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Practical knowledge for the shopfloor

1/2016

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Robotics

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CNC knowledge

On the shopfloor

Industry news

Education and training

News

Cover photo: Siemens AG/Stefan Minx

Robotics

Good news for CNC machining specialists

If you believe the market figures, most machining businesses are doing well. Machine tool builders achieved record revenues last year, and businesses are increasingly investing. New machines generally mean greater precision, higher productivity and, as a result, an increased competitive edge.

The positive economic outlook of the machining industry is good news for employees. But there is a second piece of good news for CNC specialists from the automation sector: robots for feeding in and positioning workpieces can be programmed and controlled using the same CNC systems as the machines. KUKA and Siemens demonstrate how this is done. In short, if you can do CNC, you can do robotics. CNC specialist knowledge and experience are becoming more and more valuable. ■

Siemens AG/Stefan Mirnx

Robotics

Siemens AG/P. Klingauf

Successful integration

"Robot colleagues" are becoming increasingly common in CNC machining companies. However, in order to be able to perform material handling and other tasks, robots must be integrated into the workflow of machine tools.

Depending on the application and task, a range of different requirements must be taken into consideration when connecting and integrating robots into machine tools. Perhaps the most common application is when existing machine tools are complemented with robots or existing robot cells are expanded using CNC machines.

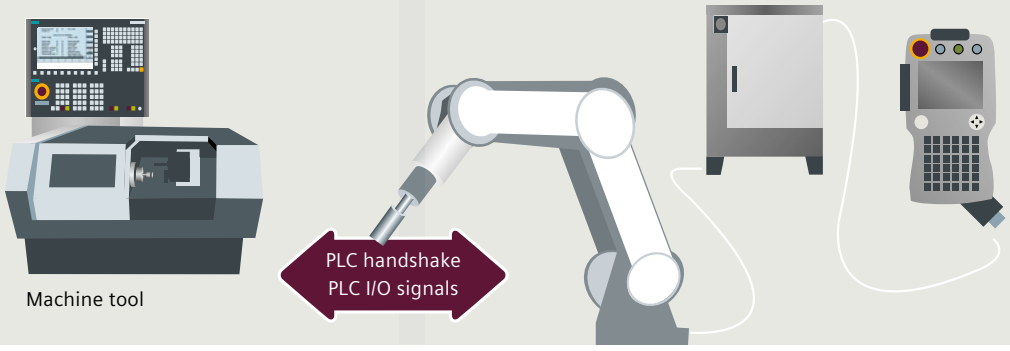
The challenge lies in the fact that material-handling robots and machine tools are designed for separate applications by their manufacturers. If they are to work together, they must be connected in the field. It sounds easy, but the two control systems — CNC control and robot control systems — are already engineered, meaning that they speak their ›

Complete solution package

Siemens Machine Tool Systems offers three solutions suitable for connecting machine tools and robots:

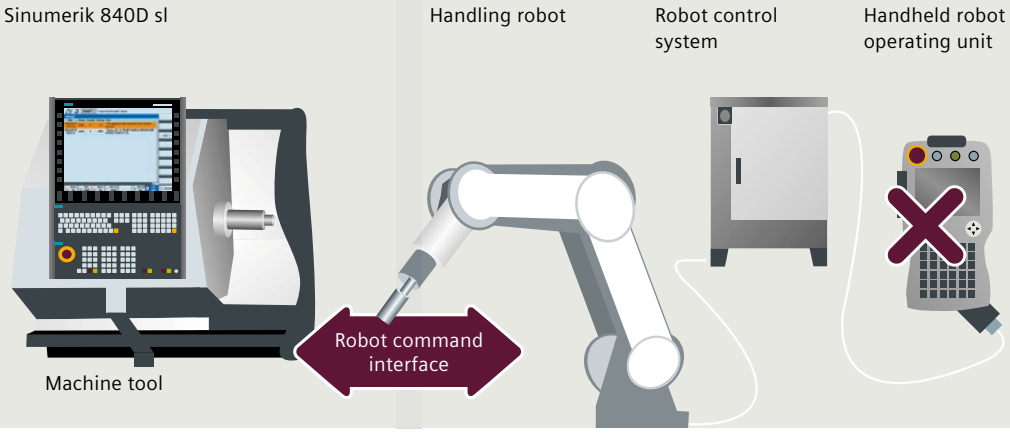
Run MyRobot / EasyConnect:
Minimizes the effort involved in connecting handling robots to machine tools and makes it easier for machine tool distributors and systems integrators to implement automation solutions for their customers

Sinumerik Integrate Run MyRobot / EasyConnect



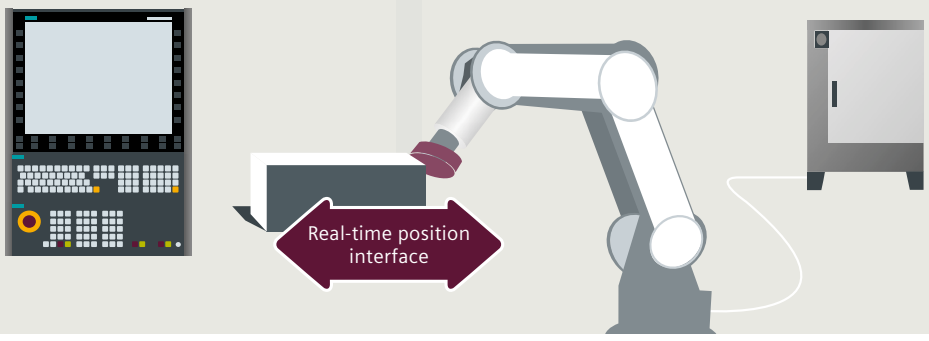
Run MyRobot / Handling:
Combines the integration of handling robots into machine tools with the greatest possible ease of use. The handling robot is operated and programmed through the CNC system on the machine tool and thus by the CNC operator

Sinumerik Integrate Run MyRobot / Handling



Run MyRobot / Machining:
Gives robots the CNC properties that are increasingly in demand and facilitates entirely new fields of application — from path-controlled handling to machine tools with robot kinematics

Sinumerik Integrate Run MyRobot / Machining



own language. As a result, communication between the control systems — and therefore synchronization of the two machines within the production process — must take place via interfaces. It is important that these interfaces be designed in such a way that even external systems integrators, such as machine distributors, can connect the handling robots and machine tools without affecting the applications of the machine tools and robots.

Connecting robots quickly and easily

With Sinumerik CNC, these connections can be created using the pre-defined Sinumerik Integrate Run MyRobot / EasyConnect project-planning interface. This interface can be flexibly adapted to meet the needs of the relevant automation solution. The concept is based on PLC handshake signals — a standard defined by the German Machine Tool Builders' Association / German Engineering Federation for connecting robots or handling systems to machine tools. Working with a standard, as well as pre-defined NC/PLC interfaces, alarms and diagnostics screens, and carefully documented example applications allows for quick and easy systems integration. Handling robots of different types and from different manufacturers can be quickly connected to machine tools using Run MyRobot / EasyConnect.

Controlling robots through CNC machines in everyday operations

Robots and machine tools are systems from different manufacturers with different architectures and operating philosophies. This poses particular challenges for the everyday operations of manufacturing companies because previously the set-up, programming and maintenance of a handling robot often required additional operating and maintenance personnel, or staff operating the machine tools had to be specially trained on the use of robot control systems. Both cost companies a great deal of time and money. Now, Sinumerik Integrate Run MyRobot / Handling offers a more elegant solution. Here, the operation, programming and diagnostics of the handling robot are set out in the Sinumerik operator interface in the machine tool. The great advantage of this is that the entire automation cell, that is, the machine tool and the handling robot, can be operated by machine tool operators without extensive training. Pick-and-place commands are exchanged between the CNC and robot control system through a special interface. The sequence program runs in an additional Sinumerik machining channel. This means that the robot is programmed in the CNC.

