BECKHOFF New Automation Technology

MATLAB® and Simulink® in real time: efficient engineering with TwinCAT 3

TwinCAT 3: the software building block for PC-based control from Beckhoff

As a leader in PC-based control technology, Beckhoff offers with TwinCAT a globally established modular software platform for powerful and highly flexible automation solutions. Thanks to the bundling of control intelligence in the software, all performance potentials and interfaces of the PC world can be fully exploited. TwinCAT 3 integrates all essential automation tasks into the overall control system, from PLC, motion control, robotics, vision, IoT and analytics to safety and the HMI. In addition to classic PLC programming in accordance with the IEC 61131-3 standard, TwinCAT supports C/C++, MATLAB®, and Simulink®. It also supports environments like MapleSim, Dymola and SimulationX via the Functional Mock-up Interface (FMI). And thanks to its modularization of software components, which does not depend on programming languages, TwinCAT supports heterogeneous teams of developers with standardized interfaces.


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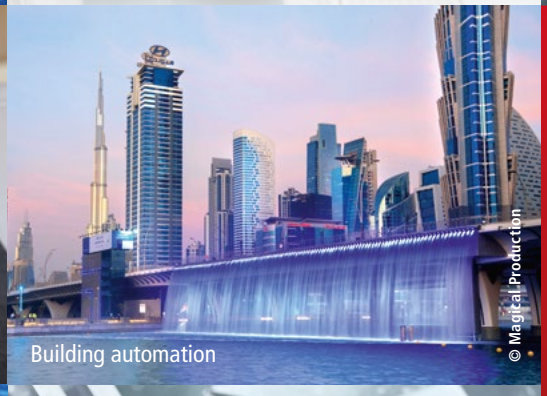
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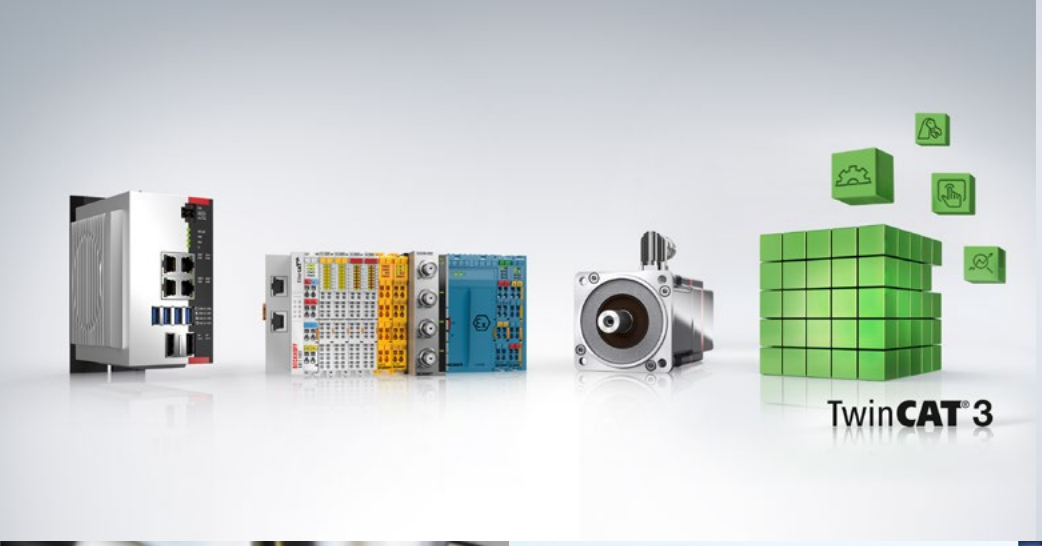
TwinCAT: The established software platform …

20 years
30 industries
75 countries
5,000 customers
20,000 applications
250,000 controllers

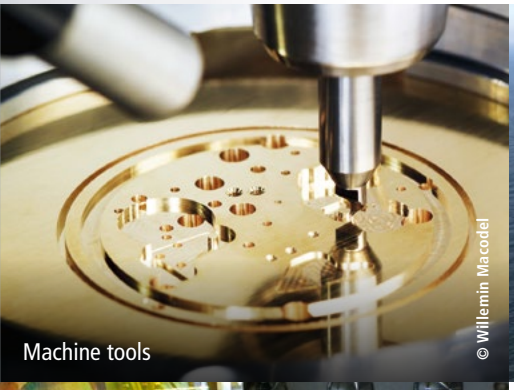
… in connection with MATLAB®/Simulink®:

- Used by more than 2,000 engineers
- In use on more than 6,500 TwinCAT machines



The advantages of TwinCAT:

