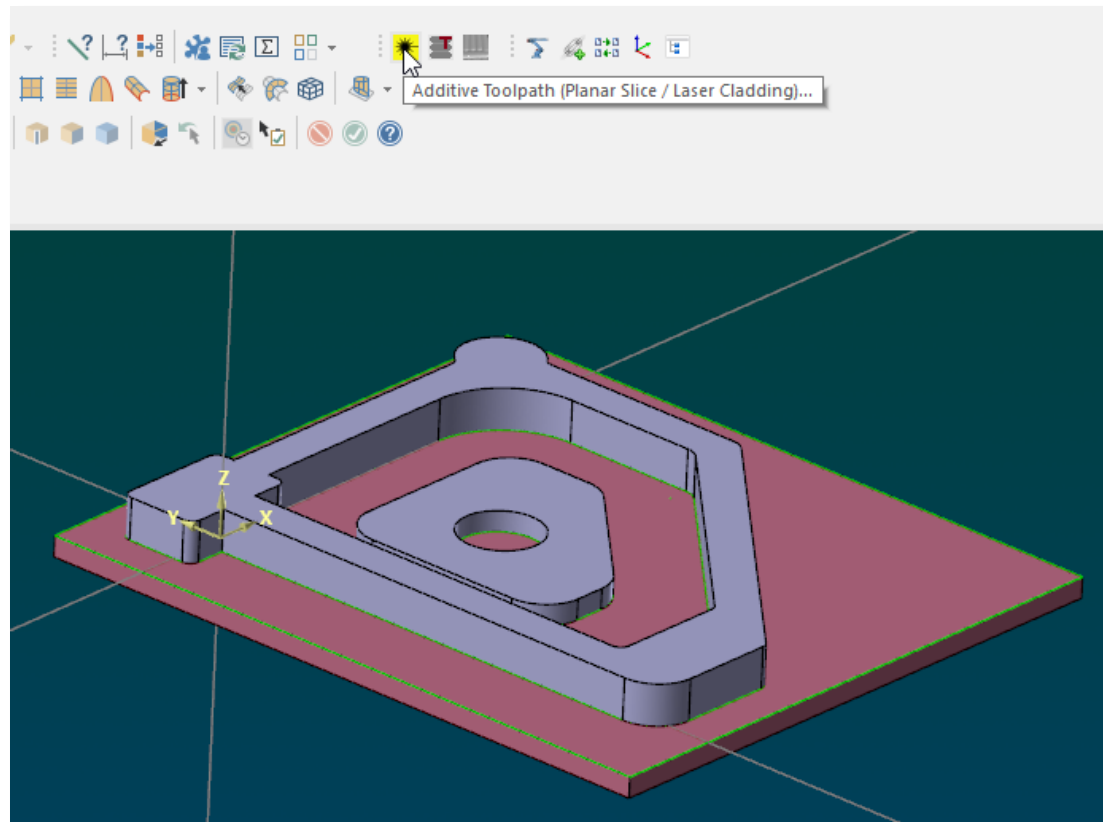
www.camufacturing.com

Additive Travel Path Generation

Select from the Mastercam toolbar and select the CAD entities to process

The following entity types are supported:

