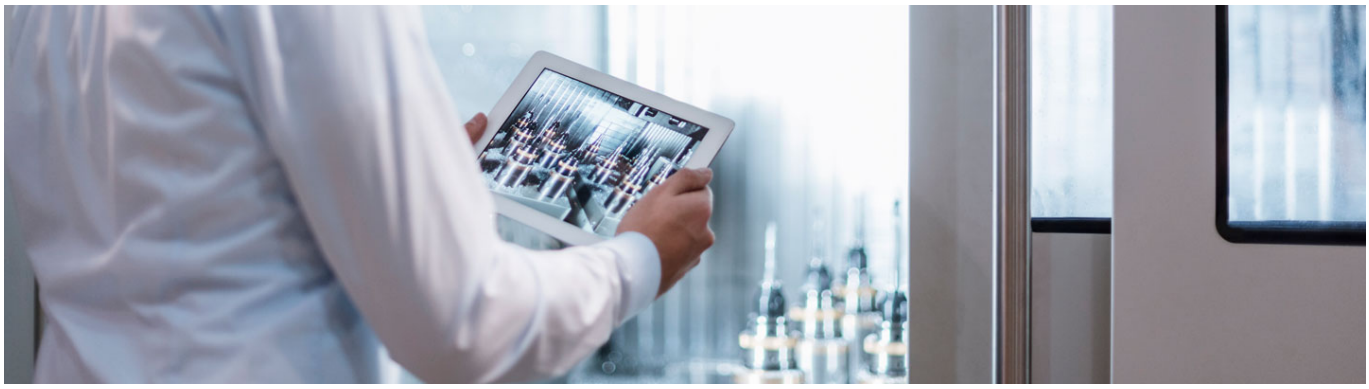

Technology

How AI and Machine Learning Impact CNC Machining

Don Sears | Jul 16, 2019

From the supply chain all the way to the finished and installed part, incremental optimization will be at the heart of future manufacturing work. What will it take to make optimization more automated? Machine intelligence and machine learning. We explore.

The engine of today's manufacturing lies within CNC machining. But where is the CNC heading? Toward continuous, automated optimization, say industry experts and academics.

Optimization may sound like a simple concept, but it is complex—especially to automate. There is so much underlying technology, including software and data—and human interpretation— needed to make automation in manufacturing a reality.

We take a look at two areas that are expected to really make an impact within CNC systems: machine learning and artificial intelligence, or "AI." Artificial intelligence—whether from software-based algorithms, smart probes or voice command—is one half of the optimization puzzle. The other half is machine learning.

Machine learning takes machine data and, in theory, self-optimizes or changes course to take corrective action. This does not mean there is no human involvement. On the contrary, it means there is consistent human involvement that defines and refines or teaches a machine the parameters of optimization—via analytical assessment, simulation, programming and testing.

Imagine systems with more predictive utility that report nuanced machine and part-building information and are pre-programmed to adjust and self-schedule downtime or trigger machine activities in a healthier cell. Imagine machine operating systems that can communicate and take action with machinists by voice command.

What's being done today to get the industry closer to this future state? We spoke to the co-founder and CEO of MachineMetrics, Bill Bither, and others to find out.

AI and Machine Learning on CNC Machines: The Value of Visibility

With a background in mechanical engineering and knowledge of manufacturing in the aerospace and defense industry, Bither recognized a need for more nuanced and real-time process software in manufacturing. Bither spent five years at Hamilton Sundstrand, a division of United Technologies,

where he designed hydraulic systems.

“There is an opportunity to leverage data to really understand what’s happening on the factory floor and to make better decisions,” says Bither. “The challenge is that it’s pretty difficult to connect to machines. So we started a company just under five years ago to increase production visibility by making it easy to connect to CNC machines.”

MachineMetrics provides real-time visualization of CNC machine analytics—or what Bither calls “descriptive analytics” that allow a company to see accurate production metrics, such as utilization rates, and track them to production goals. There are several other analytics areas it provides information on, including diagnostic, predictive and prescriptive data.

The result: throughput and efficiency increases of 20 percent or more across its 100-customer base of midsize to large manufacturers. Given its large data set across thousands of machines, the MachineMetrics platform also includes benchmarking—which helps companies measure themselves against peers and stay competitive.

Making better decisions isn’t all about investing in equipment, says Bither. With more detailed production data manufacturers can assess which processes need to be optimized. Diagnostic data can help maintenance teams and machine makers improve functions and create a real-world feedback loop.

Predictive data allows teams to understand conditions and when CNCs will need help. Prescriptive analytics capitalizes on the conditions to offer timely direction and guidance to operators.

Intelligent CNC Machining: Alarms, Triggers and Spindle Monitoring

“AI is a very generic term,” says Bither. “If a human does not have to run a calculation in their head and the machine does it, that could be considered ‘AI.’ With machine learning, there are some very specific use cases for that … There is supervised machine learning, which requires training and feedback, and unsupervised machine learning that doesn’t.”

