In the ATS test cell for Brüggli Industrie, a delta robot takes over the complete handling of punched parts.

Social enterprise Brüggli, which is headquartered in Romanshorn, Switzerland and employs around 650 people, concentrates on the training, re-education, and employment of people with disabilities or other handicaps. The Brüggli Industrie (industrial) division accounts for approximately half of the company's workforce and, apart from its own products such as portable dog crates and bicycle trailers, mainly offers manufacturing and assembly services in the metalworking industry. In order to be able to meet the increasingly high quality standards, despite increasing production volumes, previous visual inspections in manufacturing processes were replaced by a fully automated test cell. This was developed by ATS Automation GmbH of St. Gallen, Switzerland, who was able to supply an all-in-one solution from a single source, thanks to the company's comprehensive background in engineering, control and drive technology, and image processing.

Universal and optimally-accessible test cell

Special punched parts for the automotive industry are checked with the Brüggli system. However, the test cell was actually developed for universal use, as ATS chief executive Andreas Tobler explains: "The basic cell layout, i.e. the feeding of the parts, the test cell – with test stations and delta robot – as well as the discharge belts, is designed in such a way that other parts can also be checked with little conversion effort. The only things that have to be changed are the tool holders or suction grippers, and of course, the process or image processing software."

The delta robot takes over the entire handling of the test parts in order to check for punching and grinding errors, scratches, as well as dirt and foreign bodies in the bores. In the Brüggli system, the punched part is first removed from the feeding belt and placed in the front face test station, where it is checked by

Integrated control and drive technology for delta robot in fully automated test cell

Dynamic handling for fast and reliable checking of punched parts

As a contract manufacturer in the metalworking industry, the Swiss company, Brüggli Industrie has until now checked the punched parts that it manufactures with visual inspections. In order to improve quality assurance and reduce lead times, this has been replaced by a fully automated test cell with advanced image-processing systems for optical inspection from ATS Automation. As an integrated control system, PC Control from Beckhoff ensures precise test sequences and dynamic parts handling using delta robots.

The 19-inch touchscreen on the CP6203 built-in Panel PC offers sufficient space for a clear display of the visualization created with TwinCAT HMI software.

an inductive proximity sensor for errors due to indentations in the material. In addition, dirt is removed by vibration and with the aid of compressed air nozzles. Next is a surface inspection, which takes place on test stations for the top side and underside with a turning station in between. This produces three results, each based on 30 test criteria, which are evaluated by the image processing system and transferred as the final result to the control system. Depending on this value, the delta robot places the test parts on one of two discharge conveyors – for good parts or parts to be checked again – or in one of the lateral reject channels for faulty parts. In addition, stacks containing 11 punched parts each are formed on the "good parts" conveyor in order to be packed in the corresponding transport cartons.

One of the special features, according to Andreas Tobler, is the hexagonal cell design: "This method of construction allows all sides to be opened, improving

access to the inside of the test cell. The location of the delta robot in the center makes it possible to move the robot gripper to each position inside the cell, at any given work height. In addition, the attached test stations can be swivelled out in set-up mode, which additionally increases accessibility." Urs Buschor, Head of Technology & Training in Metal Occupations at Brüggli Industrie, adds a further aspect: "The cleaning of the system is considerably simplified and accelerated by this structure. Also, in the interest of ergonomics, the operator interface with the CP6203 built-in Panel PC can be moved very flexibly, rotating almost 360° on its mounting arm. The panel is always within reach, but not in the way, such as during maintenance work."

Kinetics library for simple and efficient engineering

The CP6203 built-in Panel PC with 19-inch touchscreen and Intel® Core™ 2 Duo processor (2.26 GHz) serves as the control computer and the HMI, with