Special Run MyRobot cycles expand the functionality of the CNC control system and mirror the command scope of the robot control system. The robot axes' jog mode is also set out in the CNC system; that is, it is implemented through the machine control panel of the machine tool. In addition, error and operating messages from the robot are displayed on the CNC's operator interface. The result: The operation, programming and maintenance of the handling robot become a fixed element of the CNC application, integration is greatly simplified, and the skills of the Sinumerik operator are enhanced.

Run MyRobot / Handling is currently available for the mxAutomation interface of KUKA robots. Thanks to collaboration between Siemens and KUKA, a broad spectrum of automation solutions for machine tools and industrial robots is opening up with Sinumerik.

Expanded applications and robots with CNC requirements

Alongside simple pick-and-place tasks, an increasing number of robot applications are requiring the fundamental properties of a CNC control system, such as constant speed, tool management or typical CNC programming. One example is path-controlled handling as a supplement within the machine tool, for instance, for gluing, deburring or polishing component contours. Another — even more sophisticated — example is machine tools with robot kinematics, for example, when milling molded parts made of soft or medium-strength materials.

Sinumerik Integrate Run MyRobot / Machining meets the needs of these robots. In this case, the Sinumerik CNC and the robot control system communicate through a real-time position interface. The kinematic transformation for the robot mechanics is computed in the CNC. This means that the entire available Sinumerik CNC command set can be used to move the robot — from level selection (G17), to path commands (G0, G1, G2 ...), to machining cycles. The sophisticated Sinumerik control algorithms, such as dynamic startup, jerk control, look ahead and dynamic block compression, are also available for machining free-form surfaces. If needed, users can add to these options with another NX CAD/CAM process chain from Siemens PLM that is specialized in robot applications. The highlight here is the simulation of workflows based on real robot kinematics, and a postprocessor that is perfectly tailored to Sinumerik. Run MyRobot / Machining can also be used in connection with KUKA industrial robots. ■

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Strong together

Users and robot and control specialists collaborated to create the automated manufacturing cell (left to right): Winfried Geiger (KUKA), Peter Zech, Martin Leutbecher, Volker Ress, Michael Strahlberger and Timo Rössler (all from Siemens)

Siemens AG/P. Klingauf

One of the latest innovations at the Siemens factory in Bad Neustadt is an independently operating turning and drilling cell for manufacturing bearing caps. What sets it apart? KUKA robots and the machining cell are controlled using the same CNC.

Robotics

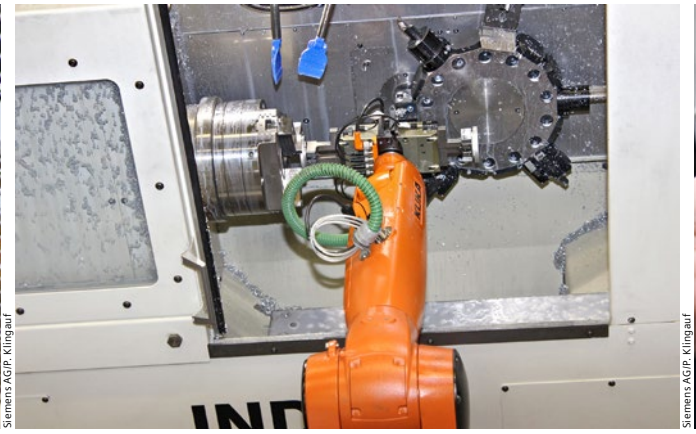
How can handling robots be used easily and efficiently in combination with CNC machines? Peter Zech, head of die casting and special machine manufacturing in Bad Neustadt, has one answer. Together with his team, Zech revamped the machining process for bearing shields and caps with a turning and drilling machine. He explains, "The parts in the old system were still of high quality, but it wasn't efficient enough anymore. The availability left a lot to be desired, and the drilling station had to be loaded manually — it was very monotonous work."

Completely refurbished turning machine combined with a drilling station

Initially, the team discussed purchasing a new turning center that could have been used for the entire process. But repeated drilling, which a separate drilling station would complete in a single step, would lengthen throughput times, and investment costs would be much too high. Another option was to replace the existing Index GE42 with a new turning machine. In the end, though, a retrofit with new Sinamics drives and Simotics motors and Sinumerik CNC system technology ›

Siemens AG/P. Klingauf

The robot places the turned component into the drilling station while a new blank is being turned



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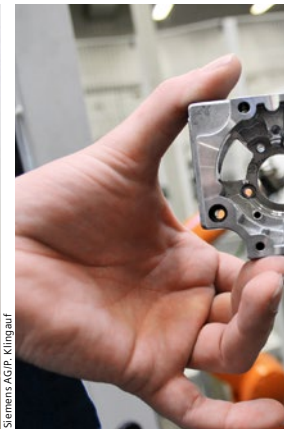

The KUKA robot transfers the new component to the turning machine after removing the turned component using the reverse of the exchangeable gripper

proved to be the best solution. Die-casting foreman Volker Ress explains why: "Since the general overhaul, the GE42's mechanical quality and precision have met our needs perfectly. And the total cost of this solution was significantly lower than that of a new machine."

The turning machine's retrofit alone, however, was not enough to satisfy Zech and Ress. Their plan: a flexible robot should be responsible for all parts handling within an independent turning and drilling cell — from the feeding conveyor system to the removal of the finished component. When selecting the robot technology, they quickly recognized that the KR Agilus from KUKA would be the best solution. "Other robots can carry out the same movements," confirms Zech, "but KUKA is known for high quality. And the seamless integration of robotics into the machine tool environment is unique. The combination of the KUKA robot with Sinumerik 840D sl makes this possible."

The CNC controls the robot

The solution is based on the Run MyRobot / Handling software interface, which Siemens and KUKA engineers developed together. Its major advantage is that machine operators are comfortable using it. Mechatronics and maintenance engineer Martin Leutbecher confirms this: "Run MyRobot / Handling is awesome. It means we can control the KUKA robot with Sinumerik Operate on our normal panel or with the HT8 Handheld Terminal. We don't have to use any other robot control system with features that we're unfamiliar with." This means the entire production process for the robot and machine can be programmed offline — without a loss of turning and drilling cell availability. For tasks such as setting up, teaching and retracting the robot, the HT8 is used as the central control unit. Timo Rössler, a machining production technician, points out another advantage: "Operators can enter the manufacturing cell safely at any time — even while controlling the robot." This is ensured by the Sinumerik CNC's built-in Safety Integrated feature. This function ensures that the robot can move only at controlled speeds.

Fully automated machining cell

Once it is set-up, the turning and drilling cell can produce series averaging 400 to 500 components per shift. Then the product is changed. "That's how we maintain optimum stock levels," explains Rössler. The feeder belt carries around 70 blanks — enough to leave the system running independently for two to three hours. During this time, the operator is able to work two additional processing lines and carry out random quality checks. After it is filled with blanks, the machining cell functions fully automatically: A vision system registers the blank and transmits the location signal to the robot, which then uses the location data to grip the component in such a way that it can always transfer the component to the Index GE42 in the correct position. When the turning machine opens, the robot first uses the reverse of the exchangeable gripper to grip the completed component and then transfer the blank. It then passes the turned workpiece to the drilling station, which drills several holes or threads in a single step. Finally, the robot deposits the fully machined component and takes the next blank from the feeder belt — repeating the process until the next product change.