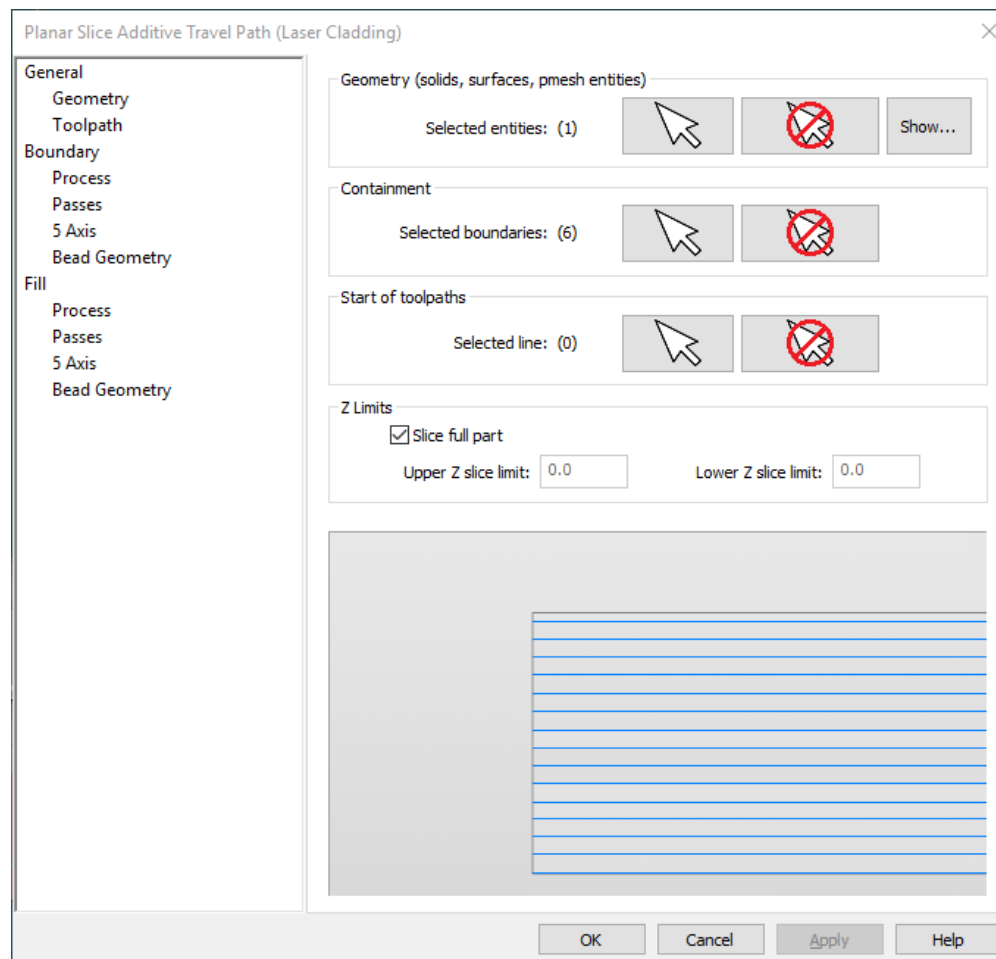
- Solids
- Surfaces
- Polygon meshes



Additive Travel Path Generation

Geometry parameters

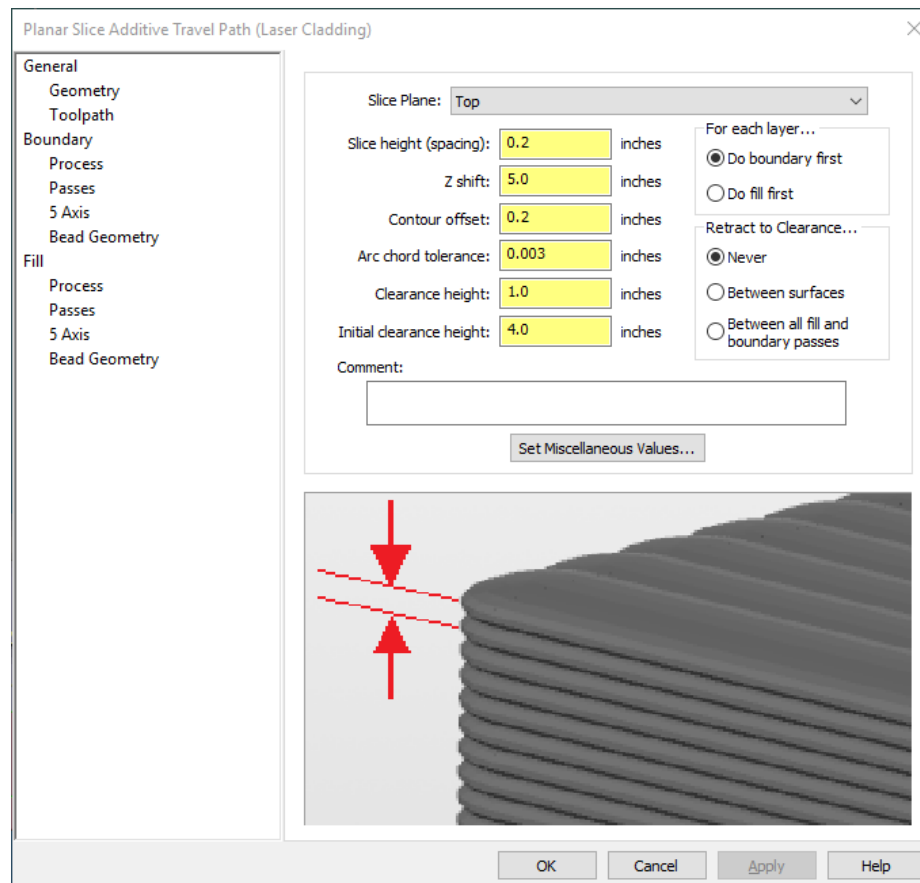
- The part may be defined by multiple solids, surfaces or polygon meshes.
- Extended travel path control is provided via containment boundaries, Z height restrictions and boundary start point control.



Additive Travel Path Generation

General travel path parameters

- The geometry may be sliced in any plane
- Slices may be offset to leave stock for machining
- User can select boundary / fill pass order
- Supports clearance Z moves to avoid tool collisions



Additive Travel Path Generation

Process parameters (laser cladding shown) for the boundary travel paths

- Separate parameters may be defined for the fill travel paths

Planar Slice Additive Travel Path (Laser Cladding)

General

- Geometry
- Toolpath

Boundary

- Process
- Passes
- 5 Axis
- Bead Geometry

Fill

- Process
- Passes
- 5 Axis
- Bead Geometry

Process Parameters

Spot Size

☒ Bead width = spot size 0.5 inches

Travel speed: 30.0 inches / min.

