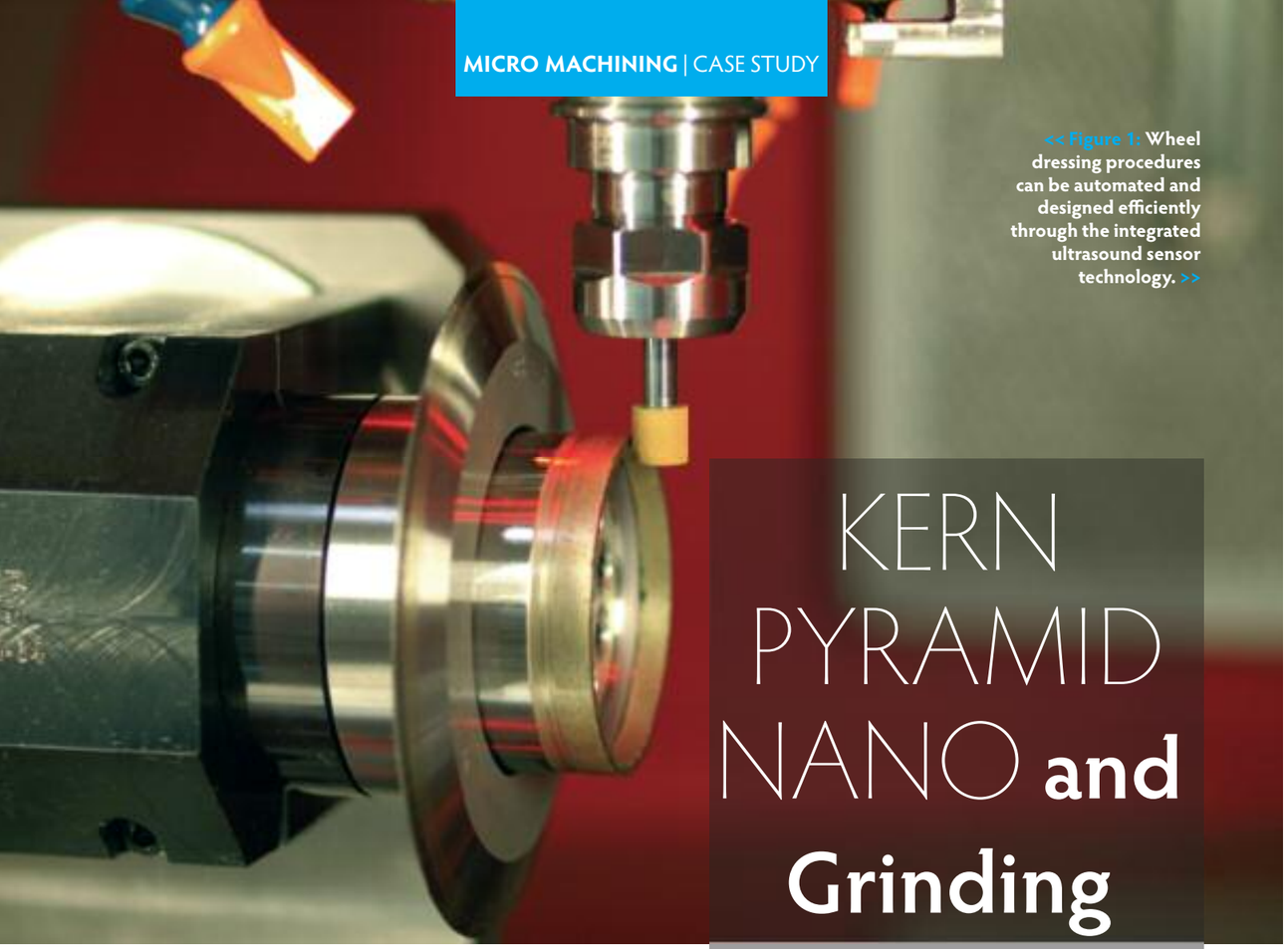


<< Figure 1: Wheel dressing procedures can be automated and designed efficiently through the integrated ultrasound sensor technology. >>

KERN PYRAMID NANO **and Grinding**

Fitted with a grinding package, the fully hydrostatic 5-axis Pyramid Nano milling centre by Kern Microtechnik is transformed into a highly flexible multi-function machining centre. The wheel dressing unit, ultrasound sensor technology and grinding software enable the machine to carry out profile, round and flat grinding tasks.

Dennis Janitza, Managing Director of Kern Microtechnik GmbH, quickly explains the advantages: "No manual wheel dressing of the grinding wheels, only one machine with a high capacity potential — that wins praises from operators and management. Highly precise 5-axis positioning of the workpieces, best hydrostatic buffering and the precision of 0.5 µm produces workpieces with grinding machine quality in only one mounting process. To top it all, the Pyramid Nano can also perform highly precise milling tasks." Hydrostatic guiding systems and drives form the basis for frictionless work, no wear and tear and thus the highest precision and stability for an almost unlimited time. In combination with the highest resolution glass scales, precision motion can be achieved that equals that of eccentric heads known within the grinding technology.

Through the integration and implementation of the proper hardware and software, the user can select from many functions that are familiar from the traditional grinding processing centres. Because a grinding wheel has a geometrically undefined cutting edge, the laser tool measuring system integrated in the standard machining centre cannot be utilised to achieve the same precision as customary for milling processes. For this reason, an ultrasound sensor technology was integrated into the machine. This sensor technology is mainly used for three applications. During the wheel dressing, it checks the contact between the tool and the dressing unit and thereby enables an economical and efficient wheel dressing and sparking out of tools. During the touching of the workpieces, the contact between grinding tool and component can be detected with a precision of less than 0.5 µm in an extreme case and the zero points can be adjusted automatically.