A good team

Run MyRobot / Handling makes the operator, machining tool and robot into a successful team. The secret to success? The operators, mostly cutting machine operators, are able to control two fundamentally disparate technologies using the familiar Sinumerik CNC system. ■

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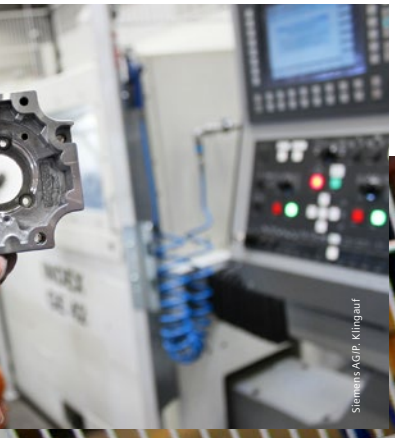
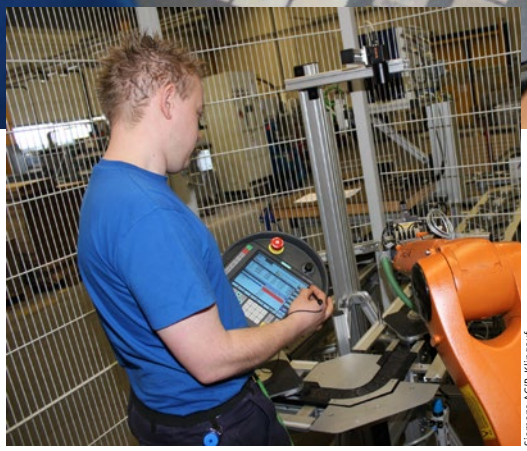


The turning and drilling cell produces an average of 400 to 500 identical components, such as bearing caps and gearbox covers, per shift



Martin Leutbecher controls the KUKA robot using Sinumerik 840D sl. He inputs the necessary commands using his HT8 Handheld Terminal

»Run MyRobot / Handling is awesome. It means we can control the KUKA robot with Sinumerik Operate on our normal panel or with the HT8 Handheld Terminal.«

Martin Leutbecher,
Mechatronics and Maintenance Engineer, Siemens

CNC knowledge

Siemens AG/W. Geyer

Compensation functions for the Sinumerik mean flawless surfaces can be achieved

Practical tip: More precise processing

Siemens provides a range of compensation functions for the Sinumerik control that lead to better results in machining.

Systematic, machine-specific deviations in machine tools are detected during professional commissioning and are displayed via settings on the CNC system. But deviations can also arise or be exacerbated during later operational processes because of environmental factors such as temperature or mechanical load. For these instances, the Sinumerik offers a range of compensation functions that complement one another. Using the actual position value encoders as well as additional sensor technology and measurements, measured deviations can be compensated for, leading to better results. Useful Sinumerik cycles such as "CYCLE996 — measure kinematics" support the end user in the continuous monitoring and maintenance of machines. ■

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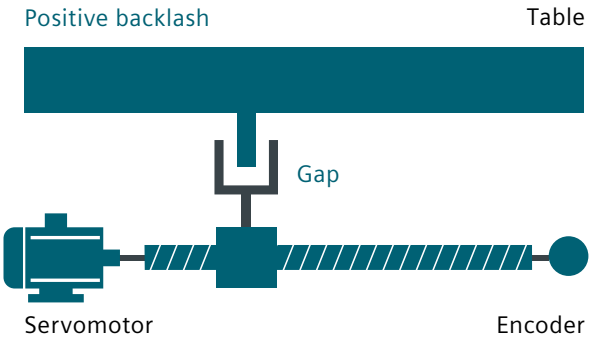
At a glance

- Backlash compensation
- Spindle-pitch error compensation
- Friction compensation (quadrant error compensation)
- Angle and sagging compensation
- Temperature compensation
- Volumetric Compensation System (VCS)
- Tracking error compensation (dynamic precontrol)
- Electronic counter-balancing

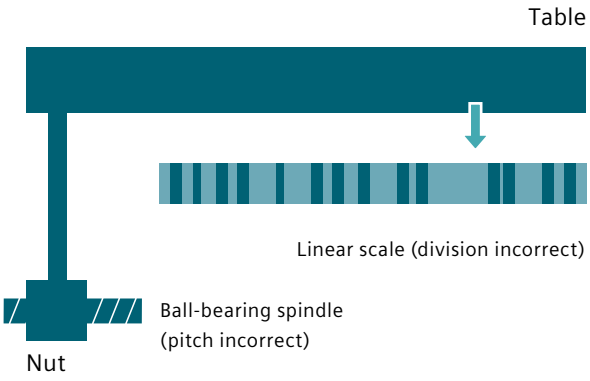
Backlash compensation



Backlash compensation

During a transfer of force between a moving machine part and its drive — a ball-bearing spindle, for example — gaps occur because a completely backlash-free mechanical set-up would dramatically increase wear on the machine and is also unachievable from a processing standpoint. Mechanical gaps cause deviations in the traverse path of axes/spindles with indirect measuring systems. This means that in the event of a change in direction, for example, the axis will travel too far or not far enough, depending upon the size of the gap. The machine table and its associated encoder are also affected: if the encoder is ahead of the machine table, it will reach the measured actual value position earlier, meaning in real terms that the machine's traverse path is too short. While the machine tool is in operation, the previously recorded deviations will be activated automatically and, using the backlash compensation on the corresponding axes, added to the actual position value when the direction is reversed.

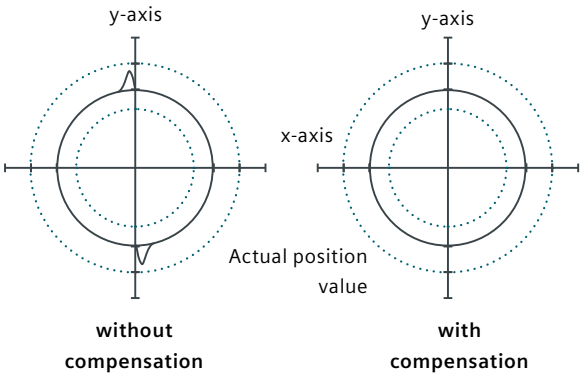
Spindle-pitch error compensation



Spindle-pitch error compensation

The measuring principle for indirect measurement in CNC-controlled systems assumes that the pitch of the ball-bearing spindle is constant at every point within the traverse area, meaning that ideally the axis' actual position is deduced from the position of the drive spindle. Production tolerances for ball-bearing spindles, however, can result in measuring deviations known as spindle-pitch errors. The problem is further exacerbated by measurement deviations that are dependent on the measurement system used, as well as the latter's installation tolerances on the machine, known as measurement system errors. In order to compensate for these two errors, the CNC machine's natural error curve is measured using a separate measurement system (laser measuring), and the required correction values are saved in the CNC system.