- bundling of control intelligence in software
- performance improvements of PC technology become fully usable for control tasks.
- all PC interfaces can be used from within the PLC: USB, serial, TCP/IP, Ethernet, PCI Express
- integration of all major control functions on a single platform
- simplified IoT connectivity
- simplified engineering
- optimized runtime
- free support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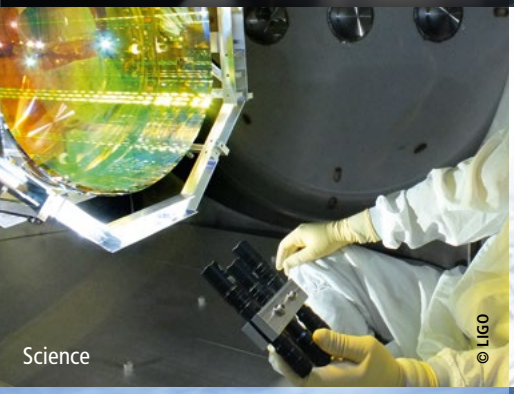
Printing industry © Beckhoff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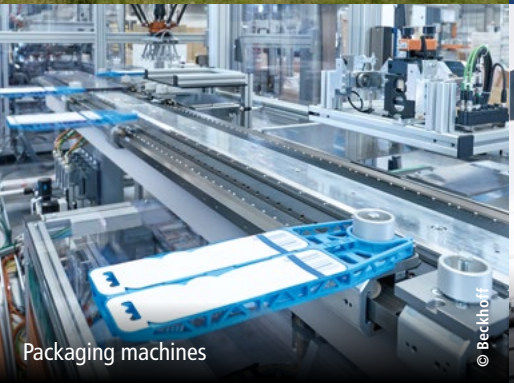
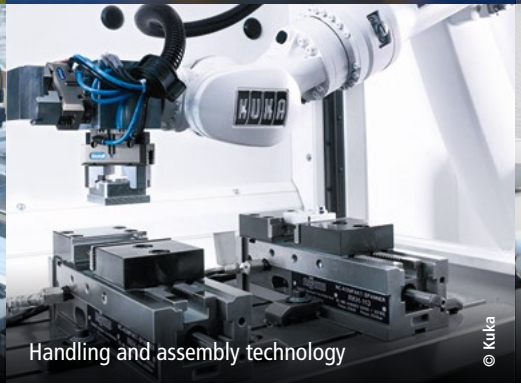
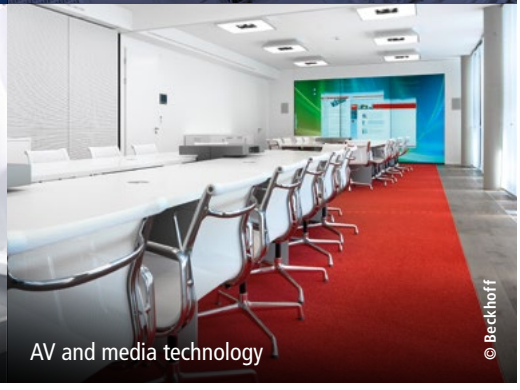

Packaging machines © Beckhoff



Handling and assembly technology © Kuka


AV and media technology © Beckhoff

Scalable and modular: hardware for MATLAB® and Simulink®

The broad spectrum of customers and applications demonstrates that Beckhoff offers a consistent and flexible modular system that can handle virtually anything. Beckhoff industrial PCs provide a scalable platform for both TwinCAT and other software applications because the devices can run a complete Windows- or BSD-based operating system along with the TwinCAT runtime environment. A high-performance communication protocol (ADS) connects the TwinCAT runtime environment with local operating system applications or remote applications over the network. The system's openness and flexibility are always at the forefront: in addition to EtherCAT, Beckhoff supports various other fieldbus systems for connecting inputs and outputs as well as motors. The fieldbus provides a real-time connection between TwinCAT and all fieldbus participants. Since Beckhoff offers a modular I/O system, the right set of input and output signals can be found for every application, while scalable servo drives and motors make it possible to select the perfect performance class and design for any application. Other drive types from Beckhoff, such as the XTS and XPlanar, enable new solutions in product transport – all fully integrated into the Beckhoff system.

IPC

- scalable performance, from Intel Atom® to Core™ i to Intel® Xeon®
- Industrial control cabinet PCs
- Embedded PCs
- Control panels
- flexible form factors
- maximum storage media flexibility
- wide range of interfaces and screen sizes

I/O

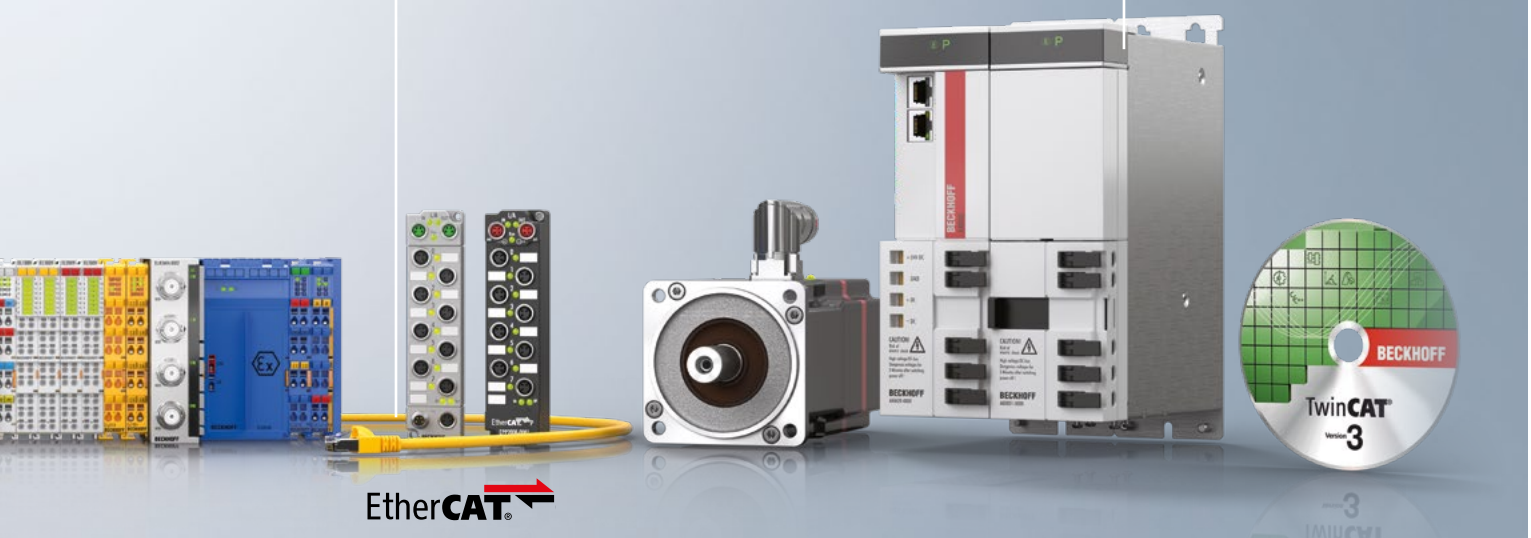
- Beckhoff is the inventor of the bus terminal principle
- more than 1,000 bus terminals, more than 100 signal types
- IP 20, IP 67, Ex
- Fieldbus and EtherCAT box modules, EtherCAT plug-in modules
- specific I/Os for motion control, safety, measurement technology, or condition monitoring and power monitoring