During rough grinding, the sensor checks whether the tool is already in contact with the workpiece and if not, it increases the movement in incremental values until the workpiece is contacted. The successful application of the Kern Pyramid Nano for grinding processes is based on the high precision and the hydrostatics of the milling machine, supplemented by a 'grinding package' consisting of wheel dressing unit, ultrasound sensor technology and grinding software.

<< Figure 2: 5-axis Pyramid Nano milling centre from Kern Microtechnik.>>

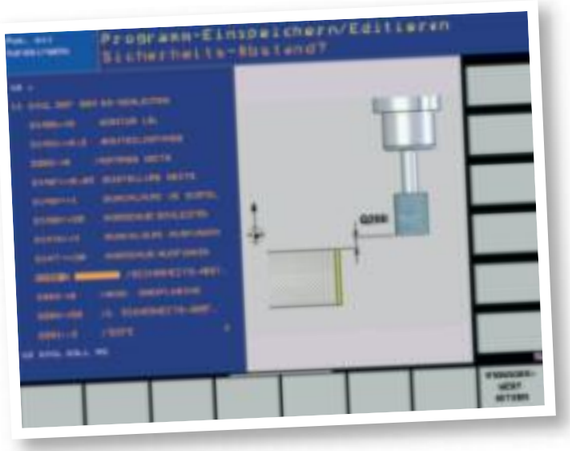
Further, manipulating the fourth and fifth axis can help minimise the set-up procedure, which normally takes a lot of time when working with conventional grinding machines. The process incorporating an automatic workpiece changing system is an optimal solution ensuring high quality and low costs.
During the finish grinding operation, the spark out cycles is monitored and the processing time is optimised.

To dress the grinding wheel there are two options, first the work is carried out by a fixed diamond, which is monitored by the ultrasound sensor technology or the optional grinding wheel dressing spindle will be installed. This spindle is controlled by the NC control unit and also features integrated ultrasound sensor technology. Through the simple change of the dressing tools, almost all grinding tools can be sharpened and shaped.

Various grinding cycles are available, which enabled the machine operator to utilise his machine for a broad range of grinding tasks, for example:

- Freely definable pendulum stroke: a programmable pendulum stroke of the Z-axis, that is independent from the NC group, enables the processing of interior and exterior contours during a cross grinding process. In contrast to the eccentric processing, the utilisation of glass scale-regulated axes not only enables round forms but also freeform profiles on the X-Y plane.
- Air grinding cycles: if the wheel is not grinding the workpiece, this is recognised and the feed rate will be increased automatically.
- Spark out cycles: sensor technology recognises when the spark out has been completed and ends the process automatically.
- Hole grinding cycles: functional pre-defined cycles available.
- Dressing cycles: simplify and support the programming of the required wheel dressing procedures.

>> Continued on page 24



<< Figure 3: The grinding and dressing cycles integrated in the NC control unit allow an intuitive and efficient utilisation of the new functionalities.>>

<< Figure 4: TDie that was manufactured with the help of a free X-Y profile and a superimposed pendulum stroke. The cross-grinding is clearly visible. >>

With the help of the ultrasound sensor technology it is possible to fully automatically determine the position of the top surface with a precision of less than 0.5 µm in order to achieve a subsequently repeatable and stable process on the component.

According to Janitza, the Kern Pyramid Nano machining centre can illustrate the many applications using profile, round and flat grinding procedures. One example is shown by profile grinding. Particularly interesting for this technology is the manufacturing of forming and cutting tools. Often this involves dies or moulds with vertical surfaces and free X-Y profiles. These profiles are programmed in two axes and then superimposed with the pendulum stroke of the Z-axis. This creates the quasi-stochastic cross-grinding process that is a characteristic for profile grinding. Interior profiles with a diameter of <1 mm can be processed as well by increasing the wheel orbital rotation.

Air bearing pockets for applications with extremely high speeds often require the highest precision. The decisive factor is the depth dimension of the air bearing pocket with respect to the top surface. With the help of the ultrasound sensor technology it is possible to fully automatically determine the position of the top surface with a precision of less than 0.5 µm in order to achieve a subsequently repeatable and stable process on the component.

<< Figure 5: The dressing spindle can be equipped with various dressing tools and can be freely positioned for optimal dressing results. >>

Through the utilisation of rotational and parallel axes, it is possible to position workpieces so that flat grinding processes can be carried out on the machine. Kern uses this technology on its own machines to produce axis components directly on the milling-grinding centre. Due to the omission of the 'flat grinding' processing step, the throughput time as well as the processing times could be reduced while simultaneously improving the quality.

An additional benefit is that the milling and grinding of hard materials (tungsten carbide and ceramics as two examples) can take place in one mounting process. Previously, the direct milling of hard materials was deemed to be unprofitable. However, over the last several months, new tools in conjunction with the proper machine technology and the suitable milling strategy have proven that this solution can be economically efficient and productive. The best results were achieved with a combination of grinding and milling processes in one mounting process. During this process, all excess material is removed through a rough grinding process without having to use the cost-intensive hard metal milling tools. Afterwards, the component is finished in a 5-axis simultaneous process with the help of the new hard material direct milling process.

Kern Microtechnik GmbH
www.kern-microtechnic.com

The article was first published in Germany, "fertigung extra" issue 3.2014, editor Jürgen Gutmayr.