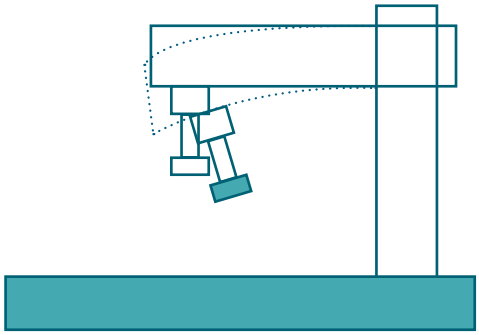
Quadrant transitions without and with compensation



Friction compensation (quadrant error compensation)

Quadrant error compensation (also called friction compensation) serves above all to significantly increase contour accuracy while machining circular contours. The reason: at quadrant transitions, one axis moves at maximum path speed while the second axis is stationary. The different frictional behaviors of the axes can therefore cause contour errors. Quadrant error compensation reliably offsets this malfunction and enables excellent results without contour error in the first phase of machining. The intensity of the correctional impulse can be set according to a characteristic curve linked to acceleration. This characteristic curve is determined and parameterized with the help of a circular shape test. In the circular shape test, the deviations in the actual position from the programmed radius (particularly at quadrant transitions) during the description of a circular contour are metrologically recorded and graphically represented.

Sagging in negative Z1 direction due to own weight



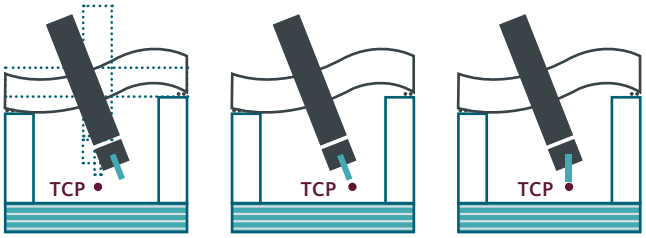
Sag and angularity error compensation

Sag compensation is implemented if the weight of individual machine elements leads to the positional displacement and incline of moving parts, as this results in related machine parts — including guide systems — sagging. Angularity error compensation is used when movement axes are not properly aligned with each other at the correct angle (e.g. vertically). As the deviation from the zero position increases, positioning errors also increase. Both types of error can result from the machine's own weight as well as from tools and workpieces. The measured correction values are calculated metrologically during commissioning and stored according to position in Sinumerik — in the form of a compensation table, for example. During machine tool operation, the relevant axis is interpolated between the table values' data points. For each continuous path motion there is always both a basic axis and a compensation axis. If the y-axis' perpendicularity is not present in the continuous path of the x-axis and the y-axis, this inaccuracy is compensated for by the x-axis in the continuous path.

Temperature compensation

Heat can cause machine parts to expand. The extent of expansion is dependent upon the temperature and heat conductivity of the machine parts, among other things. Different temperatures can result in changes to the actual positions of the individual axes, which have a negative effect on the accuracy of the workpieces being machined. These actual value changes can be offset with temperature compensation. Error curves for different temperatures can be defined for each axis. In order to always correctly compensate for heat expansion, the temperature compensation value, reference position and linear gradient angle parameters must be constantly retransmitted via function blocks from the PLC to the CNC control system. Abrupt parameter changes are automatically smoothed out by the control system in order to avoid overloading the machine and triggering the monitoring function.

Compensation of "Tool Center Point" position and tool orientation



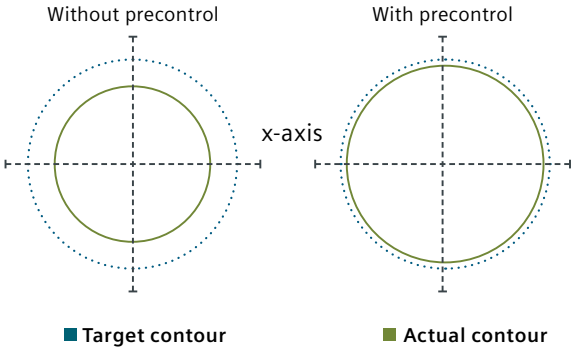
Without compensation | VCS active | VCS active with orientation compensation

Volumetric Compensation System (VCS)

Because of the positions of the rotary axes, their mutual offsetting and the orientation of the tool, parts such as turn and swivel heads may exhibit systematic geometric errors. Additionally, small errors in the guide system for feed axes will arise in every tool machine: for linear axes, these will be linear positional errors; horizontal and vertical straightness errors; and pitch, yaw and roll. Other errors may arise when aligning the machine components with one another — perpendicularity errors, for example. In a three-axis machine, that means there are 21 geometry errors that can be ascribed to the tool holder: six error types per linear axis multiplied by three axes, plus three angle errors. These deviations join together to form a total error, known as a volumetric error.

The volumetric error describes the deviation of the real, error-prone machine's tool center point (TCP) position from that of an ideal, fault-free machine. Sinumerik Solution Partners are able to determine volumetric errors with the help of laser measuring devices. All machine errors in the entire machining space must also be measured. Measuring individual errors is not sufficient. It is always entire measuring curves that are recorded, as individual error sizes are dependent upon the position of the relevant feed axis and on the measuring location. For example, errors that are attributed to the x-axis turn out differently if the y-axis and z-axis are in different positions — even if the errors are at the very same position on the x-axis. With the help of "CYCLE996 — measure kinematics," rotary axis errors can be determined in just a few minutes. This means the machine's accuracy can be constantly checked, and if necessary corrected, even during production.

Tracking error compensation (dynamic precontrol)



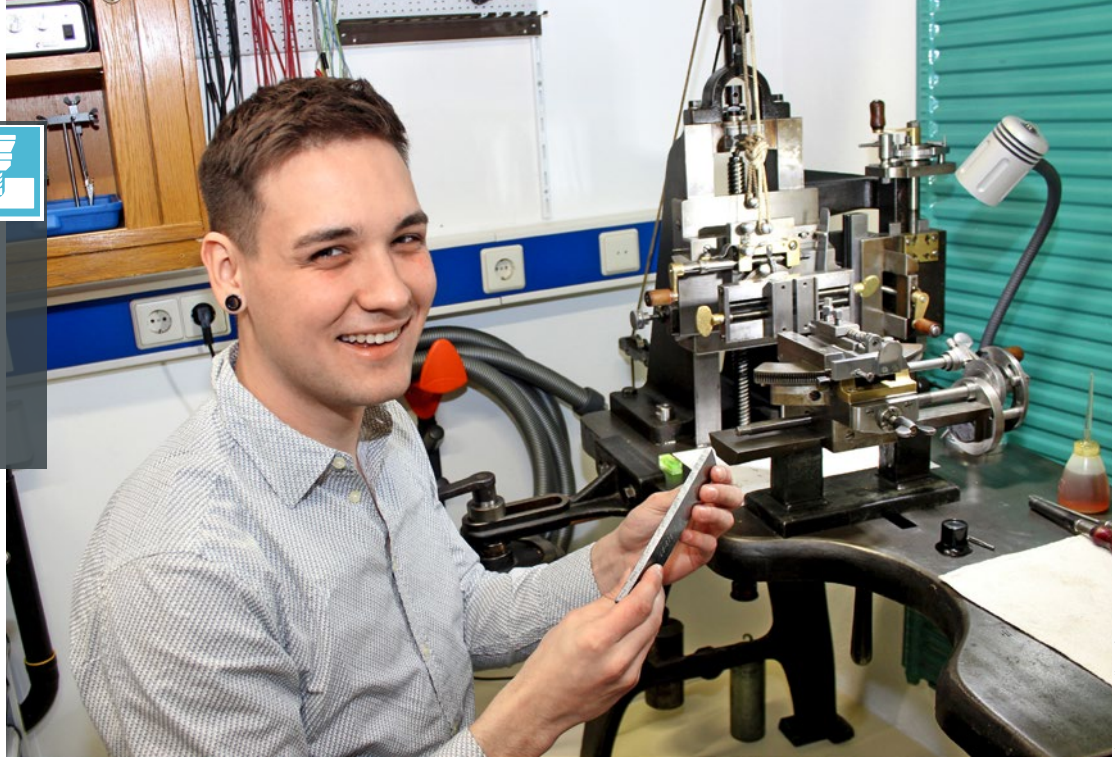
Deviation error compensation (dynamic precontrol)

A deviation error refers to the position controller's deviation from the norm during machine axis movement. The axial deviation error is the difference between the machine axis' target position and its actual position. A deviation error leads to an undesired speed-dependent contour error, especially during acceleration on contour curvatures — circles and squares, for example. With the NC high-level language command "FFWON" in the workpiece program, the speed-dependent deviation error is reduced toward zero during path-based movement. Movement with precontrol enables increased path accuracy and as a consequence better processing results.

