Successful Solution with Software CNC

Leading German aircraft engine manufacturer chooses open architecture CNC from MDSI

MTU Aero Engines, headquartered in Munich, Germany, develops, manufactures and provides service support for commercial and military aircraft and helicopter engines as well as industrial gas turbines. High quality is crucial. So when an optical 2D measuring machine failed due to a lack of replacement parts, the staff of the DaimlerChrysler affiliate needed a good solution, fast. Faced with costs of up to EUR 250,000 for a new machine, they decided instead to do a retrofit. In the search for suitable controls for the three linear and three rotary axes of the retrofitted measuring machine, they chose the OpenCNC® software CNC control from MDSI® (Ann Arbor, Michgan). The software CNC allows the MTU staff to configure and service the machine controls completely by themselves.

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Many airline passengers are dependant upon the high quality standards of MTU Aero Engines without even realizing it. In civil aviation, both Airbus and Boeing use the engine technology developed in the north of Munich. In the military field, Eurofighter, Tornado and Transall pilots, for example, use thrust technology from MTU.

At MTU the department for new nondestructive testing methods (TWPT) ensures compliance with the extremely high quality standards. The ten employees in this department develop special testing methods for measuring technology, including 1D, 2D, 3D, ultrasonic, eddy current, thermographic and internal stress measuring methods.

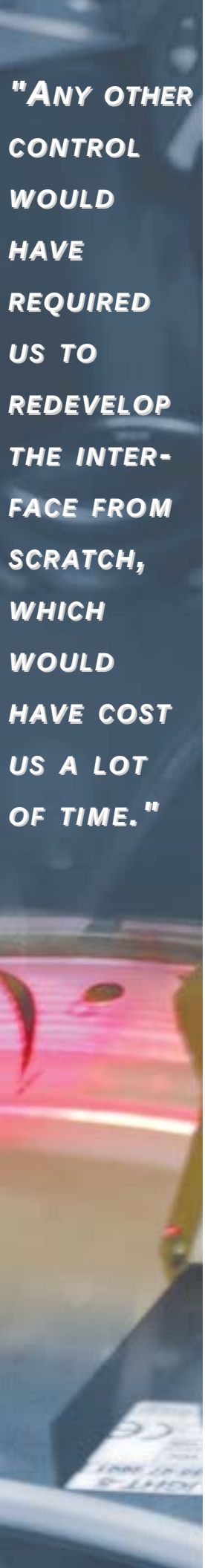
High-class workmanship: Herbert Zisik leans against a Starfighter engine - naturally with MTU engine technology.

When the optical measuring machine goes blind

The problem started when the TWPT department finally ran out of replacement parts for an important optical 2D measuring machine bought from Siemens in 1987.

MTU used the machine to check the position, diameter and shape of drill holes and punched holes in rotation-symmetric (round) engine parts for important customers such as airlines and the German Armed Forces. In the test, the parts are clamped on a rotary table and checked for accuracy by transmitted light.

A special image-processing software uses camera pictures to check the accuracy of punched holes or drill holes. The measuring machine has an accuracy of two micrometers. The camera must therefore be positioned with extreme precision over the total of 6 axes - directly via special PC image-processing software.



"Any other control would have required us to redevelop the interface from scratch, which would have cost us a lot of time."

Bringing a high-resolution ultrasonic machine to life

"Faced with the enormous acquisition costs of up to a quarter of a million euros for a new machine, it made sense to also think about a retrofitting solution," remembers Herbert Zisik from the TWPT department at MTU. "Especially since none of the measuring systems available on the market met the requirements of MTU in the laboratory and in series operation 1:1." Since MTU ran already short of replacement parts of the Siemens machine, a retrofit of this machine was out of the question. Adapting the existing Siemens control on another machine would have meant high complexity and enormous costs. Therefore they needed a "new" machine and a new control.

They were looking for a machine with linear and rotary axes, one that offered the necessary precision and measuring volume for engine components. They searched through the collection of discarded machines on the MTU premises and finally came up with a high-resolution ultrasonic system from 1992.

OpenCNC controls the camera via three linear and three rotary axes with a precision of up to five micrometers.

Extraordinary requirements

The machine needed new controls, which had to meet the following three requirements: Control commands for the measuring machine would come from the image-processing software on a PC, and then be forwarded to the actual machine controls. During testing the camera has to be moved with extreme precision - of up to five micrometers (Z axis) - via the linear and rotary axes. This was the only way to determine the accuracy of the punched holes and drill holes. Finally, MTU wanted an easy-to-use, slimmed-down solution with only the most important features.

On a visit to the Hanover Industry Fair, Herbert Zisik soon realized that the first criterion in particular ruled out many suppliers. In the end, three controls were acceptable for the TWPT department. As well as controls from Siemens, whose solutions MTU mainly used, Zisik found the software CNC from MDSI particularly suitable. At the time, he was not yet familiar with software-based CNC solutions but, as a qualified computer scientist, he was intrigued by the idea. A brief introduction to the OpenCNC software convinced him, especially when he realized that at EUR 25,000 for the entire retrofit, the MDSI solution would only cost half the price of the other offers he received.

Retrofit: From the high-resolution ultrasonic system to the optical 2D measuring machine controlled by OpenCNC.