Laser power: 4000.0 Watts

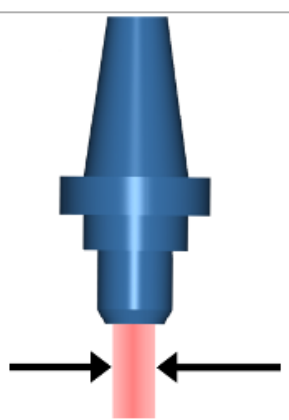
Powder Settings

Dwell time for start of flow: 0.0 seconds

Feed rate: 1.0

Source

☒ 1 ☐ 2

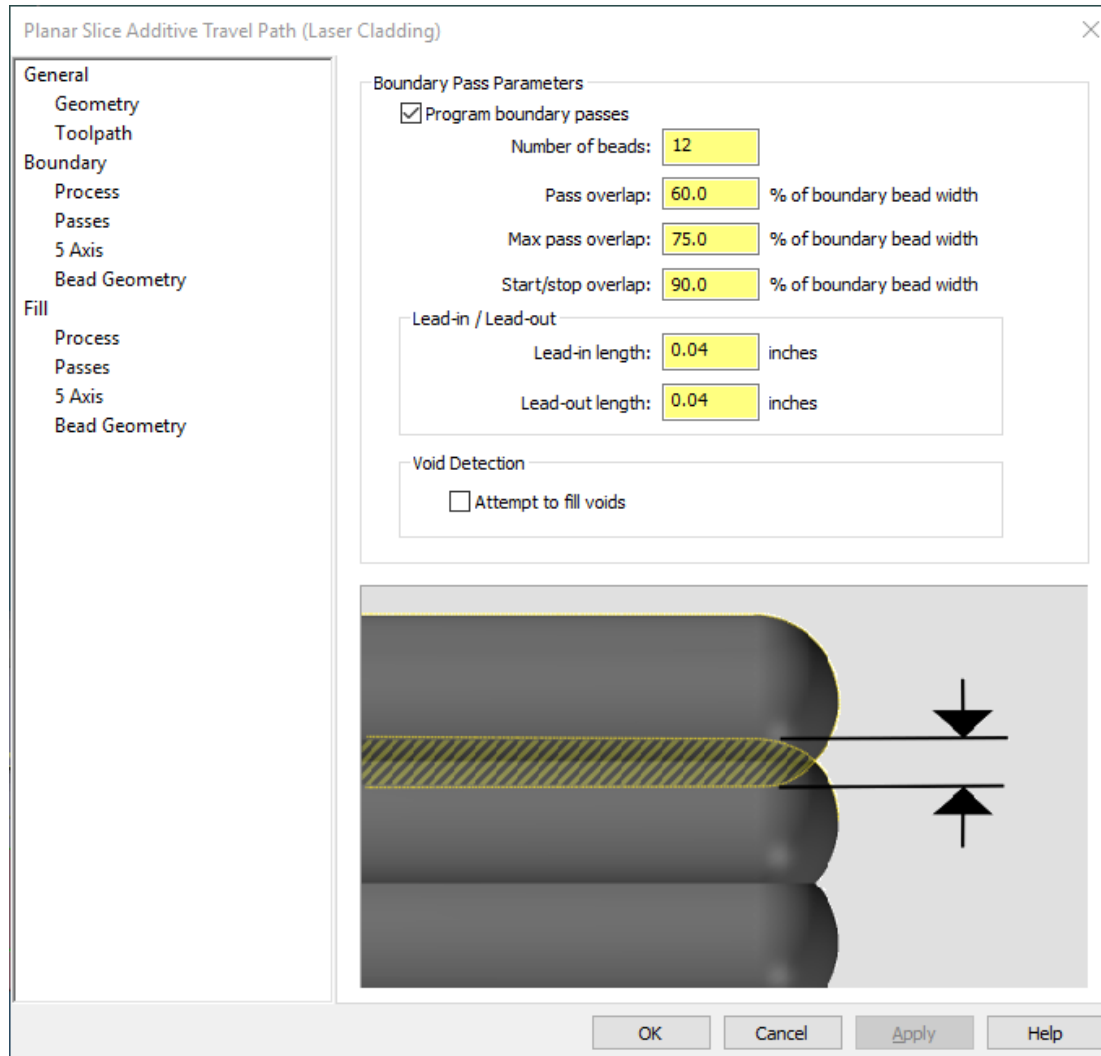