Syntax:
FFWON: Command to turn on precontrol
FFWOF: Command to turn off precontrol

Electronic counter-balancing

In extreme cases, in order to prevent the axes from sagging and damage being caused to the machine, tool or workpiece, electronic counter-balancing can be activated. In weight-loaded axes without mechanical or hydraulic counter-balancing, the vertical axis sags undesirably after the brake is released and the controller release is switched on. This undesired axis sagging can be compensated for by activating electronic counter-balancing. After the brake is released, the constant weight counterbalance torque maintains the position of the sagging axis.



With the help of the TAC Erlangen, Florentin Mack was able restore an old guilloche machine to full working order

Siemens AG/P. Klingauf

Breathing new life into old technology

Guilloche is a rare and disappearing craft in which surfaces are enhanced with special decoration. Professional support enabled Florentin Mack, a watchmaker from Ulm, to make his dream of owning a guilloche machine come true.

"Crazy, right?" Excited, Florentin Mack shows us a watch that has recently been finished. The plate is covered in a pattern of extremely fine lines. "Patterns like this are created using guilloche," explains Mack. In this process, a special machine is used to cut very fine lines at narrow intervals into a metallic surface. This creates a pattern of curved or straight lines that merge into one another — known as guilloche. This artistic decoration is used predominantly in jewelry making.

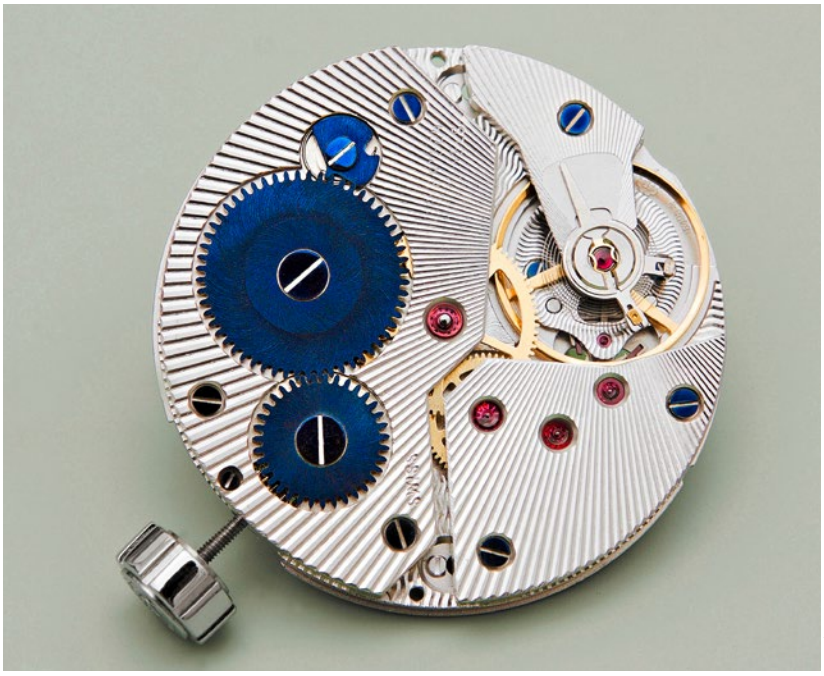
From watchmaker to guilloche expert

Mack's interest in watches began very early on, so it was only logical that he would begin training to become a watchmaker at the goldsmith and watchmaking academy in Pforzheim, Germany. He taught himself the guilloche technique, which had been long forgotten, during his training — with support from his instructor Steffen Wolf and Jochen Benzinger, an old-school guilloche specialist and master engraver who is well known among experts. The young watchmaker then began working in the Deutsches Museum as a conservator. "But guilloche never lost its grip on me, and when I discovered an ancient guilloche machine for sale in 2014, I just had to snap it up," says Mack. Unfortunately, while restoring the roughly 100-year-old machine, he realized that an essential part was missing: the integrated wave-shaped profile rails. These are ultimately what create the wave pattern, which needs to be 100% uniform. Of course, after 100 years these profile rails were no longer available to buy.

Sinumerik CNC paves the way for guilloche

Mack was ready to give up his dream of owning a guilloche machine when one of his father's contacts had a brilliant idea. Freelance CNC trainer Hans-Peter Moser was sure that the Siemens CNC experts at the Technical Application Center (TAC) Erlangen would be able to produce a replacement part. However, this turned out to be a real challenge. Mack and an application technician analyzed the requirements until they were able to work out how to design and produce the profile rails. They designed and prepared the surface on the profile rails that needed to be milled for production using NX CAM and milled the profile rails on a machine using Sinumerik 828D. They used the

Watches with an artistic guilloche pattern are a joy to behold for watch enthusiasts



F. Mack

"CYCLE832 – high speed setting cycle", to activate the Top Service function and achieve an optimal surface and contours on the workpiece.

Since mid-2015, Mack has been using the profile rails with different waveforms and running a small manufacturing company. Now, thanks to the help of the TAC employees, he can unleash his creative energy and produce unique watches with his guilloche machine. Of course, such unique pieces, often requiring days of work, do not come cheap. A guilloche watch costs between €3,000 and €13,000 — but the purchaser buys it with the knowledge that the piece is incredibly special and unique. "Without the TAC Erlangen, I would have had to give up my dream of using guilloche," explains Mack with conviction, and it is easy to see how appreciative and happy he is. ■

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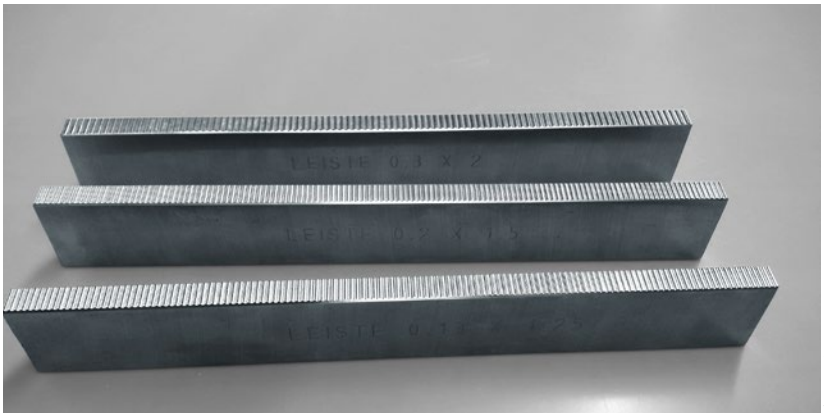
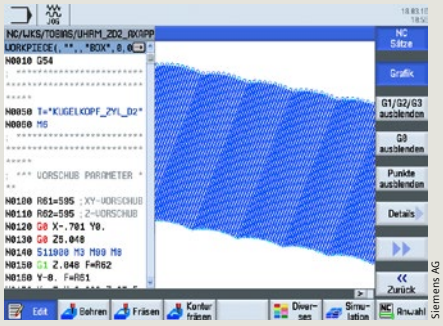


Siemens AG

The profile rails create the wave pattern



Siemens AG

High data quality in the NC program with Top Surface

For years, Sinumerik MDynamics and the Advanced Surface intelligent path control have been enabling optimized workpiece surfaces at extremely high machining speeds. There is now a new development for surface quality in mold-making: Top Surface. This function optimizes the data from the CAM system for the subsequent Sinumerik path guidance, resulting in a higher tolerance for inexact data. This tolerance is made possible by the innovative COMPSURF compressor. Top Surface is available for the Sinumerik 840D sl and 828D CNCs.