EtherCAT

- developed by Beckhoff: the EtherCAT Ethernet fieldbus
- fastest industrial Ethernet technology for all application areas from PLC to motion control to safety
- EtherCAT G: 1 Gbps transmission rate of standard Ethernet
- EtherCAT G10: 10 Gbps transmission rate of standard Ethernet; enables the implementation of extremely powerful controllers
- EtherCAT P: Ultra-fast communication plus power over a single cable
- across great distances: EtherCAT topologies distributed over kilometers support demanding applications

Motion

- scalable product spectrum for servo drive technology
- integrated safety technology guarantees safety performance level PLe; with compact drive technology up to safety performance level PLd
- as a pioneer in One Cable Technology and linear transportation systems, Beckhoff is a specialist for efficient, space-saving motion solutions
- XPlanar: Planar motor drive system for floating product motion with up to six degrees of freedom
- XTS: Linear transport system

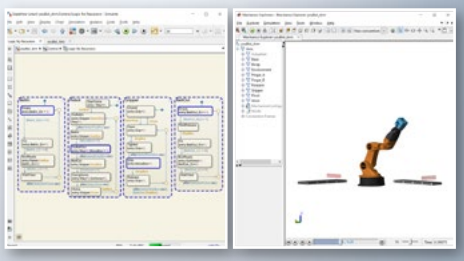


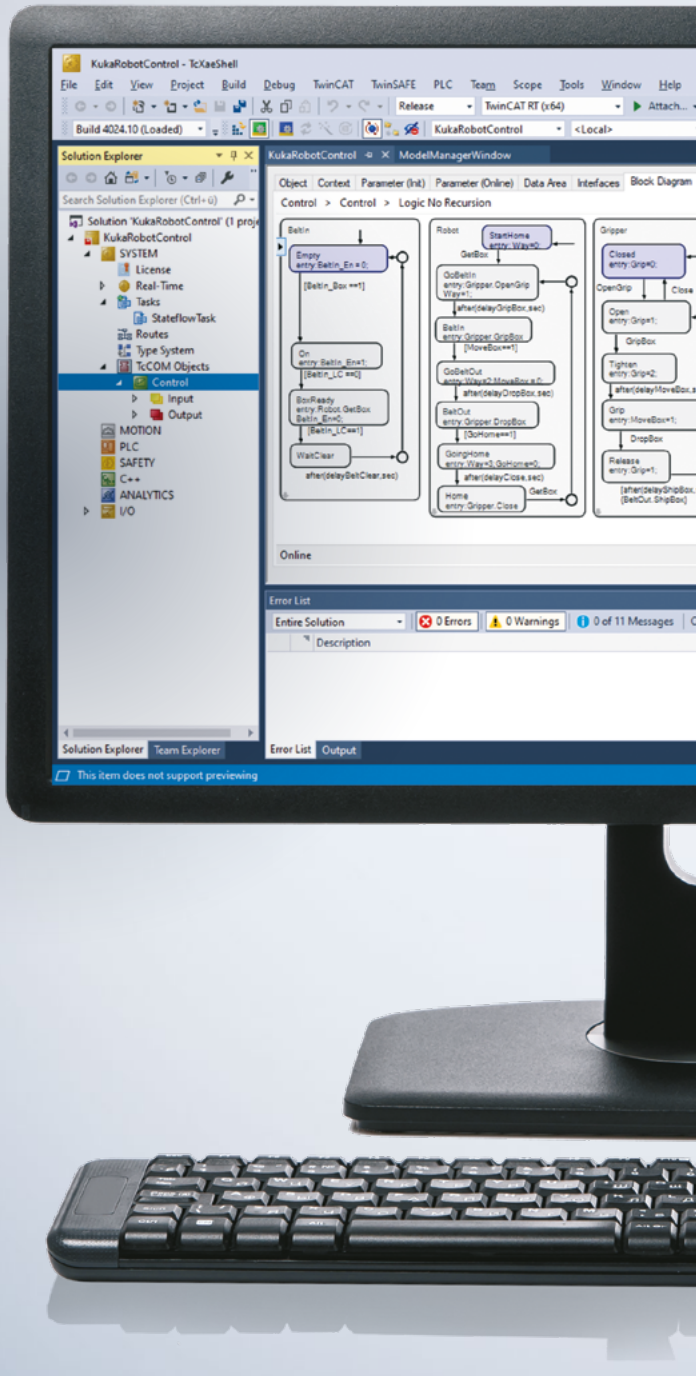
MATLAB® and Simulink®: established programming standards

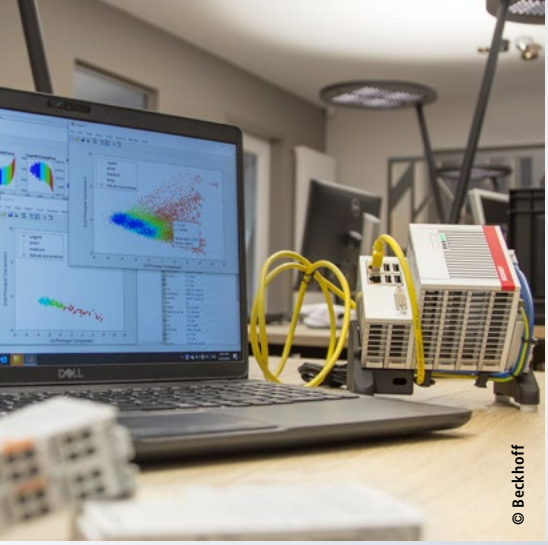
MATLAB® and Simulink® have developed into established environments for a wide range of applications worldwide, including amongst aspiring engineers. There are many reasons for this, they provide environments that allow you to focus on the engineering task, making them ideal for teaching and efficient for industrial applications. With its numerous toolboxes, MATLAB® provides an ideal environment for developing algorithms and analyzing data. It also offers multiple functions for easy access to different data formats. Model-based development has become an essential building block for digital transformation and Industrie 4.0. MATLAB®, Simulink® and ThingSpeak™ are successful in machine and plant engineering for modelling, simulation, and data analysis. The automatic code generation for industrial controllers from Beckhoff makes them even more attractive. Simulink® focuses on the integrated support of model-based design (MBD), i.e. the development, testing and verification based on a system model. The subsequent automatic generation of code for platforms such as TwinCAT is ideal for applying the tested code in production. Simulink® provides everything you need for modelling multi-physics simulations and creating open-loop, closed-loop, and AI algorithms. This ensures that only high-quality code tested on models is used on your controllers.

