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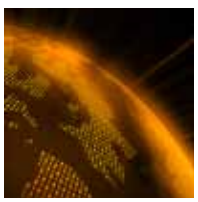
Where manufacturing begins

Additive manufacturing on its way to industrialisation

A game changer?



Additive mandufacturing on the global rise
Tim Caffrey, Wohlers Associates

"The EU needs to invest in additive manufacturing,"
Reinhard Bütikofer, MEP

Opportunities in digital manufacturing
Bernhard Langefeld, Roland Berger Strategy Consultants

Industrial 3D printing is coming to mainstream CNC

By Jason Jones, Co-founder and CEO, Hybrid Manufacturing Technologies

Hybrid Manufacturing Technologies Ltd. is the winner of the International Additive Manufacturing Award (IAMA), sponsored by CECIMO, the first ever international additive manufacturing award. The company shares why it makes sense to upgrade CNC machines, allowing them to 3D print metal, not only remove it.

Additive manufacturing (AM), also known as industrial 3D printing, is perceived by many as a threat to the CNC machining industry. However, it also represents a tremendous opportunity – one that is epitomized by recent innovations combining these two technologies into hybrid CNC machines.

Bringing AM Capabilities to Mainstream CNC

Have you ever made a mistake when machining a part and wished to be able to add some metal back? Or would you like to build up some features onto an existing billet or part? This is the promise of deploying industrial 3D printing of metal inside a CNC machine.

Beginning as an academic-industry research project seven years ago, a consortium set out to make changing between adding and removing metal as easy as a tool change. The result, first shown in 2012, is the AMBIT™ tool changeable laser cladding system, which can upgrade CNC machines into industrial 3D printers for metal. Early demonstrations of its capability have included build-up of features onto existing parts and all-in-one repair of blades and impellers – including in-process inspection and finish machining of restored metal surfaces, all in a single setup.

The system can be retrofitted onto existing CNC machines, or be fully integrated with additional functionality into new CNC machines, such as the Hamuel HSTM 1000 and Mazak INTEGREX i-400 AM. By using mainstream CNC machines as a platform, this innovation represents a new way to adopt AM.

AMBIT cladding head

AMBIT laser cladding onto blade into a Hamuel machine tool

As-clad cummins impeller

How does it work?
AMBIT™ laser-based metal deposition heads are stored in the tool magazine and are loaded into a milling spindle using the standard tool changer. Once loaded into the spindle, a supply unit fitted to the spindle, docks with a head and delivers laser energy and feedstock powder to enable directed energy deposition (a form of 3D welding) of non-reactive metal powders onto parts. It is controlled using he same CNC controller that is used for subtractive tool paths with some customized M-codes. Once deposition is complete, the head is replaced into the magazine and machining can be resumed.

AMBIT cladding head in tool changer

Adding metal vs. removing it

Summarizing at a very general level, 3D printing metal is significantly (1 to 2 orders of magnitude) slower and less precise, than removing it by CNC machining. However printing metal gives unprecedented ability to make complex geometry, can combine different materials in the same part, and is far less wasteful than machining.

Machining has been used to make critical components for 3D printers and systems since its commercialization in the mid-1980s. It has regularly been used to drill and tap holes and to perform other finishing operations on 3D printed polymer parts.

Accelerating adoption of AM systems that print metal (especially in the last 5 years) has increased the reliance of AM on machining, because nearly all parts printed in metal require some post-processing – most often machining, grinding, or polishing. To shorten print time, metal parts are often printed at a more coarse resolution to a "near net" shape relying on post-print machining to achieve the desired surface finish and accuracy.

The tandem use of these two technologies has set the stage for their convergence.

Industrial 3D printing of metal and CNC machining are complimentary digital manufacturing technologies with a bright future.

The addition of the AMBIT™ system to a CNC machines requires a laser, powder feeder, and extraction unit. The machine enclosure must be made laser safe. The installation does not compromise the milling capability of the CNC machine. An early adopter release of this product is available in selected regions.

This development, in conjunction with the announcement of further hybrid offerings in the market, is evidence that industrial 3D printing of metal and CNC machining are complimentary digital manufacturing technologies with a bright future. ■

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[1] The combination of CNC with Powder Bed Fusion AM, such as the LUMEX Avance-25 by Matsuura, is acknowledged to be a very important step in the development of hybrid machine tools, however it is not considered to be a "mainstream" CNC machine due to the extent the CNC is modified to handle loose powder in the machine.

[2] Project: RECLAIM (REmanufacture of high value products using a Combined LAser cladding, Inspection and Machining system), undertaken with support of the UK Technology Strategy Board Project No: TP11/ HVM/6/I/ AB194F with consortium members: Airfoil Technologies International Llc, Cummins Inc, De Montfort University, Delcam plc, Electrox Ltd, Manufacturing Technology Centre Ltd, TWI Ltd, Precision Engineering Technologies Ltd, and Renishaw plc.