The advantages at a glance:

- Perfect surfaces — even with CAM programs with poor data quality
- Perfect workpiece surfaces even using bidirectional milling and varying point distribution
- High independence from the calculation tolerance in the CAD/CAM system
- Ability to activate additional smoothing for the contours within the set tolerance
- Quick block searches

Michael Behrendt

When tuning parts for older Moto Guzzi bikes, true-to-size production is particularly important — something that is guaranteed by SWS CNC Fräsen, which specializes in small-series and individual pieces

On the shopfloor

Tuning specialists

Two motorbike enthusiasts from Bavaria, Manfred Sehr of SWS CNC Fräsen and Michael Behrendt of HMB-Guzzi, ensure that bike lovers can still ride older Moto Guzzi models, with their distinctive two-valve engines, to this day.

When Manfred Sehr and Michael Behrendt are asked about the first time they met, they can't help but chuckle. Sehr's search for an exhaust system for his Moto Guzzi (a 1987 Mille GT) took him to the HMB-Guzzi workshop in Röttenbach near Nuremberg. There he saw various valve covers, screws and hubs and went right ahead and told Behrendt, "We can make these parts — only better." That was the start of a successful partnership.

Success with an online shop

Originally, Behrendt ran only a small motorbike workshop. But then everything took an unexpected turn. "Moto Guzzi fans worldwide all ask themselves the same things: How can I keep my beloved bike running properly? Where can I get good spare parts and tuning parts? That's how I came up with my online shop idea," explains Behrendt. His online shop transformed the small workshop into an inter-


Julia Sehr

»We produce small-series of 20 to 100 units for HMB-Guzzi. Sinumerik scores points for its handling and the coordinated operator interface with ShopMill.«

Manfred Sehr, Owner, SWS CNC Fräsen

nationally known tuning specialist for Moto Guzzi. Tuning here refers less to the upgrading of engine performance and more to the business of replacement parts with understated visual and technical tuning to keep fans happy with their bikes.

Many original parts, however, are no longer available. In addition, explains Behrendt, "Motorbike components from the '70s and '80s are representative of the state of processing technology and materials from that time. Things are much more advanced nowadays. With modern CNC technology and new materials, we are able to produce parts that fit much more precisely and are of higher quality, and we are often able to improve their functionality and service life, too. That's why we also develop our own parts."

Demand for flexibility and good tools

SWS CNC Fräsen, Sehr's Schwabach-based company, is responsible for producing these parts. At this family business with four employees, even the boss himself can be found working at the machines from time to time. Instructions for production can take very different forms, from a sample original part to little notes with ideas for modifications sketched by Behrendt. At SWS, highly complex parts are drawn up in SolidWorks CAD, but most of the models are created in Mastercam and then programmed using ShopMill. "ShopMill is incredibly powerful, and at the same time we have a perfect view of the workpiece and every stage of the process," says Sehr.

For production at SWS, there is a DMG five-axis machining center with Sinumerik 840D, as well as four three-axis milling machines from various manufacturers that are equipped with Sinumerik 810D and 840D. Says Sehr, "We produce small-series of 20 to 100 units for HMB-Guzzi and other clients. Sinumerik scores points for its handling and the coordinated operator interface with ShopMill. We have two employees here who worked for many years with a different control system — they wouldn't want to do without Sinumerik anymore either. We use SinuTrain for training purposes."

This training is very important to Sehr. "We specialize in small-series and prototypes," he says. "Perfect precision and premium surfaces are particularly important for tuning parts. After all, we also use CNC machines to engrave decorative parts like engine and carburetor covers. We also have other clients with similar demands for medical technology, so we work with plastics, too. In order to please small-batch customers and still work cost-effectively, we have to offer them good planning and programming — and the right partner."


Siemens AG/P. Kronfeld

An old Moto Guzzi, in top condition both technically and visually, is enough to get many motorbike fans' hearts racing

For the inner child

Competitive pressure in the motorbike tuning sector is huge. Quality, appearance, technical characteristics and also price must all be just right. HMB-Guzzi has been able to gain a competitive advantage through its collaboration with SWS. Behrendt explains, "We're able to show bike fans how their parts are produced — including videos of the parts being processed on SWS's CNC machines. The click counts show that people love the videos because they're able to see that our processes are of really high quality. Their inner child simply wants to know exactly how it's done. I'm just the same." ■

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Indirectly good news

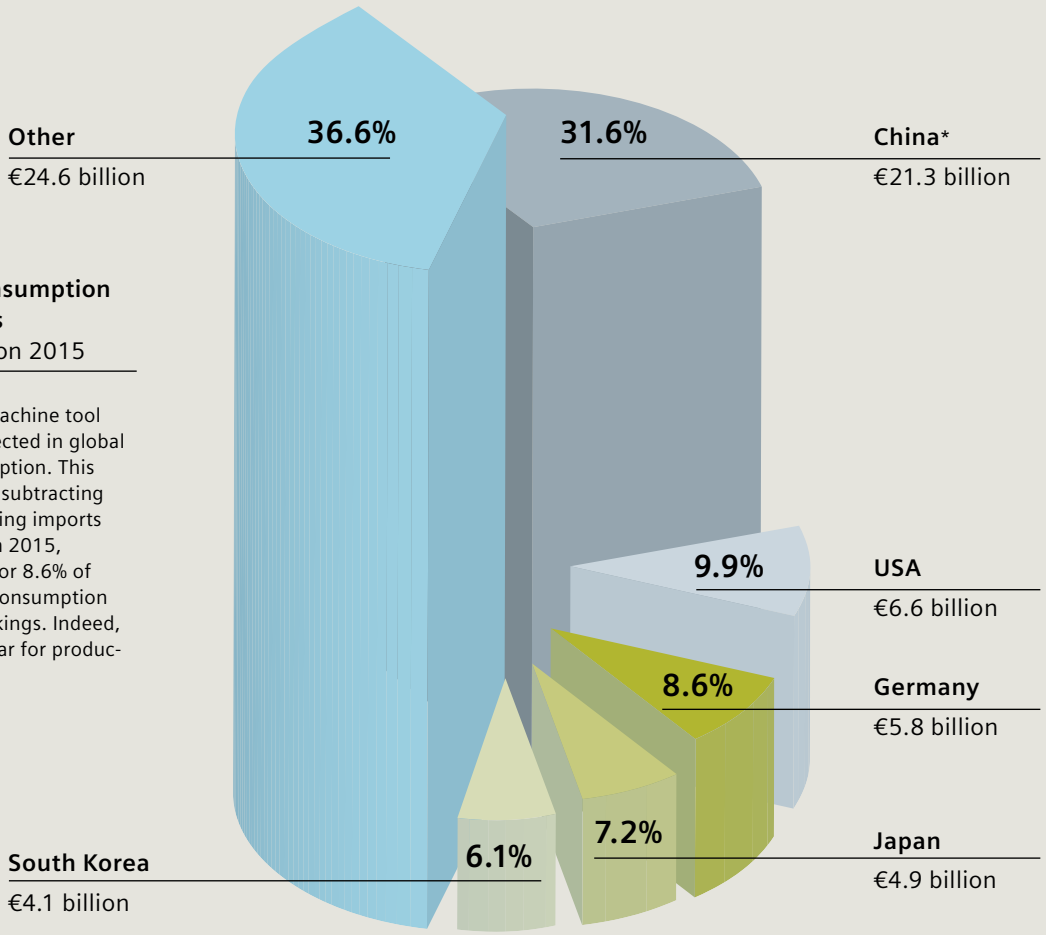
Although current figures on the status and revenues of machining companies are hard to come by, market data from machine tool builders allow observers to draw a few conclusions about the economic situation.