SIMULINK®

Model-based design
Modeling and simulation of systems, model-based development of control code, and early testing and verification – all seamlessly integrated into TwinCAT





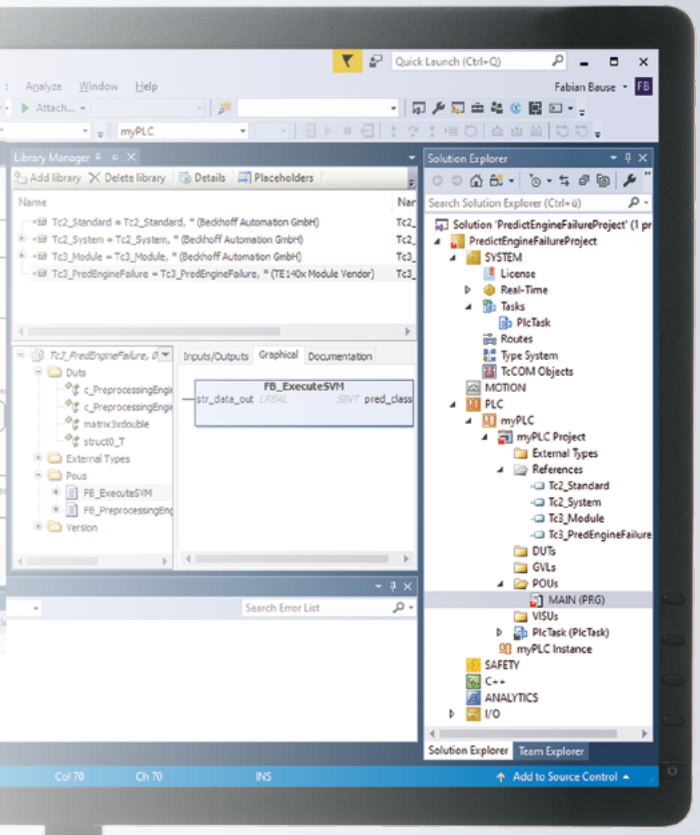

© Beckhoff

Model-based development with MATLAB®, Simulink®, and ThingSpeak™:

- early verification of software functionality through simulation
- virtual commissioning based on physical models
- direct import of CAD models
- development and testing of control software and process logic
- implementation and training of AI algorithms
- automatic generation of real-time-capable C/C++ and IEC 61131-3 code
- analysis of measurement and process data

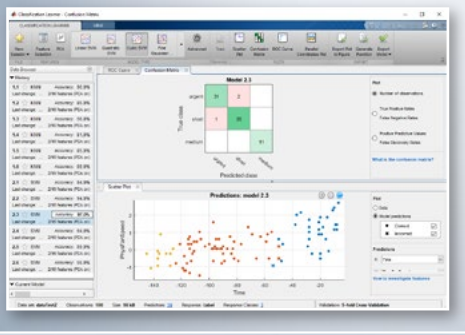
» Model-based development has developed into an essential building block for the digital transformation and Industrie 4.0. MATLAB®, Simulink® and ThingSpeakTM are successfully used in machine and plant engineering for modeling, simulation, and data analysis. The automatic code generation for industrial controllers from Beckhoff makes them even more attractive. «

Philipp Wallner
Industry Manager at MathWorks



MATLAB®

Technical computing
Reading, visualization and analysis of data; development of algorithms; creation of mathematical models – all seamlessly integrated into TwinCAT 3.



Target for Simulink®: seamless model-based design

With the TwinCAT 3 Target for Simulink® you can make models that were developed in Simulink® usable in TwinCAT 3. You can also integrate various toolboxes in Simulink®, such as SimScape™, Stateflow™, or the DSP System Toolbox™. Embedded MATLAB® function blocks are supported as well. The models are automatically translated into C/C++ code with the Simulink Coder™ and converted into TwinCAT objects with the TwinCAT 3 Target for Simulink®. TwinCAT objects created in Simulink® have the same properties and interfaces as all other TwinCAT objects. They can be seamlessly used in TwinCAT 3 Engineering. For example, you can expand them into a complete project with PLC source code, debug them, and link them to fieldbus modules. The block diagram visualization gets transferred from Simulink® to TwinCAT Engineering. In addition to the Simulink® External Mode, the block diagram embedded in Engineering can be used as a control for parameter adjustment, debugging, signaling, and status monitoring. The automatically generated modules can be integrated into the TwinCAT solution as TcCOM objects or as PLC function blocks. The inserted modules are downloaded to the TwinCAT 3 runtime environment with the entire TwinCAT project and executed in the real-time environment like all other objects. TwinCAT objects

can also be assigned to different CPU cores within the real-time environment. This makes it easy to scale even large projects, for example when simulating an entire wind farm. If speed is required in individual objects, computations can also be run in parallel in multiple cores. As a result, a single tool can support applications ranging from simple closed-loop controllers to entire machine controllers to real-time simulations.

