



Dr. Guido Beckmann,
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Interview with Dr. Guido Beckmann on the advantages of the ATRO modular industrial robot system

Modularity for maximum flexible robotics

The new ATRO (automation technology for robotics) system from Beckhoff is a modular industrial robot system that can be used to custom-build the ideal robot structure for any application, thus offering great flexibility. Dr. Guido Beckmann, Senior Product Manager for ATRO, explains how this was achieved and the user benefits that it provides in this interview.



With ATRO, a robot solution can be precisely adapted to the task at hand with any number of axes, and will be freely scalable, modifiable, and expandable.

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As active drive elements, the motor modules form the core of the ATRO system. Can you explain what sets them apart in detail?

Dr. Guido Beckmann: That's right, the standardized motor modules have integrated drive functionality and so are ultimately responsible for the kinematics. Different designs are available as either straight I-shaped modules or angled L-shape modules, and these both come in five power classes. Each power class, in turn, can be configured with different transmission ratios. These decentralized EtherCAT drive modules each constitute a highly dynamic servo drive for each individual axis of the robot – i.e., all the electronics for controlling the axes are built into the modules in the form of an EtherCAT-based 48 V servo drive, the motor with dual encoder and brake, and a highly compact gear unit. This saves space in the control cabinet.

What do the passive link modules do?

Dr. Guido Beckmann: It is only when combined with the link modules in different designs and lengths that the motor modules enable the user to create a custom robot configuration with a multitude of options for the mechanical design. The shape and length of the link modules are variable, so the reach of a robot configuration can be adapted, or multi-arm kinematics can be created using T or X modules. The modules are also used for mechanical adaptation of the different motor module sizes, which generally become smaller from the main axes to the wrist axes. Electrically, the link modules also represent EtherCAT devices that can be recognized and read by the controller, allowing the entire robot structure to be scanned automatically.

Doesn't this modularity also make assembly trickier and require more effort?

Dr. Guido Beckmann: No, because all modules can be linked to each other easily via the ATRO interface, which guarantees a fixed, screw-type connection. The modules can be screwed together by the user in just a few minutes to form the mechanical structure of the desired robot kinematics. In this way, even large robots can be built by a single person, piece by piece, with only a single tool needed for assembly.

The field of robotics involves the transportation of various media. How is this achieved with ATRO?

Dr. Guido Beckmann: Various types of media are fed through all ATRO modules internally, including EtherCAT, a Gigabit Ethernet interface, power (230/480 V AC or 600 V DC), and fluids (compressed air, vacuum, and water). These media are fed into the base module before being passed through the ATRO kinematics and can be decoupled and reused at the ATRO interfaces. This means that any robotic tool can be integrated at the end effector, including electric, pneumatic, and vacuum grippers, or else a camera can be connected via the Gigabit Ethernet interface, which is used for process monitoring or object detection. Conventional robotic solutions will route these media externally and are therefore limited in terms of rotation and use of the workspace. This limitation is completely eliminated with the Beckhoff solution, since all axes are designed to rotate endlessly, which allows for a much better Cartesian reach as well as for short positioning paths. Furthermore, interfering contours (due to externally located cables, for example) and interfering torques, particularly for cobot applications, are prevented by eliminating external media feeds.

What are the advantages of adaptable robotics in terms of sustainability?

Dr. Guido Beckmann: The most sustainable aspect of this new system is that only the axes that are really needed for the application are installed. Because, ultimately, not every application requires a 6-axis serial jointed-arm robot. Palletizing tasks can be resolved with five degrees of freedom, and pick-and-place tasks can often be executed with four degrees of freedom or with the help of 3-axis delta kinematics. In 2022, approximately 200,000 6-axis robots were installed worldwide. We assume that around 40% could have performed just as well with a 5-axis system. For a straightforward pick-and-place application, this would suffice; in fact, even fewer axes are required in some cases. This would have saved the users around 100,000 axes, which equates to 20,000 5-axis robots.

How can ATRO increase efficiency in terms of control technology?

Dr. Guido Beckmann: To date, one of the main tasks in robot integration has been mastering the interfaces between the control systems. This usually requires a lot of effort (up to 80% of the programming work) that does not add value. In the ATRO system, a PC-based control platform with the TwinCAT automation suite performs all these tasks while helping to ensure that all processes work in sync with each other and that data is available to all processes simultaneously. This also makes sophisticated applications possible, as the combination of line control, vision, and robot control, for instance, can be used to separate products using sorting processes (bin picking). Machine learning functionalities in the controller can aid movement optimization and path planning. Since all axes of the ATRO system can rotate endlessly, this unique feature provides the perfect

foundation for optimization, as it eliminates any restrictions in motion. Finally, there is no external robot controller needed, which significantly reduces the space required in the control cabinet.

Are there other advantages for robotics users from an economic point of view?

Dr. Guido Beckmann: The main economic advantage for the user is that, for the first time, the robot has been created using the application as the starting point rather than the other way around, as was previously the case. The customer only needs to buy what they need, and doesn't have to simply buy what is available on the market. With our system, we can guarantee that the customer can always put together the most efficient solution for their application. Using the same motor and link modules in different combinations also reduces variance in inventory management, thereby reducing costs and increasing flexibility at the same time. In the event of a malfunction, individual modules can be replaced quickly instead of having to have the entire robot serviced by an external specialist, as was previously the case. This reduces MTTR (mean time to repair) times, which equates to an increased machine availability in the application.

This interview was conducted by Stefan Ziegler, Editorial Management PR, Beckhoff Automation

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