How will my company grow? How secure is my job? Market analyses and forecasts provide some answers to these questions. And although the media appear to offer an overwhelming amount of data from surveys and economic analyses, when dealing with figures the situation is not that simple.

Machining is a good example. Anyone who is looking for current figures will find that they are not readily available. The reason? The industry consists of many small businesses that work for a vast range of clients and target industries. Another obstacle: although large public corporations are required to be prompt in publishing detailed

Machine tool consumption — top 5 countries
Global consumption 2015

The market size for machine tool manufacturers is reflected in global machine tool consumption. This value is calculated by subtracting exports from and adding imports to total production. In 2015, Germany accounted for 8.6% of global machine tool consumption — one of the top rankings. Indeed, 2015 was a record year for production in the industry.



* VDW elimination of the simplest machines
Sources: VDW (German Machine Tool Builders' Association), VDMA (German Engineering Federation), national associations, Gardner Publications

business results, the majority of small machining companies are scarcely required to publish anything.

Alternative means of finding data

Those looking for data on the status of machining must therefore be willing to use alternative means — which is exactly what the CNC4you team has done. The approach? "An industry's suppliers can succeed only if the industry itself is succeeding." In this case, increased revenue for suppliers demonstrates a readiness to invest, which is in turn an indication that the machining industry is healthy and enjoying economic confidence. In the following interview on the state of machine tool manufacturers, Bernhard Geis, an economist and adviser in the Department of Economics and Statistics at the VDW (German Machine Tool Builders' Association), explains whether this approach is the right one. ■

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Stable outlook after a record year

Tristan Rosler

»Metal-processing companies in Germany have also invested heavily.«

Bernhard Geis, Adviser, Department of Economics and Statistics, VDW

Important figures from the German machine tool industry

	€ (billions)		% change compared to previous year	
	2014	2015*	2014	2015
Total production	14,486	15,053	–1	+4
Machines	10,772	11,177	–3	+4
Cutting	7,912	8,400	0	+6
Forming	2,860	2,777	–11	–3
Parts, accessories	2,483	2,580	+8	+4
Installation, repairs, maintenance	1,231	1,296	+9	+5
Receipt of orders**	14,800	14,900	+4	+1

* 2015 production = preliminary
** Extrapolation based on VDW statistics

Sources: German Federal Bureau of Statistics, Ifo Institute, VDMA (German Engineering Federation), VDW (German Machine Tool Builders' Association), April 2016

CNC4you: Mr. Geis, what is the state of the German machine tool industry?

Bernhard Geis: 2015 was a record year for the industry. Revenue from machine sales increased to close to €11.2 billion. Including accessories and maintenance, revenue grew to €15.1 billion. That represents an increase of 4% compared to 2014. That is a very good result, especially against the backdrop of the various international crises and the collapse in China.

CNC4you: Can you provide figures for the machining industry?

Bernhard Geis: Yes. At €8.4 billion, machines for the industry represented the lion's share of machine tool sales. Here, too, growth was at 4%. In summary, globally, manufacturing companies invested in expanding and modernizing their processing capacity.

CNC4you: And if we focus on the German market alone?

Bernhard Geis: Metal-processing companies in Germany have also invested heavily. We determine what is known as domestic consumption by subtracting exports from the total production of German machine manufacturers and then adding the volume of imported machines. Domestic consumption has increased by 5%. Domestic metal-processing companies have therefore invested significantly more than the global average. Increased investments are a sign that the industry enjoyed very good success in 2015 and the years before. It is also interesting that revenue in ›

Western Europe has grown by a whole 10%, driven significantly by countries such as Italy, Spain and Sweden. We consider this a sign of economic recovery in the important European market.

CNC4you: Can you risk a forecast?

Bernhard Geis: Forecasts are difficult. We record the orders received by machine tool manufacturers, and according to our calculations these have grown by an additional percentage point compared to the record year 2015. That is definitely a good sign. However, we know that demand in some markets will become more volatile, meaning faster and larger fluctuations. For example, the Chinese market — whose 22.4% share makes it the largest export market for German machine tool manufacturers — took a 9% dive in 2015. That affected machine manufacturers, of course, and there is no sign that the situation will improve in 2016. The good news is that these contractions were more than compensated for by growth in other markets. This compensation should also be possible in 2016, so after a record year in 2015 I predict stable growth.

CNC4you: Let's move away from the raw figures. What long-term changes and megatrends can you observe?

Bernhard Geis: Digitalization and Industrie 4.0 are changing the relationship between machine builders and manufacturing companies. Integrating IT with the production process is becoming increasingly important. This brings with it new requirements that play an important role in the machine purchasing process.

»Digitalization and Industrie 4.0 are changing the relationship between machine builders and manufacturing companies.«

Bernhard Geis, Adviser, Department of Economics and Statistics, German Machine Tool Builders' Association

CNC4you: What does that mean in practice?

Bernhard Geis: It is no longer just the superficial machine qualities and performance characteristics that matter. In the future, it must also be possible to integrate a machine effectively into existing higher-level business and IT systems. However, typical small- and medium-sized machine tool manufacturers cannot achieve this alone, so they are dependent upon reliable suppliers — and on none more so than control system manufacturers. These manufacturers must allow small and medium-sized enterprises to meet a range of additional requirements — such as programming their own apps — as easily as possible and enable companies to interact with the widest variety of interfaces openly and flexibly. However, the demands on users are just as great: they will increasingly need to see machine manufacturers as partners, sharing significantly more information with them about their production processes and tasks. Because without this information, integration is not possible. All this will require significantly closer future collaboration between machine manufacturers, their suppliers and users. The result will be companies that are more careful in selecting their machine suppliers, placing an increased emphasis on the suppliers' advisory and service capabilities and developing closer and longer partnerships.

CNC4you: Thank you for speaking with us, Mr. Geis.

Serving machine tool builders for 125 years

In 2016, the German Machine Tool Builders' Association (VDW) celebrates its 125th anniversary. The association represents around 290 machine manufacturers, with combined revenues of more than €15 billion. The association has long done more than just represent the interests of its member companies when dealing with politics, research, the media and the public. As a versatile and in-demand service provider, the VDW provides support in the form of economic and market analyses and is a point of contact for technical, economic and legal queries and for standardization. The VDW also organizes industry trade fairs such as EMO and METAV. Other initiatives include conferences and technology symposia abroad that serve to open new markets for the export-oriented machine tool manufacturing industry. For instance, this year the first VDW events are taking place in Iran, shortly after the end of the trade embargo. Metal-processing companies also benefit from these activities as customers of VDW members. In addition, the VDW's Youth Development Foundation promotes recruitment of young talent and a modern approach to training. And on the Internet, the VDW operates a B2B information portal through its IndustryArena subsidiary www.industryarena.com.

