SIEMENS

Siemens PLM Software

NX Hybrid Additive Manufacturing

Transforming component design and manufacturing

Benefits

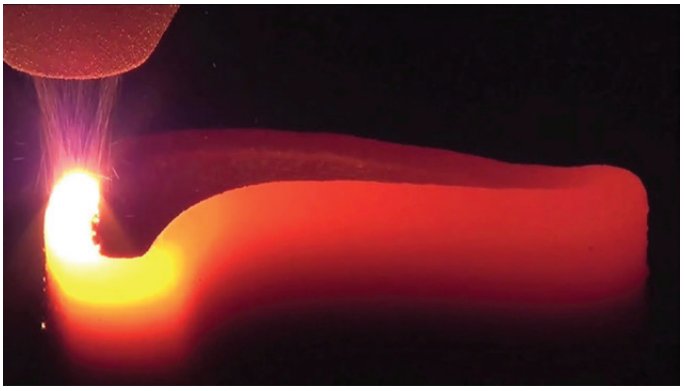
- Enable new designs
- Machine internal areas during build
- Repair parts easily
- Tightly control tolerance during build
- Produce finished parts on one machine

Features

- Feature decomposition for different build vectors
- New additive CAM operations
- Support for DMG MORI Lasertec Hybrid machines

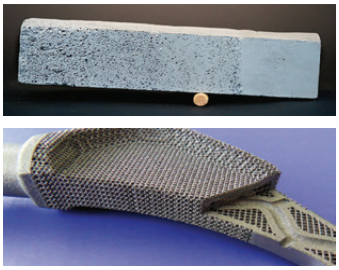
Summary

The concept of 3D printing is likely already familiar at some level since the adoption of stereolithography (SLA) machines started in the 1990s. Those first SLA machines used a laser to cure photosensitive polymers layer-by-layer in a vat of liquid polymer. Several methods for 3D printing have been developed since, including an analogous method for metals in which a laser solidifies metal powder layer-by-layer in a big container called a powder bed. The latest version of this technology solidifies metal powder without using a big powder bed, blowing a stream of powder through a controlled nozzle directly into a melt pool on a metal surface. The melt pool is created by a laser that is incorporated into the nozzle. This process change is a significant step in state-of-the-art 3D printing for metals since the big, heavy powder bed is eliminated and unidirectional layup is no longer a limitation.



3D printing with a metal deposition nozzle.

NX Hybrid Additive Manufacturing



Hybrid-additive manufacturing will fundamentally change how we think about manufacturing components.

Why this new deposition method is important

This powder deposition process allows you to place material in the desired composition exactly where you want it (and nowhere else). You can make things that are impossible to make in any other way, including:

- Internal voids, webs, honeycombs and lattice structures
- Internally-embedded components
- Parts with custom nonhomogeneous (graded) materials

As a result, material composition and placement become design variables, and engineering part performance can be dramatically improved. It might not be too ambitious to say this technology will be the catalyst for the next industrial revolution.

Hybrid manufacturing

DMG MORI has developed a new class of machine tool that brings the additive metal deposition nozzle capability of the latest 3D printing together with the axis control and metal-cutting capabilities of modern machining centers. This combination means that metal deposition can be performed along various axes. And the 3D printed material can be machined to precise tolerances at any stage in the process, even going back and forth between metal deposition and metal cutting as often as needed. This combination of additive and subtractive manufacturing is the basis of the term: hybrid-additive manufacturing.

NX Hybrid Additive Manufacturing

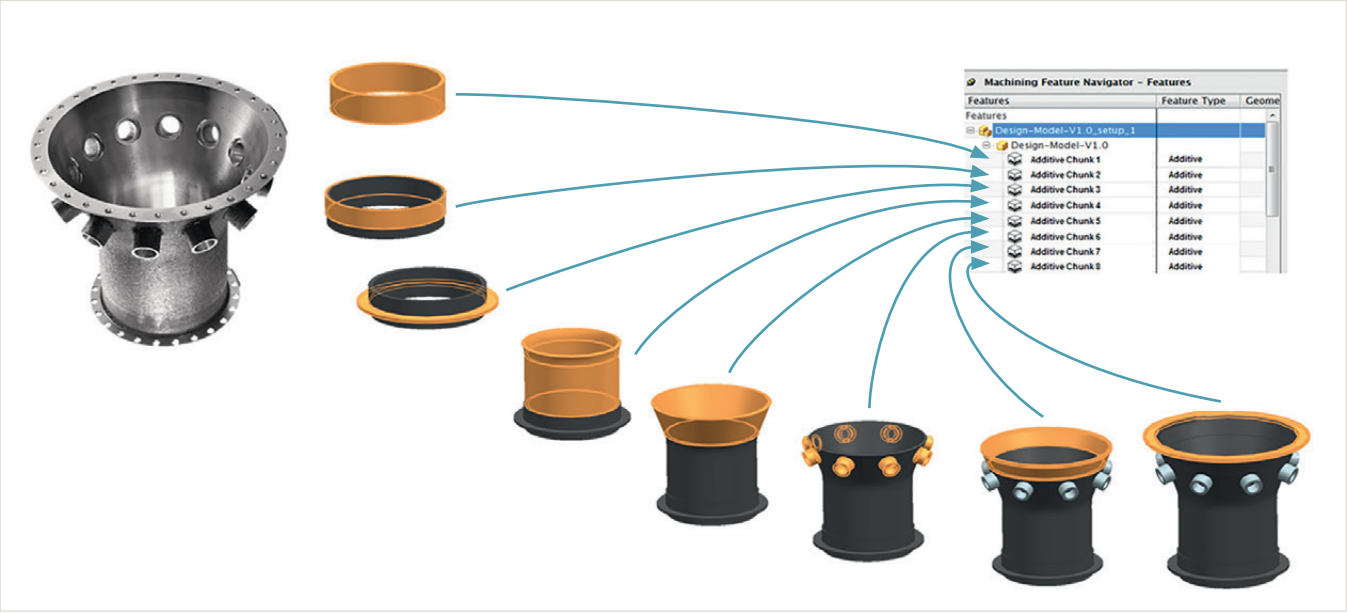
NX™ software provides support for new hybrid-manufacturing technologies in which additive manufacturing (3D printing or metal deposition) is incorporated with subtractive (cutting) methods in a traditional machine-tool environment. These manufacturing techniques will revolutionize the way we think about making parts. By building complex geometries, including internal cavities, and then machining them for tight tolerances as they are built, new classes of parts can be manufactured, or many setups may be consolidated into one.

