Machining with feeling

PROCESS CONTROL - Adaptive Control & Monitoring (ACM) from Siemens optimizes the core process of machining.

The ACM (Adaptive Control & Monitoring) software was originally developed by Omative,

an Israeli with 20 years of experience in real-time machine optimization. It was purchased by Siemens back in 2018 and is now an integral component of the "CNC Shopfloor Management Software" portfolio. Peter Leupert is quite happy about this situation. He, together with his colleagues in Bad Neustadt are also Siemens employees – and their jobs involve actually using machine tools. Leupert and about 1600 of his colleagues turn out over 700,000 electric

In the Bad Neustadt plant, Leupert is responsible for using machine tools to machine the various parts and components for electric motors - and he is always on the lookout for optimization potential. It is not without reason that the Bad Neustadt plant is seen as a showcase of innovative technology within Siemens as a whole: Here, digitalization solutions are implemented over the complete value-added chain to continually boost productivity.

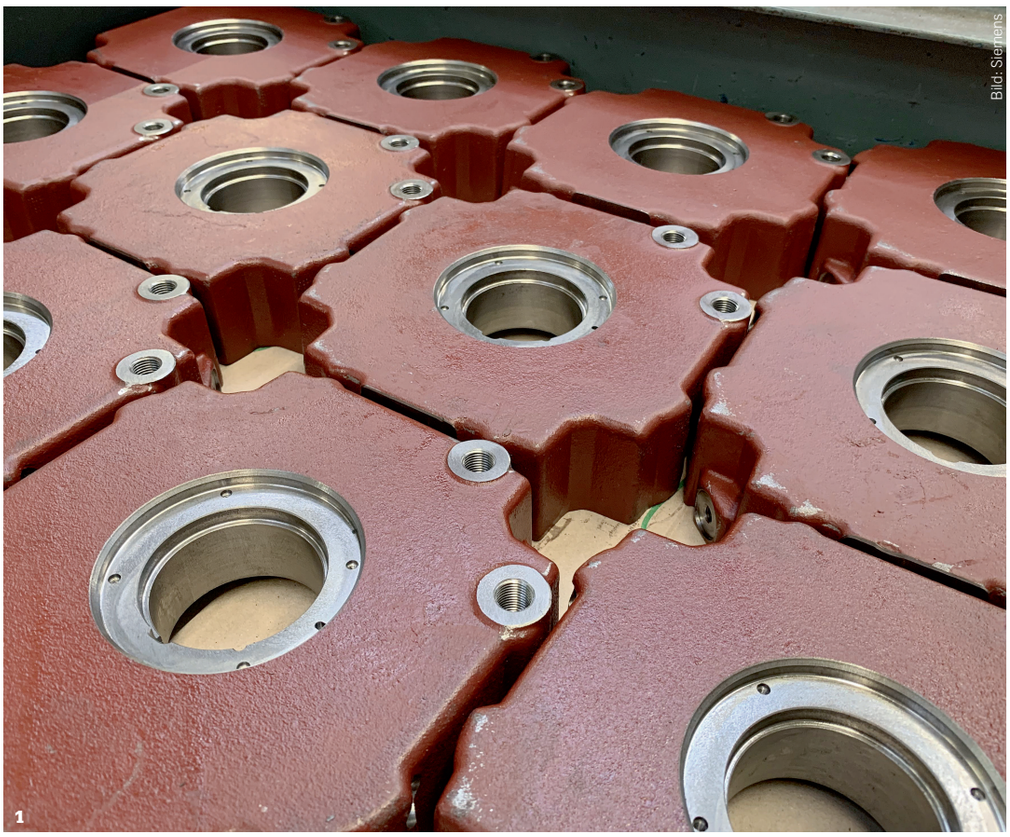
The implementation of ACM is a further step to push forward digitalization in production landscapes based on a Siemens solution. "We are continually working hard to boost productivity. We are supported by the fact that almost all NC programmers now work in a 3D environment, and have embraced the digital twin approach", stated Leupert.

Iron, steel or titanium

The Bad Neustadt production landscape is characterized by a high variance of parts and materials. Materials such as cast iron, steel and titanium are used to fabricate enclosures and bearings. Although the processes are well established, machining these types of materials is anything else but routine work.