ℹ️ At a glance

**Solutions for robotics and handling**
Control and Drive Technology for the delta robot
in a test cell

Customer benefit
Simplified engineering through integrated control system

Applied PC Control
– TwinCAT Kinematic Transformation: delivers robotics
  functionality with simple parameterization
– TwinSAFE: optimized machine safety in
  every operational state
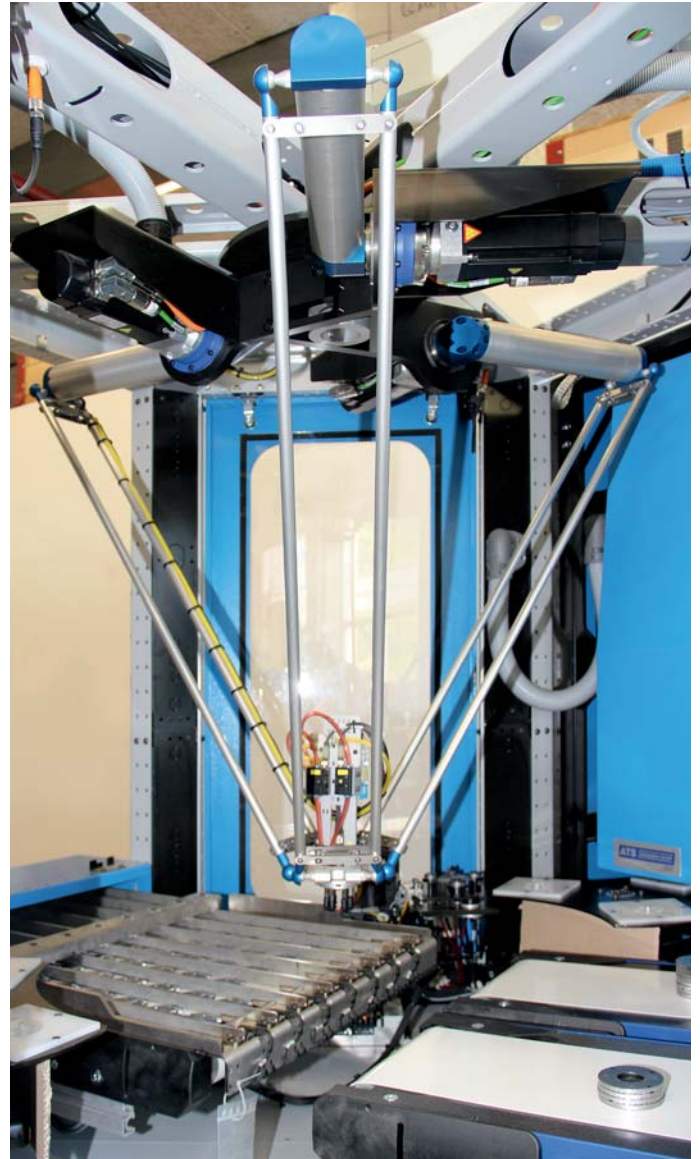
Control and Drive Technology from Beckhoff – from the CP6203 Panel PC through to the AM30xx servomotors – enables dynamic delta robot control and, thus fast and precise test sequences.

Windows XP as the operating system and TwinCAT NC I as the control software. Andreas Tobler comments: "The main advantage for us was the preconfigured robot kinematic functions, which greatly simplified the engineering process. TwinCAT Kinematic Transformation (Level 3) offers an excellent solution for a delta robot, in particular, as in our case, when it is designed for efficient parts transport at high speed and with a relatively simple mechanism. At the beginning of the development process some three years ago, Beckhoff was the only supplier with an open control system, through which all requirements could be met, with a specified kinematics module tailored to our own delta robot mechanism."

Due to the flexibility of TwinCAT, there was sufficient space for individual adaptations on the software side, as well. Thus, the positions of the delta robot are not controlled by an NC program as usual, but directly in software through the TwinCAT PLC. Andreas Tobler comments: "From a conceptual point of view, we wanted to control the complete test cell from the PLC. A special function block was programmed for this to allow the direct specification of all positions.

Apart from that, a single parameterization was sufficient for the engineering. This concept has significantly simplified the sequence control. For example, the positions can be simply moved to and fixed via the operator interface for robot teaching, without the necessity to change the NC program."

Five servo and two stepper motor axes provide dynamic implementation of the position specifications: Three dual-channel AX5206 Servo Drives move the three robot axes or the rotary tables of the two surface checking stations, accomplished via three AM3033 and two AM3022 servomotors. In addition, two EL7031 stepper motor terminals with AS1000 stepper motors control the intermediate turning station, aided by two EK1100 EtherCAT Couplers and a total of 55 EtherCAT Terminals for I/O data processing.

