■ EiMa Maschinenbau, Germany

Innovative Machine Concept

Thanks to Mechatronic Support, an HSC machine for heavy and light metal machining made its debut on the market without the need for a prototype.

EiMa produced the first HSC machine for machining large volume parts for the aerospace industry

Siemens AG

EiMa, a company from Frickenhausen near Stuttgart in Germany, is an expert in special machinery. The company gained a wide range of experience in light construction and gantry systems through the construction of large woodworking centers. This experience can be successfully applied to solutions for machining aluminum, plastic and composite materials. The focus is now on High Speed Cutting applications (HSC) with high removal rates and fast tool and workpiece change.

New Machine Concept Using Mechatronic Coordination

It is vital for HSC machines to have the mechatronic coordination of construction, drives and control technology to ensure the overall performance is adequately consistent for the high precision required. For this, EiMa engineers use the degree of freedom that is offered by Sinumerik CNCs and the integrated drive technology. It became clear that, thanks to the control technology available today with a skillfully designed HSC machine for aluminum, in principle it is also possible to carry out heavy machining of steel and other hard materials.

The biggest advantage lies in the fusion of HSC and heavy machining in a single machining center for large volume parts, as the need to acquire and setup a second large machine for heavy machining becomes redundant.

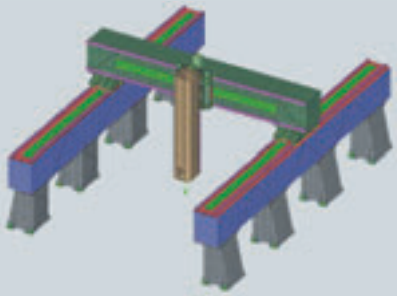
EiMa constructed a five-axis HSC gantry milling system for large volume parts made from aluminum and CFK (carbon fiber reinforced plastic) with a traversing range of 9800 x 4000 x 1500 millimeters (X, Y, Z axis) and a removal rate of five liters of aluminum per minute for a well-known European aerospace company. The investor was impressed that both aluminum and titanium can be processed on the HSC machine and that all parts are produced on one single machine. The only obstacle: before the order

EiMa
Siemens AG

The HSC five-axis milling center for large volume aluminum or CFK parts can also process titanium and steel

Maschin Optimization with Mechatronic Support

- Machine analysis using specially trained application advisors
- Examining machine concepts using simulation to check the vibrational behavior
- Creating a virtual machine model with all the features of a real machine



The structural dynamics of the simulation provides information about the natural frequency, the strengths occurring during operation and the limiting factors of the construction or drive design

is made, EiMa should demonstrate that the innovative concept also delivers the necessary productivity, precision and surface quality in large gantry spans of this kind and at such far travel distances.

Machine Optimization Thanks to the Simulation Model

In this situation, the machine manufacturer teamed up with Siemens Mechatronic Support specialists, which confirmed the machine concept in principle and authoritatively verified the machine design. Using a 3D model of the machine structure and a rough sketch of the axis guides, Siemens created a first Finite Element Model (FEM) that confirmed the function capability of the concept proposed by EiMa.

Using the target data for machine productivity and production precision along with EiMa's planned spindle speeds and feed rates, Mechatronic Support then determined the drive design suited to construction. The dynamic properties of these drives were taken into account for the mechatronic simulation of the structural dynamics.

After the machine manufacturer and the Mechatronic Support team evaluated the simulation results, EiMa optimized the construction in areas where there was still scope for improving performance. These changes were implemented into the FE model of the machine element and the simulation was repeated. Leading designer Gunther Nagel confirms: "The first optimization of our construction, based on the simulation results, allowed us to increase the natural frequency of the machine by over 15%; the second cycle added another 5%."

The available FE model offers the opportunity to quickly check the effects of axis length changes on the machine dynamics. The FEM calculations also showed that for the X- and Y-axis linear drives were the only consideration. Since these motors have a steady dynamic performance even over long travel distances, they also offer advantages for EiMa for a future scalability of the machine. After consultation with Siemens, the corresponding products were configured and the detailed engineering of the machine was scheduled.

Achieving Optimum Results Together with Experienced Partners

The very first milling attempts were met with positive feedback from the end customer. And this is no surprise: not only were the expected cutting power and production precision for titanium achieved, but in HSC operation, instead of the required five liters per minute of aluminum processing performance, a full eight liters per minute were "teased out" of the design plan.

"This was only possible through working together with Mechatronic Support," says EiMa managing director Markus Eisold. "The new technology, the enormous size of the machine together with the performance data requested by the end customer – we would not have had this opportunity by ourselves." The collaboration with Mechatronic Support in this project will reap long-term rewards for EiMa. Even during the construction phase of the first machines (just using the FE model and the machine simulation), new, additional orders were acquired, including building the cabin for a Russian aircraft manufacturer. ■

info	www.siemens.com/mechatronic www.eima-maschinenbau.com
contact	peter.hofsaess@siemens.com