- **Prototype:** This application accounts for most of the 3D printing and stereolithography processes to date. Quickly evaluating prototypes will continue to be a strength of additive and hybrid technologies
- **Production:** New laser sintering (powder bed) capabilities are moving us toward using additive manufacturing approaches for part production. The hybrid techniques will accelerate this trend
- **Repair:** By combining metal deposition and traditional metal cutting into one machine environment, there are many possibilities for using the application for repair and refurbishment

Solution details

The NX Hybrid Additive Manufacturing solution includes a suite of unique capabilities across computer-aided design (CAD) and computer-aided manufacturing (CAM) that enable the development of programs for the new DMG MORI hybrid machines. These are organized in a special toolbar for utilizing the additive-manufacturing processes.

The additive manufacturing toolbar.



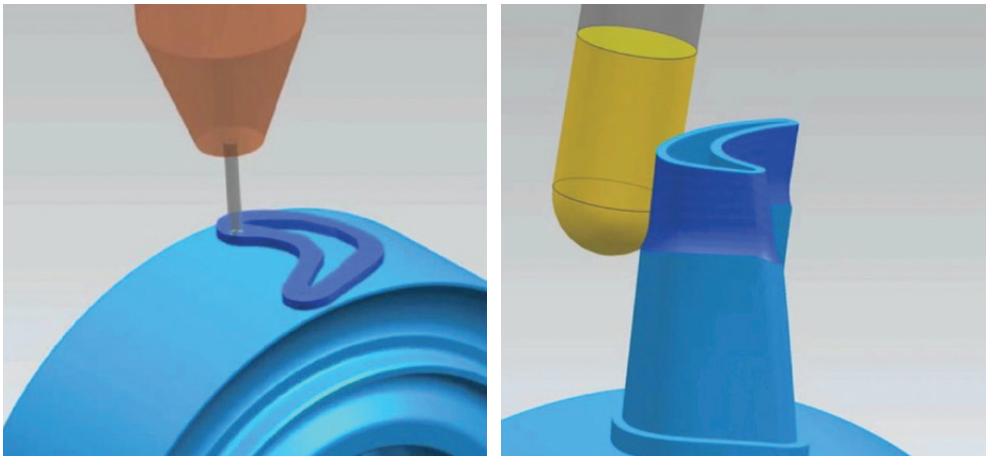
Automatic and semiautomatic decomposition of parts into features for additive/subtractive operations definition.

Feature decomposition by build vectors

As a preprocess to programming the deposition paths, the build volume is analyzed for possible layup vectors and subdivided to make a sequential layup using as many vectors as necessary.

In-process workpiece

The in-process workpiece for NX CAM now supports both additive and subtractive steps in any order. Hybrid Additive operations may be co-mingled with metal cutting operations, so the in-process workpiece must be able to represent both new material placed by the powder nozzles as well as removed material cut away by the machining operations. The verify capability also reflects both of these modes.



In-process workpiece and verification works for both additive and subtractive modes.

NX additive manufacturing deposition operations

Programming the powder deposition head means slicing the feature (decomposed subvolume) and building motion paths for each layer. This sounds very similar to the roughing approach we are familiar with in the NX CAM cavity mill operation, but programming motion for an additive process is fundamentally different from programming cutting tools. Patterns must not retrace areas (so they are not overbuilt) or overheat areas by staying in one region too long.

Planar-additive operations work from planar slices, while rotary additive operations work from cylindrical slices.

The NX Hybrid Additive Manufacturing solution provides the following specialized additive operations:

- Planar thin wall helical – provides a helical outline pattern at each slice with no fill
- Planar spiral – provides a spiral fill pattern at each slice
- Planar smooth offset follow part – provides an offset fill pattern from the part outline inwards at each slice
- Planar zig zag infill – provides a raster (zig zag) fill pattern at each slice
- Rotary spiral – provides a spiral fill pattern at each slice
- Rotary thin wall helical – a helical outline pattern at each cylindrical slice with no fill
- Rotary helical around part – provides an offset fill pattern from the part outline inwards at each cylindrical slice

Applied CAx
We do this *every day*

Contact Applied CAx

6700 N. New York Avenue, Ste 231
Portland, Oregon

800-746-8134

www.AppliedCAx.com/NXCAM

46834-Y6 5/15 H