The premises of MTU Aero Engines GmbH, the leading German aircraft engine manufacturer, are located in the north of Munich.

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Introduction to OpenCNC

The first task in the retrofit was to redesign the control cabinet of the ultrasonic system, reducing dimensions by a third. Then the OpenCNC software was installed on a commercial Pentium III PC. For precise camera control over three linear axes - with traverse paths of between 400 and 900 millimeters - the positions of the axes were measured laser-interferometrically. The existing deviations could be compensated for in an initial approximation. The same procedure was then performed again on the three rotary axes - swivel radius plus/minus 120 degrees (A), plus/minus 110 degrees (B) and 360 degrees (C, rotary table).

The rotary axes A and B were mounted to the Z axis. These axes hold the camera and a sensor for measuring 3D surface data, so that both can be turned and swiveled. The latter is essential for capturing the 500 to 1600 holes per part at specific angles.

The benefits of a software CNC already became obvious during installation. Because of OpenCNC's familiar and intuitive Windows-based user interface, the correction data from adjusting the axes controls could easily be stored on the PC.

From PC to PC

Before the former high-resolution ultrasonic measuring machine could begin operating as an optical 2D measuring machine, the communication interface between the Optimas image-processing software on one PC and OpenCNC on the other PC had to be customized. Ulf Müller, now of ibatec-GmbH, Duisburg, needed less than a day for this task. The control commands from the image-processing PC were transferred via the serial interface to the OpenCNC PC, from which they were sent to the machine. This is where the software CNC proved its high flexibility. "It was relatively easy to adjust our proprietary communication interface from the old controls to OpenCNC," explains Herbert Zisik. "Any other control would have forced us to redevelop the interface from scratch, which would have cost us a lot of time."

MTU Aero Engines:

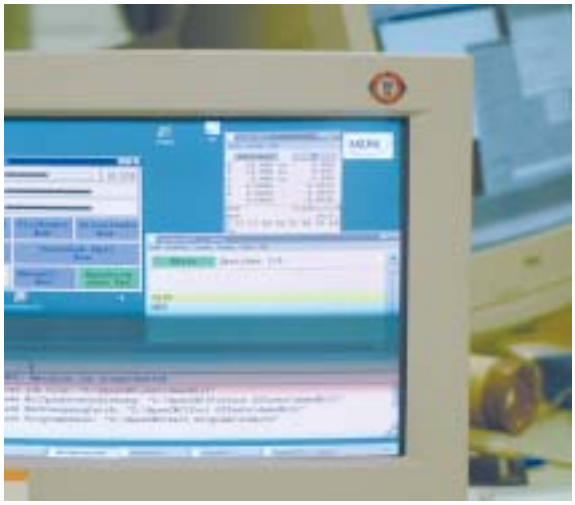
MTU Aero Engines is Germany's leading jet engine manufacturer. More than 4,000 employees in the north of Munich develop, manufacture, market and provide service support for aircraft and helicopter engines, military and civil alike. Customers of the DaimlerChrysler affiliate include manufacturers and operators of aircraft engines and industrial gas turbines across the world. MTU has subsidiaries in Germany, Brazil, China, Malaysia and Canada and has cooperative ventures with the who's who in the engine system integration and manufacturing community such as Pratt & Whitney, General Electric, Rolls Royce, Snecma, Volvo and FiatAvio. In the year 2002, the 8,700 employees of MTU worldwide achieved a turnover of more than 2.2 billion euros.

In addition, the software CNC automatically gathered all data produced on the measuring machine in real time without requiring operator input. The resulting log provided precise information on the measuring process, thus allowing more accurate planning.

Short training and updates via e-mail

Herbert Zisik and the other TWPT staff required very little training. During the introduction phase of OpenCNC, Zisik had already familiarized himself very well with the use of the control software and trained the other staff himself. This eliminated the time-consuming and expensive training familiar to Zisik from other MTU departments.

Herbert Zisik also appreciates the benefits of OpenCNC when it comes to maintenance and the costs involved. Software does not break down, which makes OpenCNC completely maintenance-free. If the hardware breaks down, OpenCNC can easily be installed on another PC via CD-ROM with all the customizations that have been made. If only one hardware component fails, all that is required is to visit the local PC supplier and replace it.



The control commands are sent from the image-processing PC via the OpenCNC PC (at the front) to the measuring machine.

Easy integration into the company network

But the software CNC also has another major advantage. The OpenCNC PC could immediately be integrated into the corporate network. If any adjustments need to be made to existing control routines, Zisik simply sends an e-mail to Ulf Müller and then directly installs the files sent in reply. "It really can't be any easier than that," summarizes Zisik.

Taking stock

Although Herbert Zisik had no experience at all with software CNCs, he decided to take a chance on OpenCNC, and it has been an excellent decision, he says. "It was the system's user-friendliness that especially convinced us," says Zisik. "Unlike the controls of the old machine, OpenCNC is manufacturer-independent and can easily be customized to meet our special requirements. All our wishes were fulfilled." All in all, the retrofit with OpenCNC only cost MTU a tenth of what a new machine would have cost, and the return has far exceeded what they imagined.

"OpenCNC is manufacturer-independent and can easily be customized to meet one´s special requirements."

MDSI

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