▶ **www.beckhoff.com/TE1400**

Advantages of Target for Simulink®:

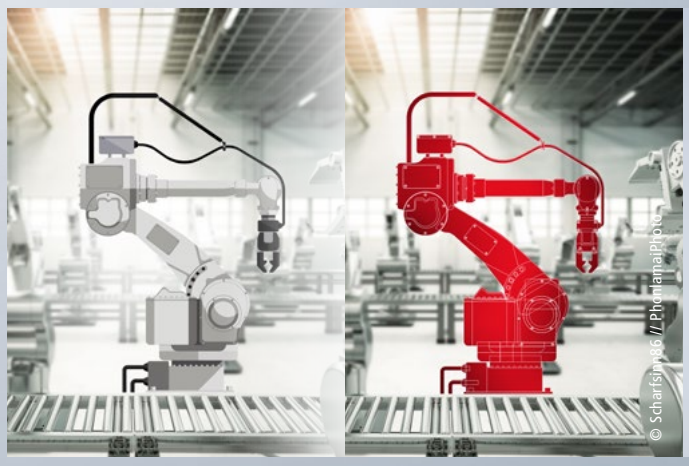
- seamless integration in TwinCAT
- translation of real-time-capable TwinCAT objects
- functions can be bundled in your own TwinCAT library
- support for continuous integration
- seamless debugging in TwinCAT
- online changing of modules libraries
- block diagram control in TwinCAT
- multi-core support

Renewable energy sources

In the area of wind power, tidal power and smart grids, the demand on the quality of the systems are especially tough. For example, the electrical and mechanical loads on wind turbines must be determined and evaluated over their 20-to-30-year life cycle. Furthermore, some of the network operators' requirements can be proven only with simulations – failure cases must be inspected and load calculations validated. Accordingly, designing new installations begins with models containing the systems' control codes. As a result, the model-based development process is very common in this industry. It should therefore come as no surprise that the validated control code is also used as-is in the system controller, which can be seamlessly accomplished with Target for Simulink®.

Automobile industry

In this industry, model-based design is the only way to successfully master the ever-increasing demands of customers and governmental authorities in complex technical systems. Accordingly, the immense penetration of MATLAB® and Simulink® in this industry is not surprising, with applications ranging from wind tunnels to HiL test beds to complete simulators and trucks, passenger vehicles, and racing cars. The application field for controllers and control platforms of the type that TwinCAT combines in a unique manner is highly diverse. The openness of Beckhoff control technology, combined with the performance of EtherCAT and industrial PCs, is a particularly attractive and widely used basis for operationally and financially successful applications in the automotive environment.



Digital twins

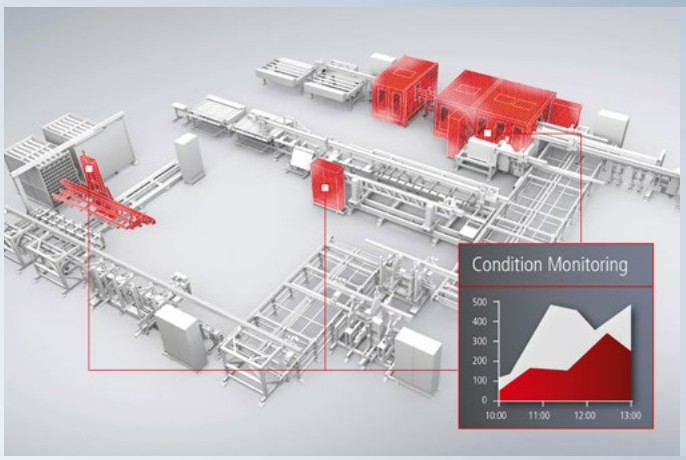
Model-based design is a key factor for the success of Simulink®. A digital twin recreates the behaviour of a physical installation in a model. During the development phase, the model represents the requirements profile, while virtual commissioning reduces the danger of unforeseen complications and allows the user to optimize the control code. With TwinCAT and Target for Simulink®, behavioural models of an installation can be executed in real time on an IPC. Thanks to the scalable performance of Beckhoff's industrial PCs, a digital twin can be operated on the same system controller in parallel with the actual control code. While the machine is running, the digital twin can then be used to detect anomalies or to further improve the equipment.

Target for MATLAB®: data science in control

With TwinCAT 3 Target for MATLAB®, you can use MATLAB® functions in TwinCAT 3. The functions are automatically converted into TwinCAT objects and used seamlessly in TwinCAT Engineering. The automatically generated modules can then be integrated into the TwinCAT solution as TcCOM objects or as PLC function blocks. The inserted modules are downloaded to the TwinCAT 3 run-time environment with the entire TwinCAT project and executed in the real-time environment like all other objects.

Advantages of Target for MATLAB®:

- seamless integration of MATLAB® functions and classes in TwinCAT
- translation into real-time-capable TwinCAT objects
- functions can be bundled in your own TwinCAT library
- support for continuous integration
- seamless debugging in TwinCAT
- online changing of modules libraries
- MATLAB® code control in TwinCAT
- support for parallel computing



Predictive maintenance

A condition-oriented maintenance strategy focuses on a plant's high and predictable level of availability, making it one of the most important parameters for increasing overall equipment effectiveness (OEE). The Predictive Maintenance Toolbox™ from MathWorks is an ideal solution for developing condition indicators and making predictions. The integration of its algorithms into the PLC allows for synchronous access to all relevant machine data. Since the monitoring system is transparently integrated into the controller, it is not a separate black box solution.

Machine learning

A support vector machine, a decision tree or a neural network running directly in the controller? No problem with Beckhoff. Classifiers carry out product tests synchronously and directly in the controller or detect faults in the production equipment. Regression algorithms implement virtual sensors, parameterize a system according to the situation, or are embedded directly into the control loop for model-predictive closed-loop control. The algorithms are trained outside of the TwinCAT real-time environment and can be exchanged on-the-fly while the machine keeps running.

Testing and measurement technology

The direct integration of testing and measurement technology into the machine controller reduces the complexity and cost of testing systems, simplifies the engineering, and speeds up the testing processes. The Beckhoff I/O portfolio delivers the raw data to the controller, where it can be stored in databases for documentation purposes or get (pre) processed in the real-time environment. MATLAB®'s extensive signal processing algorithms, also in combination with integrated simulation models for HiL testing, form an outstanding basis for building integrated, modern and powerful testing systems.

