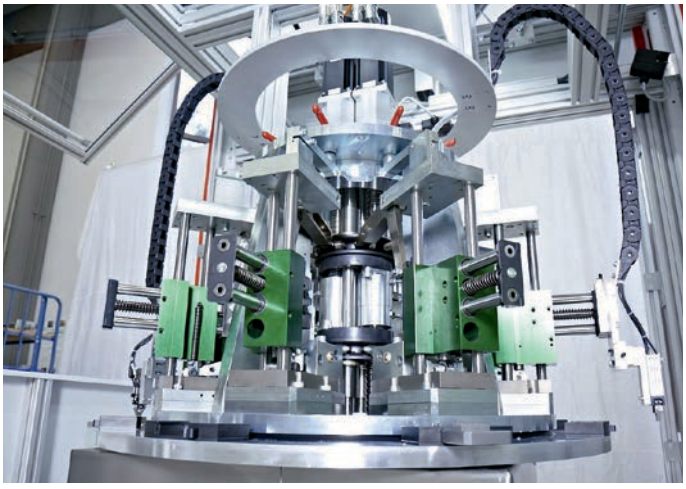
The CGM rotary indexing system presented by IMA at the Automatica 2014 trade show is particularly compact and versatile through the use of PC-based motion control.

TwinCAT 3 as control software for a rotary indexing system

Virtual master uses electronic cam plate to synchronize three-axis motion system

IMA Automation, based in Amberg, Germany, facilitates the ever-changing needs of assembly applications with a new, compact rotary indexing system, which enables up to eight assembly steps. The system offers enhanced production flexibility and, at the same time, increased operational and energy efficiency. Making these improvements possible are PC-based control technology with TwinCAT 3 automation software from Beckhoff, as well as the replacement of pneumatic drives with high performance servo drive technology.

The automotive industry is a prime example of dramatically increasing production demands, as Thomas Ernst, Technical Director of IMA Automation Amberg GmbH, states: "Cars have essentially become 'internationally-recognized works of art'. Experts estimate that the OEM contribution of parts has fallen to around 25 %, with the remainder originating from suppliers around the globe. This presents industry suppliers with a challenge: On the one hand, each new order improves plant capacity utilization. On the other hand, each order is different, i.e. even the smallest connector must be customized for individual manufacturers. In addition, there have been tremendous improvements in injection molding technology. In the past, up to nine individual components had to be assembled for a connector. Today, this number has fallen to three or four. Many existing assembly systems, such as rotary indexing machinery with 12 or 16 main workstations, are too large and inflexible for these requirements."



The CGM has eight main workstations.

Compact rotary indexing system features high assembly flexibility

IMA resolved these challenges by developing the CGM, a servo-driven rotary indexing system with eight main workstations. Thomas Ernst explains: "The CGM is ideal for companies producing small parts from a limited number of components with moderate production volumes. Target sectors include the automotive, electronics, and consumer goods industries, with custom versions for the pharmaceutical and medical sectors in development. The system is more compact and flexible, while offering increased cost-effectiveness in terms of data acquisition, operation, and maintenance when compared to comparable cam-controlled systems with 12 or 16 stations or pneumatic solutions. Feeder drives and motion are centrally-controlled in a purely electromechanical manner. When compared with pneumatic systems, this not only results in higher cycle capacity – up to 50 cycles per minute – but also reduces energy consumption."

In the CGM servo-rotary transfer machine, the three main movements of the rotary indexing table (horizontal stroke, vertical stroke and rotary movement) can be controlled freely and independently of each other via individual servomotors. This provides the system with maximum flexibility for a wide range of movements or sequential processes. "By decoupling the handling and rotary movements, we can control the waiting times between the individual stations," said Thomas Ernst, highlighting a key benefit of the drive concept. The rotary switching motion can take place at full speed, even if the pick-and-place move-

Leveraging the multi-touch functionality of the CP3919 Control Panel, a graphical rotary controller can be flexibly integrated via software.

The fanless C6525 IPC with external heat sink (left picture) is designed for space-saving installation in control cabinets.

IMA developer Hans-Jürgen Bumes said:

"The three motion axes of the rotary indexing system are synchronized using the camming function of TwinCAT 3. The existing hardware and software solution modules came in very handy."

ments are slower. The stroke lengths and sequences are freely programmable, allowing the gripping times and insertion positions to be quickly adapted to different system concepts.

Open control technology with high-performance motion control functionality

This high level of machine flexibility is achieved through the implementation of PC-based control, as IMA programmer Franz Lederer explains: "For the CGM, we benefited from the scalable and open control technology from Beckhoff, which we have used in our machines since 1997. Even in the earliest days, the key reasons for adopting the technology were the openness to interface with higher-level systems, which is typical for PC-based systems, the wide range of I/O components, and high-performance data communication, which at the time was still based on Lightbus. Key features of the new CGM rotary indexing system include the exceptionally compact design of the control components, short control and reaction times, and the flexibility to implement different encoder systems."

Another significant aspect was the availability of high-performance hardware and software solutions for motion control applications. IMA developer Hans-Jürgen Bumes said: "The three motion axes of the rotary indexing system are linked and synchronized via a virtual master, a benefit of the camming function (cam plates) provided by TwinCAT 3 automation software. The existing hardware and software modules came in very handy, especially since TwinCAT facilitates flexible and efficient engineering. EtherCAT, the open, high-speed fieldbus, provides the ideal communication infrastructure as an established and widely-used standard for third-party devices and components."

The fanless, built-in C6525 IPC is the centerpiece of the control system. The system is operated via a CP3919 multi-touch Control Panel, which is connected via DVI/USB Extended. The multi-touch panel offers a 19" screen, as well as software implementations for traditional operator control elements, such as buttons and control knobs. The I/O level consists of EK1100 EtherCAT couplers, EL1819 (16-channel digital input) and EL2809 (16-channel digital output) HD EtherCAT Terminals, as well as EL2008 (8-channel digital output) and EL2024 (4-channel digital output) EtherCAT Terminals. An EL6851 DMX master terminal is used for LED lighting control and operating status display.

TwinCAT 3 for high performance axis synchronization

On the software side, IMA uses TwinCAT NC PTP (for point-to-point motion). The core functionality is motion control via the NC Camming library, as well as an axis function block that specifies the associated movements through curves and a virtual master axis. The curves for the axes are automatically generated as a jerk-optimized profile, based on a predefined algorithm with a selection of target points, and then loaded into the NC. Specifically, the procedure utilizes motion functions, and the individual motion laws and points are rewritten cyclically.

The operation is facilitated by TwinCAT PLC HMI, a tool for visualization created in the TwinCAT PLC engineering environment. It can be used to parameterize the CGM motion control functionality in tabular form, so that completely different motion sequences can be affected simply by changing the parameters (target points), without the need for reprogramming. The different curves are processed sequentially, as defined. Several sequences (movements) can be predefined, then simply selected.

Further information:
www.ima-automation.de/en
www.beckhoff.com/TwinCAT3