OK Cancel Apply Help

Additive Travel Path Generation

Pass parameters for the boundary travel paths

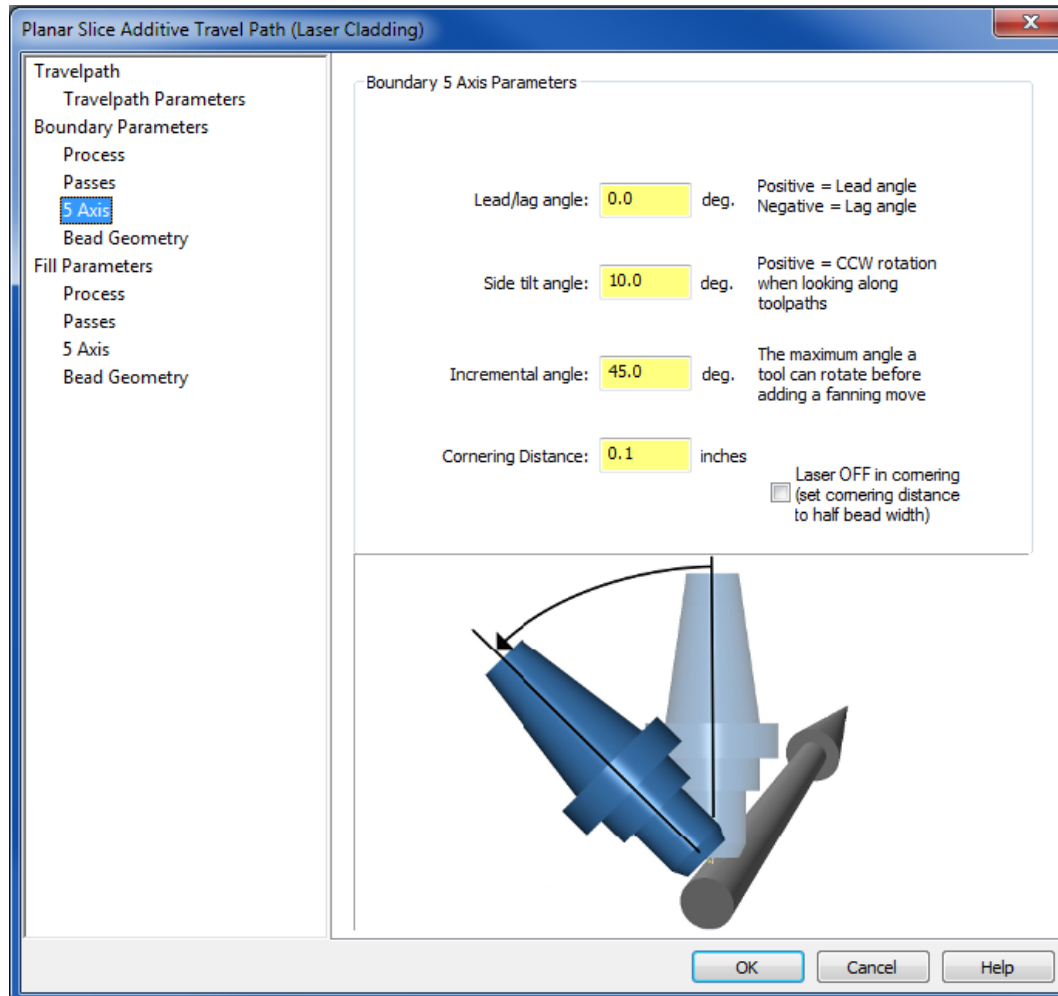
- Can identify and fill voids left due to overlap settings