Tools for work-flow automation and optimization

The provision of Targets for transferring MATLAB® or Simulink® code into TwinCAT objects forms the basis for efficient engineering in conjunction with Beckhoff products. Further solutions deepen the link between Beckhoff and MathWorks.

The TwinCAT 3 Target for Embedded Coder provides even more far-reaching possibilities for code optimization and adjusting the automatically generated code. In addition to combining MATLAB® and Simulink® modules in your TwinCAT solution, you can also use TwinCAT 3 Target for FMI to integrate TwinCAT objects from simulation environments such as MapleSim, Dymola, or SimulationX.

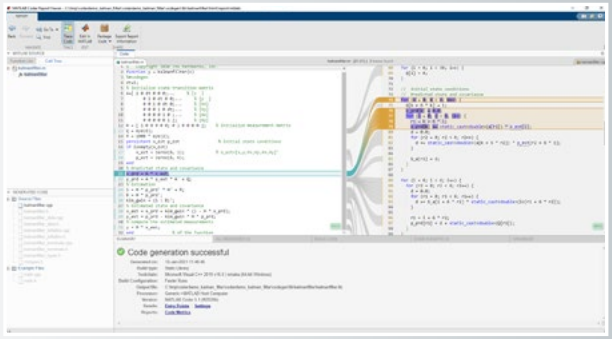
The TwinCAT Automation interface provides an interface to the TwinCAT Engineering environment (XAE) that can be operated from within MATLAB®, enabling your continuous integration process. Automatically create instances of your generated TwinCAT objects, combine them in your configuration, and start TwinCAT without a single mouse click in TwinCAT Engineering.

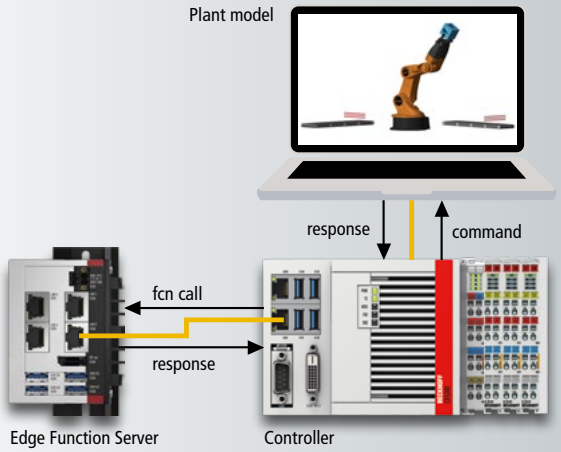
Model-based development is a critical factor for success in many areas of automation. The interface for MATLAB®/Simulink® accelerates your engineering by providing communication modules for software-in-the-loop simulations. In addition, Beckhoff

Target for Embedded Coder
Support for the Embedded Coder provides extensive optimization options for the Simulink® coder and the MATLAB® coder. This applies to the control of generated functions as well as to the integration of legacy code and data types. With regard to the performance of the code, you can insert command set extensions (SIMD) for the specific CPU architecture. Traceability reports and code documentations are also supported.

Interface for MATLAB®/Simulink®
Use this product to create highly effective, bidirectional communication between the TwinCAT runtime and MATLAB® or Simulink®. During the engineering phase, you can use the tool for software-in-the-loop simulation. During the machine runtime, a simple tool for distributed computing is provided – call up MATLAB® functions from within TwinCAT. MATLAB® functions can be executed locally on the controller or on the network, for example to optimize parameters or for predictive maintenance. You can also create machine visualizations based on MATLAB® apps. Display relevant process data within the app and issue user-defined commands.

▶ **www.beckhoff.com/TE1410**





supplies with its TwinCAT 3 EtherCAT Simulation a product for hardware-in-the-loop simulation.

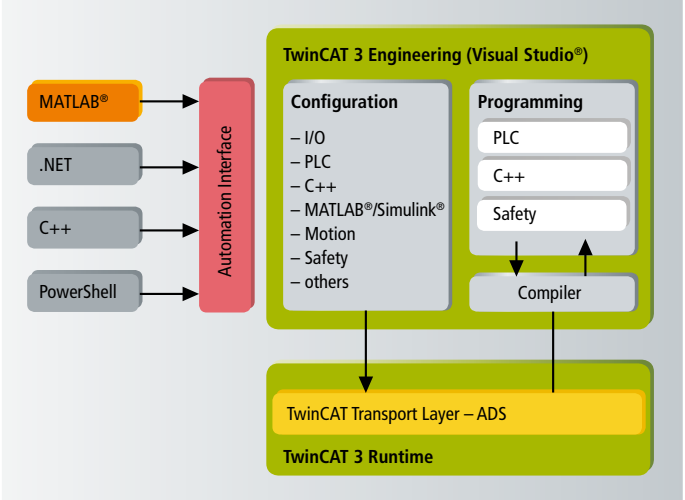
When the machine runs, the interface for MATLAB®/Simulink® supplements the TwinCAT runtime with an interface to the MATLAB® Compiler Runtime (MCR). Combine functions in the TwinCAT real-time environment with functions that are executed in the MCR. TwinCAT IoT also provides you with an interface to the ThingSpeak™ IoT platform. Aggregate and work with data anywhere and create holistic analyses of your machines worldwide – all with the familiar capabilities of MATLAB®.

