Chiseled in stone

KUKA.CAMRob enables the robot to understand CNC data

There are wood shavings on the floor. A spindle traces fine contours onto a piece of wood which gradually changes shape. A few minutes go by and the silhouette of a sports car slowly emerges from the wood. The spindle glides along it, modeling and refining the form. It is guided by a steady hand – that of a robot. The robot is transformed into a woodworking model builder with the aid of the KUKA.CAMRob software package, unveiled by robot supplier KUKA Roboter GmbH at AUTOMATICA 2006. Visitors to the fair watched spellbound as a KR 60 HA (High Accuracy) produced a wooden picture frame for a photograph that had just been taken.

Industrial companies are facing ever greater competition. They want to reduce production costs without having to compromise on quality. For this reason, new fields of application are opening up all the time for industrial robots, whose systematic on-going development allows them to establish themselves in a vast range of different markets. Compared with conventional machines, they offer high machining flexibility with lower investment costs.

A robot is an interesting prospect for many branches of industry due to its optimal combination of high payload capacity and low space requirement. It can be incorporated into a machining station or installed on a linear unit, for example. Combined with a turntable, it can also handle unwieldy workpieces.

Robots are also increasingly taking over jobs of which they were previously considered incapable. Until recently, no-one would have considered robots to be capable of milling models, as demonstrated at AUTOMATICA, for example, and nobody had thought to use them as “stonemasons” either.
However, the KUKA.CAMRob software package, paired up with the KUKA Milling application module, endows robots with precisely those capabilities that qualify them for these tasks.

With the KUKA.CAMRob software and the Milling application module, KUKA is offering the world’s first complete system for automatic CNC machining with a robot. This technology allows NC programs to be converted into robot programs. The data required by the robot for milling, grinding or drilling are provided directly by the PC. In a CAM station, the data are integrated into the CAM software by means of a 3D CAD program and the machining strategy is defined. A postprocessor uses the five-axis CNC data to generate multiple-axis robot programs.

The small test and verification program KUKA.VerifyCNC checks whether the CNC data are also available in a suitable format for the KUKA.CAMRob software. This program is a freeware software program, developed specially for KUKA.CAMRob, that can check the format of the NC programs and the program commands used in them. This means that potential customers can verify their CNC data for possible use with CAMRob before buying the CAMRob package. If the NC data pass the test with KUKA.VerifyCNC, there are no further obstacles to adapting the data with CAMRob for machining with a robot.

A key task of the CAMRob software is the adaptation of NC process programs to the specific environment of the robot. The motion strategies of a robot operated with external axes, for example, are defined in CAMRob. The workspace can be vastly enlarged by mounting the robot on a linear unit. This makes it possible for very large workpieces to be machined efficiently and cost-effectively using a single robot. A turntable can also be used to increase the workspace of a robotic machining center. Large workpieces can be optimally positioned and repositioned on the turntable for machining by the robot. But when does the linear axis move and when does the robot perform a machining motion? These process settings can be defined in CAMRob with the aid of user-friendly input menus.
The integrated simulation environment in CAMRob enables the programmer to view an “online” simulation based on his or her settings and to decide whether the motion strategies are acceptable or in need of further optimization.

Further options can be added to expand the robot system to a full-blown machining center. A tool changer allows the fully-automatic execution of extensive machining programs with roughing and smoothing processes and a range of different processing tools.

One of the major advantages of KUKA robot systems is the comparatively high degree of stiffness and accuracy. For machining processes, KUKA preferentially uses robots that have been subjected to a special, extensive calibration procedure allowing them to achieve greater path accuracy and absolute accuracy, and thus also the best machining results. This has already been ascertained in the past by customers in neutral benchmarks from the aerospace and automotive industries.

**From plastics to stone**
From plastics to wood, and from different metals to stone, robots are used to machine a wide variety of materials.

When specifying an industrial robot for machining purposes, potential customers must be fully aware of the technical possibilities. Although KUKA robots have meanwhile been optimized for machining processes, the requirements placed on them, in terms of accuracy, process forces and stiffness, must be checked for feasibility. KUKA offers extensive ranges of robots that have been specially designed for specific applications.

*Applications with plastics, wood and modeling materials:*
The KR 60 HA with its payload capacity of 60 kg is the usual choice for such applications, and is available from KUKA in a package including a milling spindle with a rated power of 8 kW. This application module has been specially tailored by KUKA to the specific requirements of these sectors.
The complete peripheral equipment (e.g. frequency converters and water cooling for the spindle, processing tools with a tool changer system, turntables, etc.) is designed using materials that are appropriate to the machining processes in question. The principal machining functions of this optimally coordinated machining package are available from KUKA as a “Plug & Play” package which can be put into operation by the end customer with a minimum of effort.

*Machining of CRP materials, cast materials and metals:*
Just as for the machining of wood and plastic materials, KUKA also offers a suitable package for higher-density materials. With a KUKA robot KR 240 AA (payload: 240 kg) or KR 500 (payload: 500 kg), a milling spindle with a rated power of 16 kW or 25 kW, and the corresponding accessories, customers receive a package that offers an excellent price/performance ratio for machining these kinds of materials.

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