Additive Travel Path Generation

5 axis parameters for the boundary travel paths

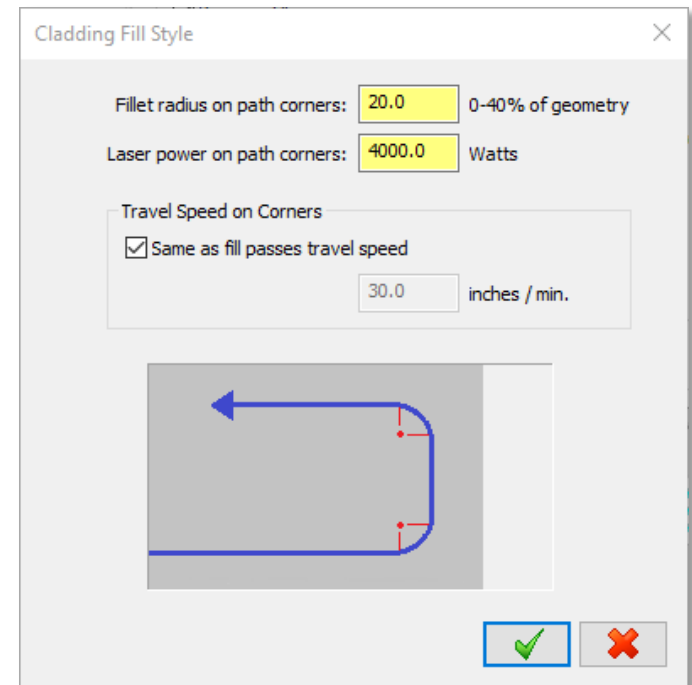
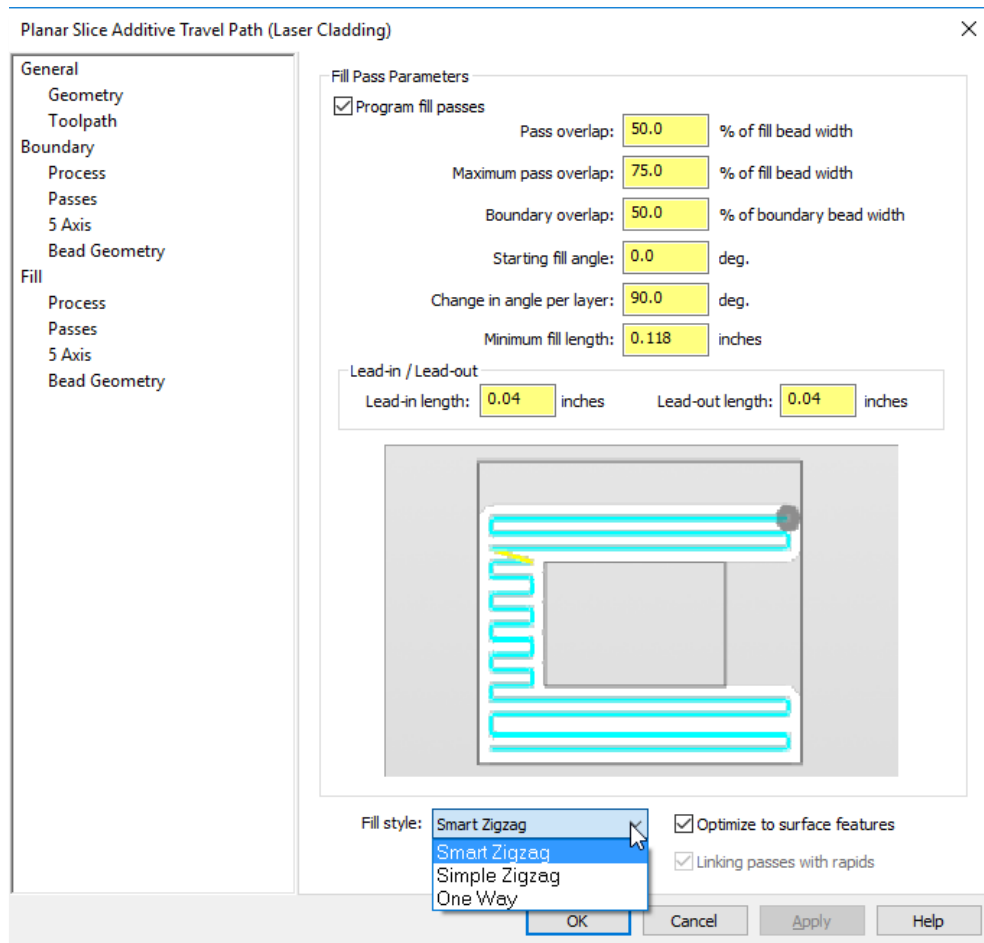
- Lead-lag and side tilt are supported for both boundary and fill passes