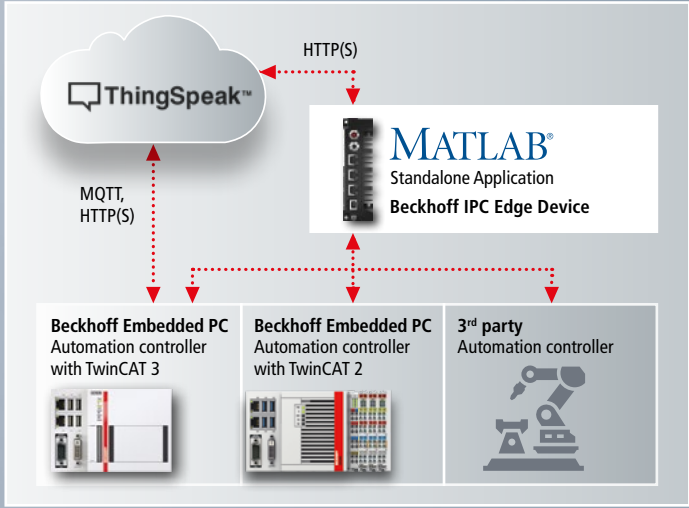
MathWorks Partner

TwinCAT Automation Interface
By enabling the completely remote control of the TwinCAT Engineering environment, the Automation Interface makes it possible to automatically create programs and configurations via a scripting language, such as MATLAB®. Create or update your TwinCAT solution automatically directly after converting your Simulink® or MATLAB® code into a TwinCAT object. Create and activate automatic test runs in TwinCAT to improve the quality of your solution. Use your TwinCAT know-how to develop a complete solution from within MATLAB® and Simulink®. Automating the project creation speeds up the engineering process and improves the quality of the resulting software.

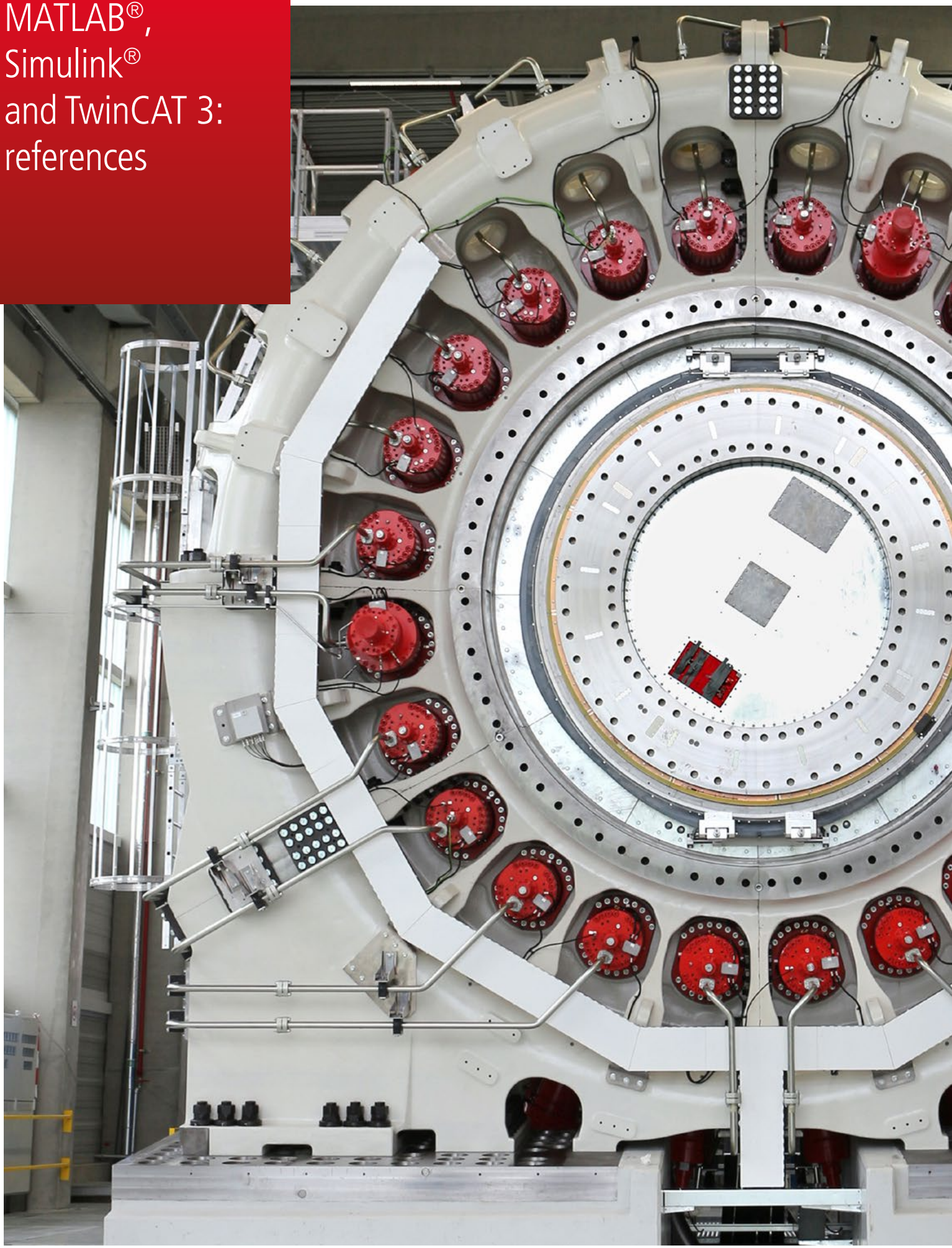
TwinCAT IoT
Create bidirectional communication between the ThingSpeak™ IoT platform and TwinCAT. ThingSpeak™ is a powerful cloud-based environment for running MATLAB® code. By directly connecting to the TwinCAT real-time environment via HTTP(S)/REST or MQTT, data can be sent and processed directly from the controller to ThingSpeak™, and corresponding evaluations can be shared directly with TwinCAT. ThingSpeak™ visualizations for the representation of machine data can be seamlessly integrated into the TwinCAT HMI so that there is always full transparency on the machine with regard to data and evaluations.

