

Industrialization of Additive Manufacturing

With unique seamless PLM software and scalable automation solutions

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Siemens industrializes additive manufacturing

Individualized mass production, functional design, high energy and resource efficiency—as well as shorter innovation cycles—the advantages of Additive Manufacturing are being leveraged more and more in the industrial environment. Whether powder bed fusion, directed energy deposition, material extrusion or jetting, these techniques build-up workpieces layer-by-layer based upon digital 3D design data. Techniques like these allow extremely complex structures to be created, which are both light and stable—in fact, parts can finally be created cost-effectively with batch sizes of just one. And digitalization offers the best possibilities of exceeding the requirements associated with additive manufacturing.

Unique seamless software and scalable automation solutions

Siemens is the only company offering seamless software and automation solutions for additive manufacturing — where the advantages of digitalization fully come into their own. With PLM software, designers, engineers and machine tool end-users have a seamless process chain available that extends from development and design, up to data preparation for components for 3D printing. Siemens offers machine tool builders solutions for equipping industrial 3D printers based upon its automation solutions firmly established in the market.





Seamless workflow—from development through to the finished part

With digitalization, industry is using seamless software tools in every product development phase. Siemens offers the ideal solution with its PLM software NX having functions specifically for additive manufacturing applications, which provides a seamless workflow. NX covers the complete process—from development and design, through preparing the build job—up to generating machine code for the 3D printing system.

More specifically, the complete digital process chain is emulated in a single, integrated associative software environment—allowing it to be operated from a standard user interface. Tools for developing, simulating, manufacturing preparation and 3D printing are embedded in one seamless and integrated system. This means that data conversion processes—prone to errors with possible loss of information—are not required. This is how NX ensures high process reliability and efficiency.

Mature for serial production—NX for additive manufacturing

The completely seamless NX solution for additive manufacturing facilitates a seamless process chain, even when it comes to complex printing techniques. As a result, high-quality products can be produced in series on additive manufacturing machines.



Totally Integrated Automation-

where all automation components interoperate efficiently

When it comes to production systems, automation plays a decisive role in the industrialization of additive manufacturing. Totally Integrated Automation from Siemens ensures that all automation components work efficiently. The open system architecture covers the complete production process and utilizes a standard approach across the board: consistent data management, global standards and unified hardware and software interfaces. This common approach minimizes engineering costs, shortens time-to-market and increases flexibility.

PLC-based automation solutions with SIMATIC

With SIMATIC, the core of Totally Integrated Automation, machine users can depend on the highest degree of integration and seamlessness. The basic automation based upon SIMATIC, the SINAMICS drive system and SIMOTICS motors to move the mechanical units of the machine for powder bed fusion and jetting techniques offer some unique advantages:

- As a result of its scalability, solutions can be flexibly and cost-effectively adapted to address the actual requirements
- Shorter time-to-market is achieved through integrated engineering and efficient programming in the TIA Portal
- Diagnostic functions are simply configured and do not have to be programmed

SIMATIC highlights

When it comes to industrializing additive manufacturing, manufacturers of 3D printing systems especially profit from the following SIMATIC highlights:

Safety technology embedded in the controller

SIMATIC S7-1500 is the only software controller with Safety Integrated available on the market. The integrated safety functionality helps save space and reduce costs as an additional safety controller is not required.

OPC UA and PROFINET—open standards for communication concepts

With PROFINET, Siemens uses the Ethernet standard for automation. OPC UA has established itself as the open, non-proprietary communication platform linking control systems to the ERP level and to the Cloud. Combining the individual strengths of both standards facilitates secure and seamless vertical communication in the complete automation and IT environment.

Two possible configurations are shown here as examples. Customized automation solutions can be configured to address the specific requirements of the machine.



Powder bed fusion

With the powder bed fusion technique, the powdered material—i.e. metal, plastic or ceramic is applied to a build platform, the powder bed. The laser beam precisely melts the powder and fuses defined points to the layer below. The laser repeats this process until the part to be created has been completed.







Seamless CAD/CAM-CNC chain from NX through to the SINUMERIK-controlled machine at Hoedtke GmbH & Co. KG

CNC-based automation solutions with SINUMERIK

The 5-axis capabilities of the SINUMERIK 840D sI CNC provides a high degree of flexibility in additive manufacturing. Whether material extrusion or directed energy deposition—the SINUMERIK 840D sl, together with SINAMICS S120 drives and SIMOTICS motors, facilitate precise and dynamic multi-axis motion control.

SINUMERIK highlights

When it comes to industrializing additive manufacturing, manufacturers of 3D printing systems especially profit from the following SINUMERIK highlights:

Seamless and integrated CAD/CAM-CNC chain

Based upon the CAD model of the component, the material deposition strategy for additive techniques can be generated in NX by applying 5-axis motion control. The path is calculated for the production process in NX in the same way as conventional machining processes, generating runnable CNC programs. After an encrypted data transfer to the machine (to protect intellectual property), this data can be processed directly by the CNC.

One possible configuration is shown here as an example. Customized automation solutions can be configured to address the specific requirements of the machine.



Material extrusion

Material extrusion is a technique frequently used in the plastics industry. This process involves melting and applying a very fine stream of plastic.



Direct energy deposition

In the direct energy deposition technique, metal powder is directly fed to the weld location and melted using a laser.



Support structures can be reduced thanks to 5-axis motion control

For 5-axis machines, in addition to the three linear axes, there are two rotating and/or swiveling axes. This creates the basis for multi-dimensional motion control strategies, and allows the nozzle to be moved relative to the build platform. Material can be optimally deposited for the build process by appropriately orienting the print head as well as the part itself. For example, in material extrusion, this allows most of the support structures and special support materials to be eliminated. Higher build rates, more efficient material utilization and, last but not least, better surface quality can be achieved as a result of the high dynamic performance and precision of SINUMERIK.

Maximum technology in the machine

The SINUMERIK 840D sl's high level of system openness gives machine builders the opportunity of integrating technological functions that are precisely tailored to address their specific machine requirements. These extend from their own machine-specific user interfaces up to compile cycles—all made possible by the open CNC kernel and drive architecture, which is absolutely unique to the market. Packed with these innovative features, the SINUMERIK 840D sl guarantees the highest degree of technological expertise in high-performance additive manufacturing production systems.

Everything about the SINUMERIK CNC platform can be found on the web

usa.siemens.com/cnc

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