The cast parts delivered to the plant are non-homogeneous when it comes to hardness, and they have an uneven workpiece surface as a result of tolerance fluctuations. And it is important to state that this isn't just from batch to batch, but from part to part.

»With a situation such as this, NC programmers are worried about tool breakage or even damage to the machine tool spindle. Consequentially, they work on the worst-case scenario and program feed rates so that the tool is protected" explained Leupert. However, this conservative approach has a decisive disadvantage: It costs time



1 The ACM adaptive monitoring and control module ensures, in the future, that parts will be able to be machined faster with higher reliability and safety.

2 Sergej Schauermann (right) is the Siemens expert for the adaptive control and monitoring system (ACM). Here, machine setter Harald Zirkelbach provides support when setting up the program.

3 Optimization is checked out at the monitor. Significant deflections (left-hand area of the red curve) indicate inefficient machining, and are smoothed when using ACM (right-hand area of the red curve).

This is where ACM comes in: To address these issues, ACM intelligently leverages the current process data. During machining, the software reads in the tool information data from the NC program. Using actual tool cutting data and continually monitoring the spindle load, the system can identify overload situations and can then respond by appropriately reducing the feed rate. In extreme cases, this can also mean that an alarm is output and the machine is stopped.

Productivity increase

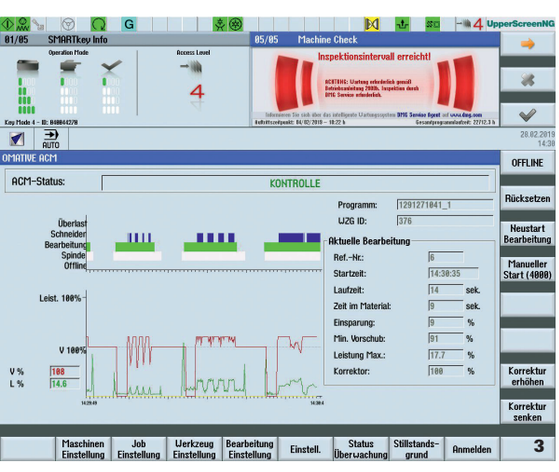
However, what is interesting is that the adaptive control also identifies the inverse situation: At locations where the programmer was too cautious, with an appropriate setting, ACM facilitates that an optimum feed rate is achieved and increases the cutting velocity. This is especially noticeable when carrying out roughing operations when milling, meaning that higher material quantities are removed: "Our first test runs have indicated that for some parts we can reduce the machining times by eight percent or more" explained Leupert. At a first glance, this doesn't seem a lot per part, but over the course of the day, it accumulates to provide significant time savings. This represents another immense productivity increase through machine tool digitalization.

And another aspect is especially important for him: Reducing the stress and load on tools. "A tool like this can easily cost €400 and more. Several dozens of such tools are used on a machine. Reducing the stress on our drills, milling tools and indexable inserts represents a significant cost saving potential" explained Leupert.

ACM means that tools do not have to be withdrawn from the workflow too early. But even more importantly, dull or faulty tools are not used further. This is because ACM essentially prevents tool breakage – but if it does occur, then it is reliably identified. An unidentified tool breakage is especially aggravating, as frequently, a broken drill results in more tool damage in the same drilled hole.

This new system has additional benefits for another event that should not happen at all: tool collision with the workpiece or the clamping device. If the machining operation has been professionally programmed and the machine is equipped with tools with the correct dimensions as specified, then a collision should not happen in the first place. However, experience has shown that errors are made. ACM and real-time monitoring also have their advantages in this area. Collision monitoring identifies this special situation, and immediately stops the feed rate. This prevents more significant damage to the machine.

Picture: Siemens



Picture: Siemens

» New parts are required maybe twice a week - however, parts must be modified 20 to 30 times per month. These parts have to be organized and machined for series production. Although this does not significantly change the work of NC programmers and machine setters, we are still happy about the increased process reliability and productivity", stated Leupert. The following aspects change:

- Air cutting times are reduced
- Stress is reduced on the tool as it enters the material as a result of the lower feed rate.
- The feed rate is increased for low spindle loads.
- For extreme cutting conditions, the feed rate is reduced in order to protect the tool against overload.
- Time saving of between 7 % and 25 % per tool, depending on the workpiece and machining technique.