Additive Travel Path Generation

Fill pass parameters

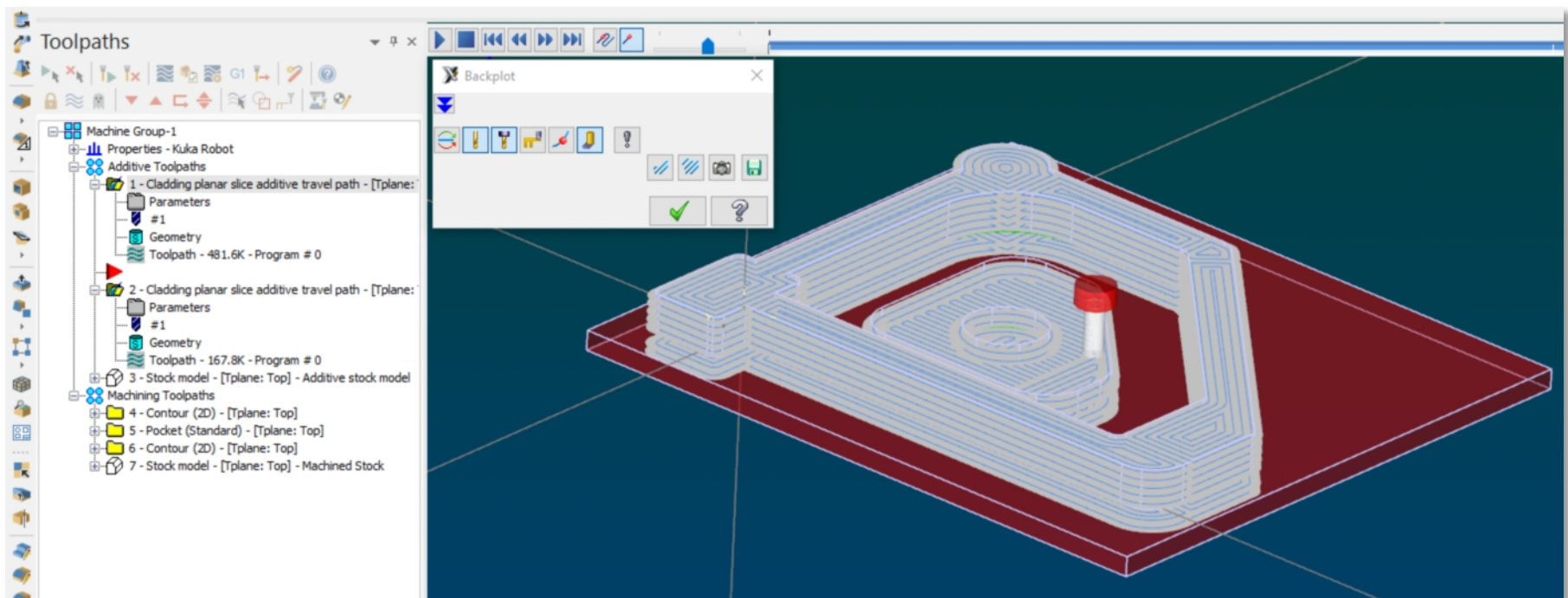
- Fill travel path angle may be changed for each layer
- 3 fill styles are supported
- Separate corner power and travel speed settings for each style (laser cladding shown)



Additive Travel Path Generation

The laser cladding additive operation is added to the Operation Manager

- Travel path is fully associative to both operation and geometry
- Operation parameters may be edited at any time
- If geometry is edited, the operation can simply be regenerated
- Backplot and machine simulation are supported