Understanding spindle failure or automatically classifying downtime could require machine learning, explains Bither. Alerts that are triggered by simple logic that notify an operator that a machine has gone down three times today is not necessarily machine learning per se—but it is the kind of rules-based, intelligent algorithm that helps human operators easily track and manage systems.

Intelligence-based technology makes an operator’s job a more proactive one. Well-timed information can be the difference between losing days of profit from a CNC and being able to schedule and organize alternate paths to production goals.

Automation and smart sensor-based intelligence has also come to inventory management and vending solutions for tooling. Learn how to take control and cut down on waste in supply spend.

A Near-Future Maintenance Example: AI Teaches Machines to Recalibrate

Like cars, CNC machines also need tuneups. With so many components and gears churning out parts and cutting at high temperatures and tough materials, CNCs get serious workouts. So they need to be calibrated.

Knowing when a CNC needs to be calibrated is a major challenge—as is the work required to do it, which entails downtime and lots of trial and error to get back into production.

Today when CNC machines need to be recalibrated, manufacturers often have to use specialty engineering resources that are expensive and hard to come by. A recalibration procedure can "take hours and several iterations to reach an acceptably low error value," writes artificial machine intelligence company Bonsai AI in a ***case study report*** about a recalibration proof of concept in partnership with Siemens and the Commonwealth Center for Advanced Manufacturing. Its work with Siemens and CCAM resulted in an automated recalibration system that ran more than 30 times faster in the test environment than the human operators, "achieving an error rate of less than two microns in one to four iterations."

"A big buzzword for us is 'adaptive automation' which is all about how to adapt an existing process to improve its productivity, cost and quality," says Matthew Stremler, a research manager at CCAM. "The breakthrough we achieved here using Bonsai AI demonstrates that organizations can deploy the latest AI technologies in a noisy real-world system."

Bonsai AI was recently ***acquired*** by Microsoft.

Rethink Your Approach to Metalworking

Small changes in tooling, processes and procedures can add up to big productivity gains. With an average of 75 percent of a manufacturer's costs attributed to the manufacturing process, there are opportunities to reduce spending and improve productivity in such areas as setup time and cycle time.

To help you tap into these savings opportunities, look for metalworking experts to supplement and educate you on innovative technologies and process improvements for your operation.

Learn more.

AI and Machine Learning Enable Smarter Decisions and Deeper Understanding of Tool Failure, Tool Life and Part Quality

MachineMetrics is not alone. Engineers at the Advanced Manufacturing Research Centre's Factory 2050

in Sheffield, U.K., are also using AI and machine learning for machine utilization. They are using edge computing hardware to track power consumption in automotive suspension components. They also work with Tinsley Bridge to monitor manufacturing processes.

"Interrogating our machine utilization rates means we have better visibility of what was being manufactured and when, and the ability to assess if we are scheduling effectively," says Russell Crow, director of engineering at Tinsley Bridge, in a *Metrology News* ***article***.

The next phase of this project is to teach the machines to learn and detect non-conforming components in production and find inconsistent tool wear that could affect part quality.

"The insights the AI will provide will allow us to identify when our machines will require intervention for tool changes, or how long we can run them without intervention," says Crow. "Predicting tool failure and prolonging tool life will also affect our right-first time rates, reducing non-conforming parts and boosting productivity."

 ***Do you need a technical question answered? Ask the MSC Metalworking Tech Team in the forum.***

Automation in Manufacturing Frees Up Time for Crucial Problem Solving

The future of machining will undoubtedly be more automated. With an impending skills gap and technological evolution happening simultaneously, automation will elevate the value of workers who program, troubleshoot and maintain automated CNC systems and manufactured parts.

Industrial designers, process engineers and machine operators will work more closely together than ever before, ***industry experts*** expect.

"[M]ost manufacturers believe that the No. 1 cause of the skills shortage is 'shifting skill set due to the introduction of new advanced technology and automation,'" write the Manufacturing Institute and Deloitte in their ***2018 report*** on the skills gap and future of work

To learn much more about future skills needed on the shop floor, read "Industry 4.0: Manufacturing Skills Needed in Smart Factories."

But getting to a place of automation requires complex machine programming and deeper integration of internet and cloud-based technologies. The future, for lack of a better word, will be optimized to be optimal for production. And digital skills, along with soft, critical thinking and people management skills, are also needed, per the Deloitte and Manufacturing Institute study, which writes:

"In manufacturing, this generally translates to solving problems in production, such as having the ability to identify quality failures with parts coming off an automated production line and, more importantly, to take actions that remediate the problem in real time."

Crow, of ***Tinsley Bridge***, concurs. Future quality comes from process and machine optimization together.

"In the future the insights into our data will allow us to run our machines more effectively, so we can free time for our engineers to work on value-added tasks such as programming for multiple jobs or machines, creating a smarter factory that will help us manufacture technically advanced products," says Crow.

How painful a process is machine recalibration for you? Talk about it in the forum. [registration required]