Sinumerik training is now even more convenient

SinuTrain 4.7, the new version of the offline programming software, is an exact reproduction of the modern user interface Sinumerik Operate 4.7. The highlight of this new development: The free basic version, which is valid for an unlimited time.

The SinuTrain software for Sinumerik Operate 4.7 runs on almost any desktop or laptop PC, as it has low hardware requirements: a 1.5-GHz single-core processor, 1 GB RAM and a graphics card with 640 x 480 pixel resolution are sufficient. Experienced SinuTrain users will immediately notice the completely redesigned framework interface when they launch Version 4.7 — the so-called workbench, which re-creates the production machinery in a virtual environment. By clicking on a machining center, the programmer is directed to the corresponding Sinumerik Operate programming interface with the appropriate software version.

Free basic version

Version 4.7 of SinuTrain includes — for the first time — a free basic version that is valid for an unlimited time. This is particularly useful for presentations and basic training, as it allows the user to bring up all Sinumerik functions live and practice using them. As in the full version, programs for three-axis milling machines or two-axis turning machines can even be transferred to and run at appropriate machining centers. If the user later purchases and installs a license, it automatically applies to all other programs that have been created. The software can be downloaded from the CNC4you portal: ■

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SinuTrain 4.7 is an identical reproduction of the CNC user interface Sinumerik Operate 4.7

Siemens AG

Benefits at a glance:

- Machine tool operation is not halted by programming work, which increases machine availability
- 1:1 reproduction of the CNC user interface Sinumerik Operate 4.7, allowing employees to work in a familiar environment
- Free DXF reader that simplifies the import of CAD data
- New "workbench" framework interface for a simpler overview of machines
- IBN archive for easy importing of CNC machine data
- Low hardware requirements — a standard desktop or laptop PC is all that is required
- Free basic version that is ideal for demonstrations and training
- Cost-effective license options for individual or multi-station use
- Cost-effective training packages with additional student licenses and programming manuals

New certified trainers for Sinumerik CNC

Siemens AG

Helmut Graf (left)
of the LPT Akademie

Siemens AG

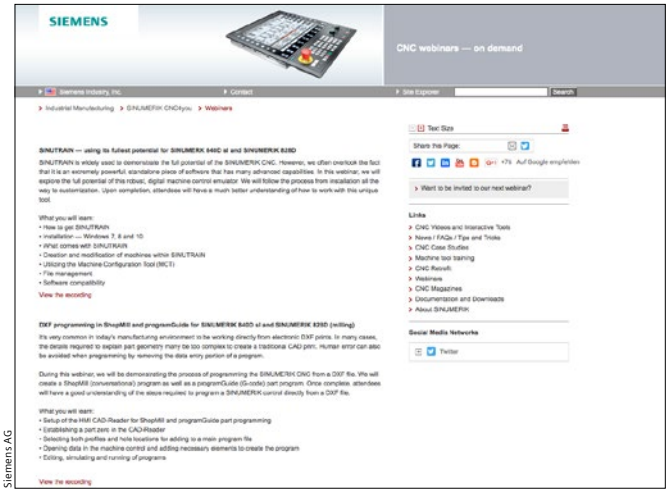
Christian Mertens (left)
of the VDW-Nachwuchsstiftung

"From the shopfloor, for the shopfloor" — Siemens awards special Sinumerik certificates to independent trainers under this slogan. One of the newest trainers is the precision and mechanical engineer Helmut Graf. He turned his CNC hobby into his profession and in 2011 became head of the LPT Akademie. The LPT Akademie offers a wide range of training courses covering metalworking and NC technology services. Christian Mertens from the VDW-Nachwuchsstiftung (the training foundation of the German Machine Tool Builders' Association) is also newly certified. He offers training courses on Sinumerik Operate.

You can find an overview of our certified trainers in the Education and Training section of the CNC4you portal. You can book these trainers for courses directly. ■

↗ **siemens.com/cnc4you**

Webinars



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Siemens USA offers webinars on various topics, such as DXF programming. You can participate in these live events or watch the replay videos later.

Each webinar lasts around one hour. ■

↗ **usa.siemens.com/cnc4you**
↗ **sie.ag/1Wp9cN6**

New workpieces

Our collection of CNC workpieces to reproduce is growing. New additions include a ballpoint pen, salt and pepper shakers that look like screws and Christmas trees for turning and milling.

Want to get started right away? You'll find all the templates, including manufacturing instructions, at siemens.com/cnc4you → CNC workpieces. ■

↗ **siemens.com/cnc4you**

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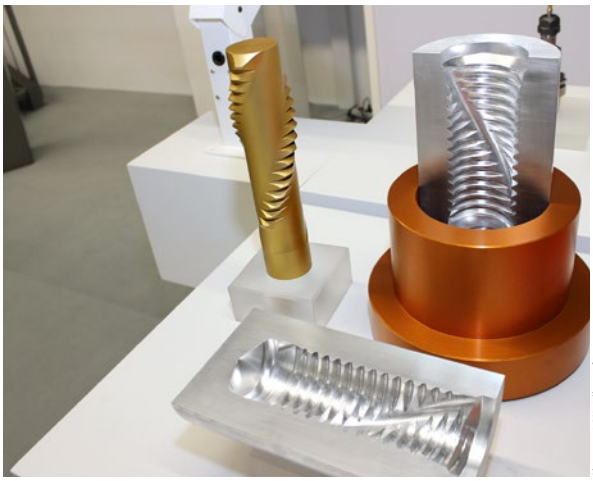
Salt and pepper shakers that look like screws

Create threads at the press of a button

Female threads can be created in many different ways. The thread experts at Emuge Franken and Audi have developed what is by far the most efficient method. The new technology is called Punch Tap or helical thread-forming and allows M6 female threads to be created around 75% faster than with other processes. As a technology partner, Siemens provided mechatronics support to aid implementation and ensure an easy-to-use cycle. You can find details of the new technology and its availability at:

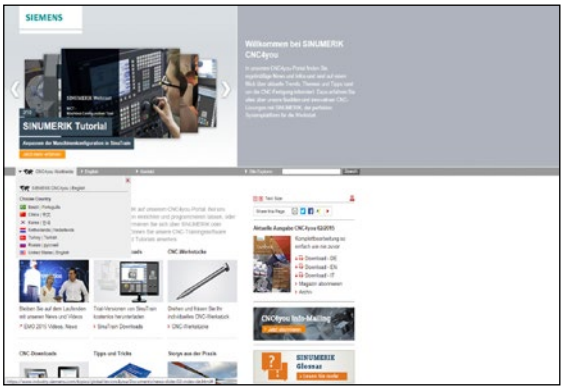
↗ **siemens.com/cnc4you**



Siemens AG/P. Klingauf

With Punch Tap, female threads can be created 75% faster

CNC4you portal goes worldwide



The CNC4you portal is enjoying great popularity worldwide. The portal is available for several countries: Brazil, China, Korea, the Netherlands, Turkey, Russia and the United States. You can find these country-specific pages at CNC4you worldwide.

↗ **siemens.com/cnc4you**

Important dates — mark in your calendars

CIMES	**June 22–26, 2016**	Beijing, China
IMTS	**September 12–17, 2016**	Chicago, United States
AMB	**September 13–17, 2016**	Stuttgart, Germany
JIMTOF	**November 17–22, 2016**	Tokyo, Japan

You can find an overview of additional trade fair dates and training courses in the Events section of the CNC4you portal.

↗ **sie.ag/1TEVXG6**

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Published by
© Siemens AG 2016

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Article No.: E20001-A1900-P610-7600
Printed in Germany