PC Control as the integrated control architecture

In the opinion of René Meili, developer at ATS, PC Control offers great advantages with its integrated control architecture through the integration of the robot
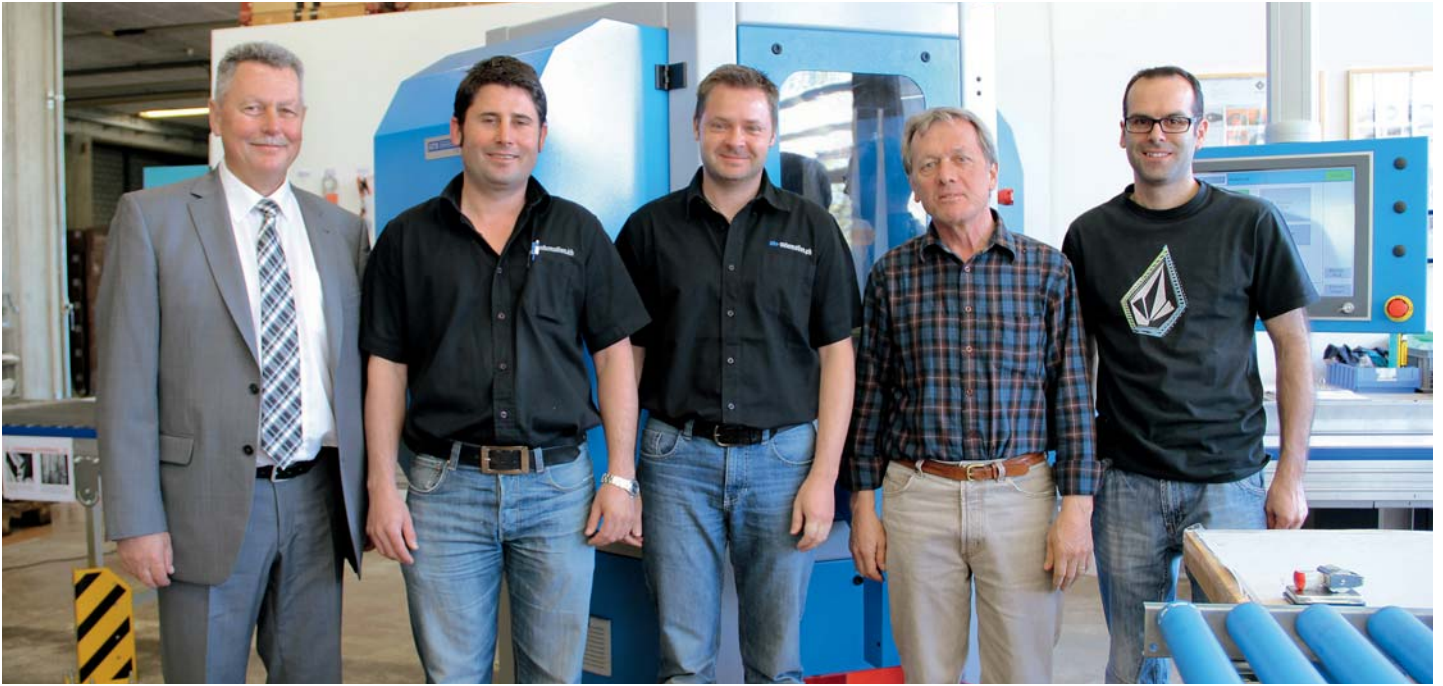
From left to right: Stefan Keller, Beckhoff Sales Eastern Switzerland, Andreas Tobler and René Meili of ATS, Urs Buschor and Giuseppe Pennimpede of Brüggli Industrie.

kinematics alone. Additionally, he notes that machine safety is also an integral component of the overall system using TwinSAFE from Beckhoff: "The Panel PC executes all control and visualization tasks, from the user-friendly operation to the delta robot. Therefore, no separate robot and safety controllers are required. This universally-integrated control architecture simplifies engineering and reduces the total cost of the solution."

Andreas Tobler confirms the advantages of PC Control: "In order to ensure optimal machine safety in every operational state, we chose the integrated TwinSAFE safety solution. This is implemented with the EL6900 TwinSAFE PLC, four EL1904 TwinSAFE digital input terminals, and an EL2904 TwinSAFE digital output terminal. In addition, there are AX5805 TwinSAFE drive option cards for the AX5206 Servo Drive. The safety functions for emergency stop (STO) and safety door monitoring were implemented in this way. We benefit here from EtherCAT, which to a large extent offers not only high performance, but also the advantage of universal data communication. Our goal right from the outset

was to acquire I/O data, solve safety challenges, and synchronize drives with one comprehensive bus system." Giuseppe Pennimpede, Quality & team manager at Brüggli Industrie, mentions a further aspect: "The use of TwinCAT HMI also offers advantages because, thanks to the seamlessly integrated visualization, the required variables are universally available without a data export or import. Accordingly, changes of variables, for example, can be carried out quickly and without error."

Further information:
www.ats-automation.ch
www.brueggli-industrie.ch
www.beckhoff.com/robotics