

■ EiMa Maschinenbau GmbH, Germany

Reduced Downtime

VCS software for Sinumerik 840D sl compensates for machine tool axes errors.

Portal milling machines are needed, particularly by the aviation industry, to manufacture larger workpieces – for example structural parts or wing components. Demands in terms of positioning accuracy continue to rise for these machines across the whole working area (volumetric accuracy) and in some isolated cases, values below 50 micrometers are required.

To achieve this level of accuracy, the quality of mechanical production, machine components and machine assembly needs to be extremely high. Companies wishing to achieve this goal in an economically viable manner will need to use control-based compensation methods. With the Sinumerik 840D sl Volumetric Compensation System (VCS), the remaining residual error is reduced considerably during positioning across the whole working area.

Limited compensation with CEC tables

Each of the three feed axes on a cartesian machine tool has six types of error that influence the positional deviation of the TCP (Tool Center Point) and the orientation error of the tool. In addition, cartesian machines also have three squareness errors on the axes, which means that a total of 21 types of error

occur in a complete physical model. As a result, both an offset in the tool tip and an orientation error of the clamped tool occur at the TCP on a three-axis machine tool.

On NC-controlled machine tools, the aim is to reduce the linear positioning error of the machine axes through spindle pitch error compensation. The Sinumerik 840D also offers a means of reducing straightness and squareness errors with correspondingly combined CEC tables (Cross Error Compensation or sag compensation). However, this method does not take into consideration errors caused by roll, pitch and yaw of the feed axes. These types of error have a noticeable effect, in particular on portal milling machines used in the aerospace industry due to the high effective lever (extended Z-slide).

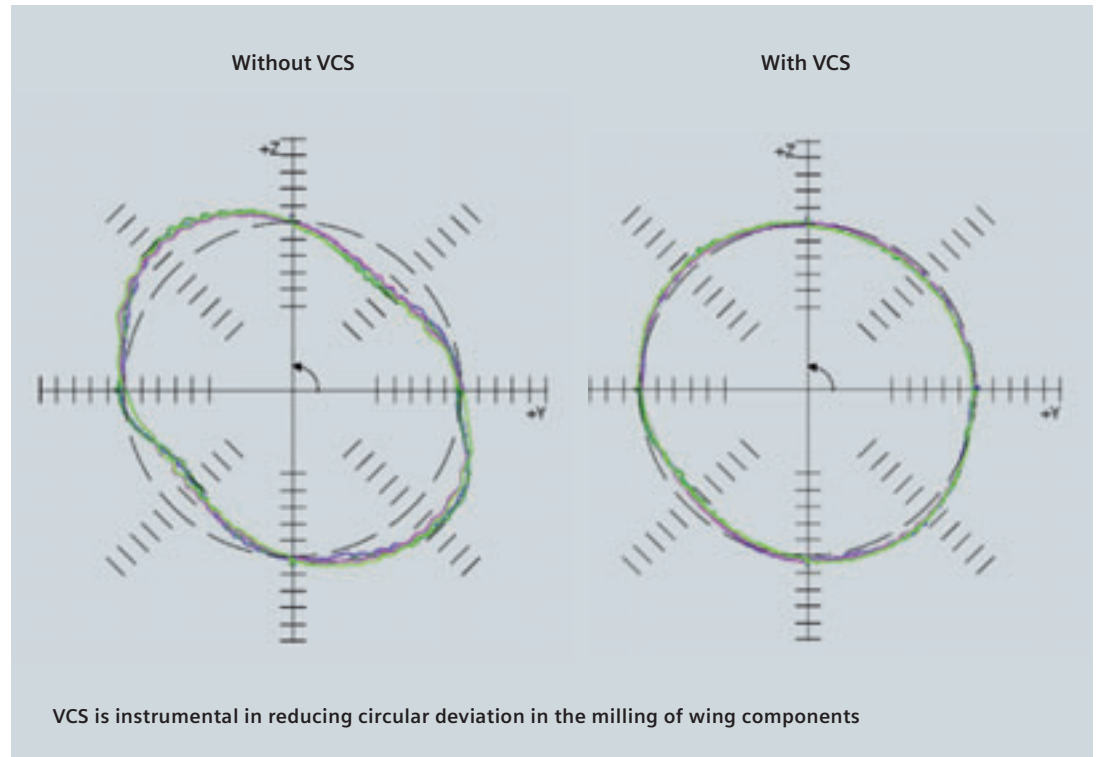
Comprehensive compensation with VCS

The new VCS software for the Sinumerik 840D sl is well suited with this task. The software facilitates compensation of all 21 geometric errors in machine tool axes, thereby significantly increasing volumetric accuracy across the entire working area of a portal milling machine. The degree of feasible error reduction depends on the individual circumstances and



Highlights of the Volumetric Compensation System (VCS)

- ▶ Safe, tried and tested procedure
- ▶ Reduction in mechanical machine revisions
- ▶ Shorter machine downtimes
- ▶ Improved production results at low additional costs
- ▶ Improved understanding of the behavior of a machine



the conditions in which the machine is being used. While only volume errors on the TCP of a three-axis machine can be corrected with VCS, it is also possible on five-axis portal milling machines with a tilt-swivel head to reduce errors in tool orientation.

The first step in setting up VCS is to measure all 21 types of error on the machine. This is carried out using a precision laser interferometer. The software supports partner products from Renishaw (XL-80), Automated Precision (XD laser) or Etalon (laser tracer). The calculated data can then be converted to a VCS file and stored in the Sinumerik system. The high level of automation, when using a laser interferometer, makes it possible to complete measurements and machine calibrations within the space of just one day, depending on the complexity of the tasks involved.

Recalibration instead of mechanical rework

At EiMa Maschinenbau GmbH in Frickenhausen, Germany, the VCS solution was tested on a Gamma Linear portal milling machine equipped with Sinumerik 840D sl. The machine is a mobile portal equipped with linear drive systems and is used in model construction and parts manufacture. The length of travel

is 2650 millimeters on the X-axis, 1850 millimeters on the Y-axis and 1150 millimeters on the Z-axis. The calibration was performed by AfM Technology GmbH in Aalen, Germany – a company specializing in machine error measurement and VCS commissioning – using a laser tracer.

Large machine tools, in particular, can change in shape during the course of normal operation, for example as a result of buckling or sagging – or settling of the machine base. Errors of this kind were previously rectified by means of mechanical correction at the machine, which could often be a lengthy process. These days, a company can carry out recalibration by measuring geometric errors and applying compensation on the control side using the Volumetric Compensation System, thus keeping machine downtime to a minimum. ■

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