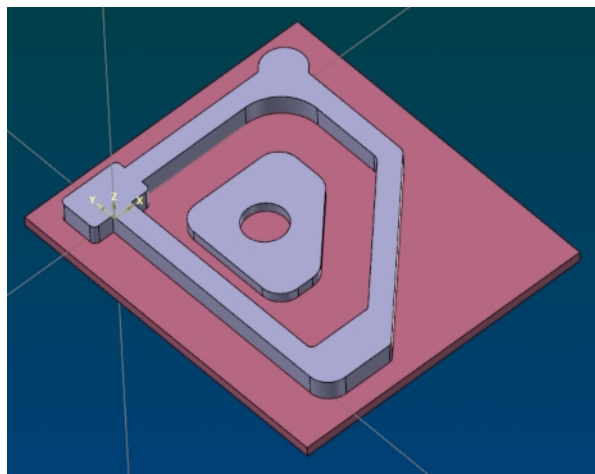


Additive Travel Path Simulation

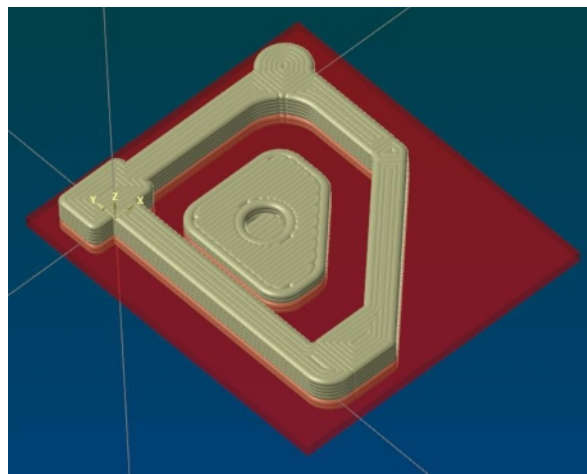
A virtual model of the additive part can be created and used to validate subsequent machining operations

- Model is stored in Mastercam as a polygon mesh and can be exported to other CAM systems for use as a stock model
- Optionally, a Mastercam stock model can also be generated and used with subsequent machining operations in Mastercam

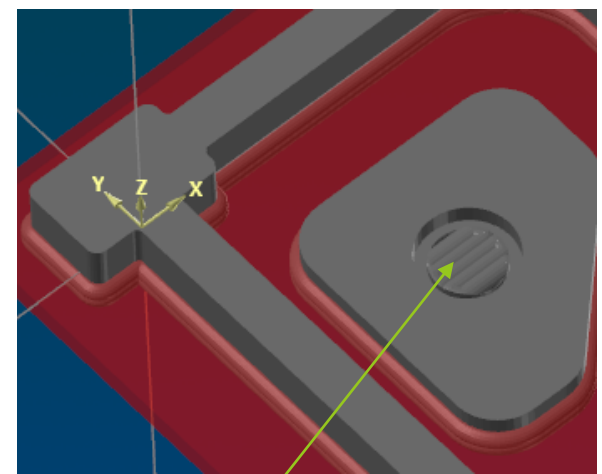
CAD Model



Additive Stock Model



Machined Stock Model



Un-machined stock

NC Output (laser cladding shown)

Uses standard Mastercam post-processing engine (MP)

- Can be customized for any additive process

```
%  
O0001  
(Bracket)  
(DATE=DD-MM-YY - 05-03-15 TIME=HH:MM - 23:24)  
(MCX FILE - D:\MY DOCUMENTS\MCX\ADDITIVE MANUFACTURING\WIDGET.MCX-8)  
(NC FILE - D:\MY DOCUMENTS\MY MCAMX8\MILL\NC\WIDGET.NC)  
(MATERIAL - P20 SS)  
G20  
G0 G64 G17 G40 G80 G90 G93 G98  
( Initial Tool )  
G0 G54 G90 X6.1357 Y.01 C0. A0. M5  
Z-.9969  
/ M101 (LASER READY ON)  
/ M103 (POWDER 1 ON)  
/ M105 (SHIELDING GAS ON)  
/ G4 P8  
/ ( Powder feedrate: 10. )  
/ ( Laser Power = 3000 Watts )  
G1 G93 X6.135 Y0. Z-.9969 C0. A0. F999.99  
/ M102  
G1 X6.1252 Y-.1492 Z-.9969 C0. A0. F160.54  
G1 X6.0958 Y-.2958 Z-.9969 C0. A0. F160.54
```



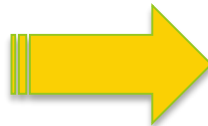
Relating process parameters to bead geometry and vice versa

Variables

Feed Rate
Power
Focal Length of Lens
Laser Speed
Contact tip to work Distance

Constants

Work Bench and Torch angles
Shielding Gas
Nozzle Type
Tip Size
Base Material



Width

Dilution

Profile

Height

Pene-
tration



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