

Case Study

Robots for polishing ceramic hybrid interior parts

Joint development of a high-tech solution

Georgensgmünd (D): The backlit gear stick display in a premium car is a masterpiece of design. However, since there was previously no known production method for manufacturing the required surface finish of this ceramic hybrid component, the only option was to create a new solution.

Challenging task

Aesthetics, design and functionality – the expectations of discerning buyers looking to purchase a luxury car grow with every new model. Interior designers respond to these demands by devising more and more elegant solutions, which require increasingly sophisticated production processes. It is exactly these types of challenge which Toolcraft, a company based in the German region of Middle Franconia, relishes overcoming: “We like to solve complex tasks which can’t be tackled using standard solutions. Our staff boast outstanding engineering skills and our aim is to grow by working on complicated projects together with our partners. After all, anyone can accomplish simple tasks,” says Managing Director Bernd Krebs.

The manufacture of a futuristic-looking gear stick display fitted this bill precisely. The required surface quality could not be achieved using conventional production methods. Nevertheless, leading plastics engineering company Oechsler, which has made a name for itself as a renowned supplier for the automotive industry, decided to take on the challenge. The global company, which has around 2,300 employees, commissioned systems integrator Toolcraft to perform the crucial task of polishing the ceramic surface of the display. Toolcraft in turn brought software developer Unicam and robot manufacturer Stäubli on board.

Together, the four technology companies worked on developing a polishing solution capable of being used on a production line. Thomas Wieland, Team Leader Robotics and Engineering at Toolcraft, summarises the specific requirements as follows: “When producing ceramic hybrid parts, it is essential to polish all sections of the ergonomically shaped freeform surface by applying an extremely even and continuous force. Experience has shown that this should be possible using specially developed tools, a high-precision robot and an extremely precise path planning method.” The interdisciplinary teams of specialists worked under immense pressure to develop a suitable polishing cell. Time was of the essence since the new vehicle model was about to go into production. The outcome of the teams’ efforts can be seen at Toolcraft’s production facilities in Georgensgmünd, where, for some time, four identical robot cells have been polishing displays around the clock, operated as part of a three-shift working pattern.

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A task for high-precision robots

A quick glance at the plant shows just how much knowledge and expertise has gone into the joint venture. The process and plant are currently completely unique. The centrepiece of the cell is a highly precise Stäubli TX90, which is equipped with a high-speed spindle and automatic tool change system for the polishing process.

Wieland explains why the team only considered this six-axis robot as suitable for use in the cell: "Solely the most precise robot on the market with perfect trajectory control came into question for this project. Thanks to its superior drive technology, the Stäubli TX90 alone was able to fulfil our requirements. To ensure the process runs as perfectly as possible, the robots were measured with the utmost accuracy at Stäubli's manufacturing plant in Faverges, France. This trick of the trade enabled us to achieve absolute precision."

Since it was impossible to fulfil the quality objectives set with off-the-shelf polishing tools, the project team had to use their initiative. Toolcraft's experts therefore set about developing their own customised polishing tools and prepared these for batch production. To ensure that the parts can be manufactured reliably and precisely, tool length measuring systems are integrated into the plants. Once a particular wear limit is reached, a fully automatic tool change system switches the tool in use by the Stäubli robot. This enables the plants to run with a high degree of autonomy.

The four plants each have nine processing stations on which eight different types of component can be produced. Pneumatic zero-point clamping systems are used to precisely yet gently clamp the gear stick. During the simultaneous machining of the ceramic hybrid freeform surface, the Stäubli TX90 must exert a completely even amount of force; otherwise, it is pre-programmed to reject the part.

Path programming is of crucial importance

Besides robots with excellent trajectory control, extremely precise path programming is one of the requirements for optimum polishing results. The experience of Unicam Software GmbH's programmers proved invaluable for this. Christian Grohmann, application engineer at Unicam, explains more: "We performed the complex path programming offline using the software Octopuz. We then used real-time simulations to optimise the path down to the last detail."

Here, too, the Stäubli TX90 proved more than up to the task. All of the programs, which require a great deal of memory due to their complexity, are stored on the CS8C robot controller. The controller's huge memory capacity pays off here and enables the optimum flow of data. This means that the overall performance of the robots, in terms of both their mechanical strength and efficient control technology, makes a considerable contribution to the project's success.

However, Managing Director Krebs believes that the way in which the plants now exceed all expectations with flying colours is primarily down to the people involved: "It would have been

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impossible to develop this globally unique solution without the strong working relationship between the four companies and the pooling of all our resources. Only the spirit of cooperation, the great commitment of all project participants and their ability to collaborate across companies enabled this plant design concept, for which there are no alternatives capable of being used on production lines, to be implemented.”

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