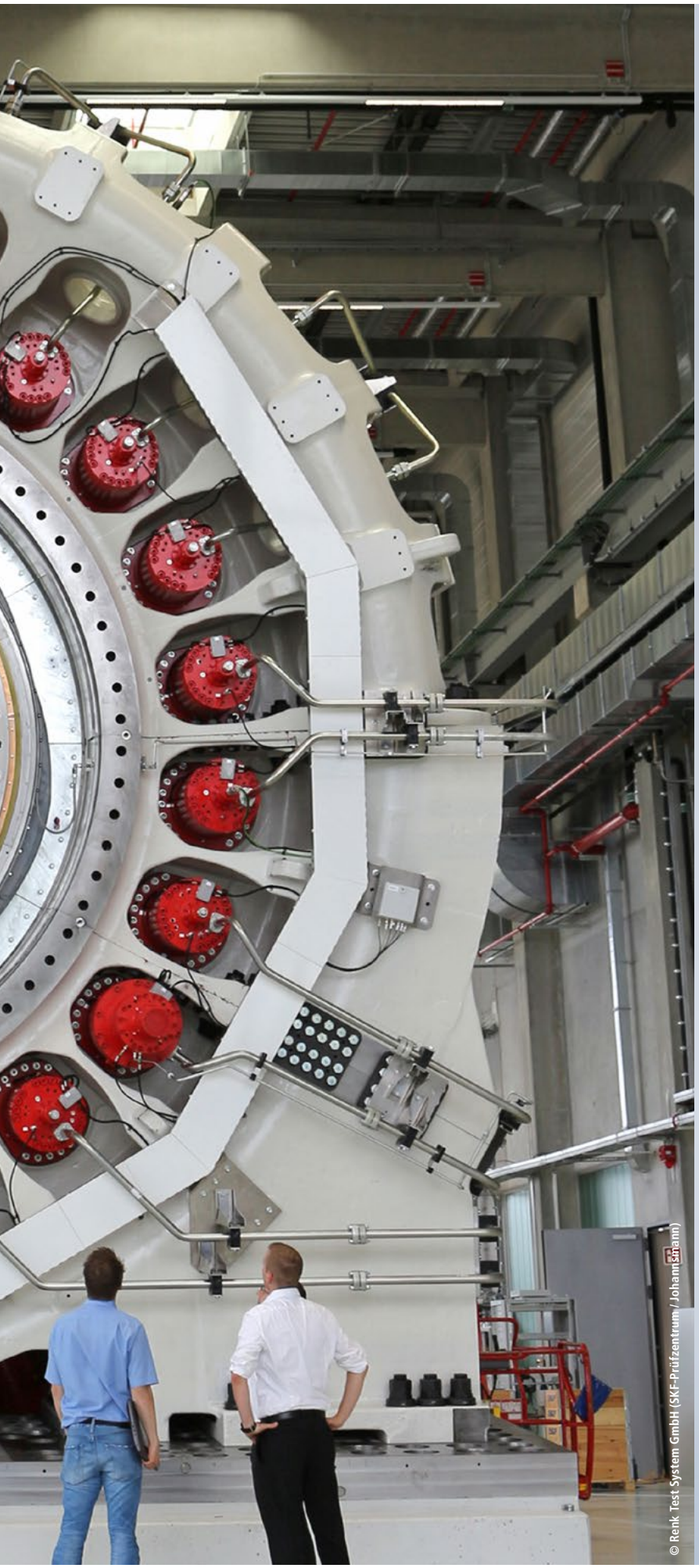
▶ www.beckhoff.com/IoT





MATLAB®, Simulink® and TwinCAT 3: references





RENK Test System GmbH

Using leading-edge automation, the world's most powerful large bearing test stand at SKF tests wind turbine main bearings with a diameter up to 6 meters.

What was the challenge?
The highly complex control system was developed and tested in MATLAB®/Simulink® and should not be reprogrammed in the controller. The test bench is a custom-made product, so the control cannot be tested on a prototype.

How did you solve this?
Automatic code generation and integration of the controller developed in MATLAB®/Simulink® into the test bench control (Rapid Control Prototyping) as well as virtual commissioning of the controller on a model of the machine.

What commercial benefit could you gain?
Reduction of risks due to malfunctions during commissioning. Reduction of the commissioning time and, thus, the costs.

How did the TwinCAT 3 Targets help you master the challenge?
Easy integration of Simulink® models in TwinCAT 3 software enables PLC- and Simulink®-engineers to work closely together. The generated TwinCAT Objects integrate seamlessly into the complete Beckhoff Automation system.

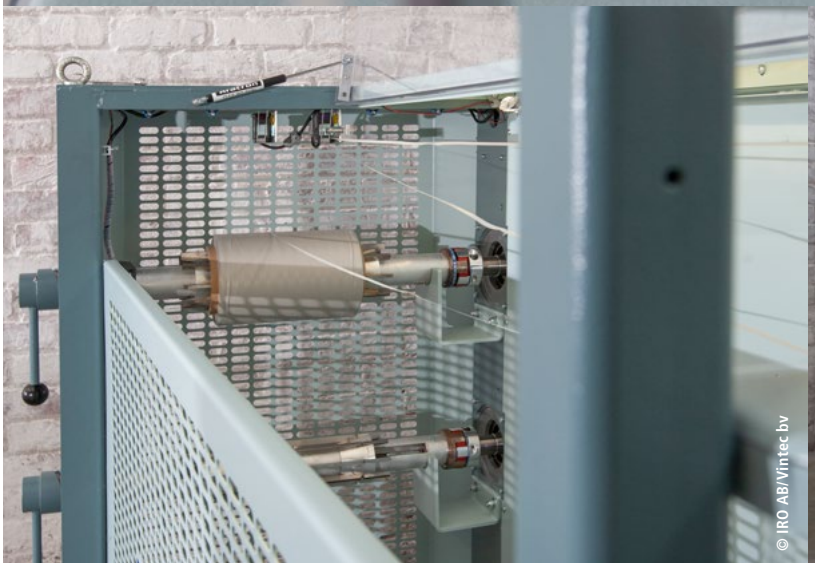
How did the Beckhoff system in general help you master the challenge?
The RENK Dynamic Data System (RDDS.NG) is a RENK proprietary product and is used for test bench control, data acquisition and visualization. RDDS uses Beckhoff hardware for I/O. Furthermore, TwinCAT 3 handles the calculation of the application created with RDDS.NG in real-time (TcCOM module and task).

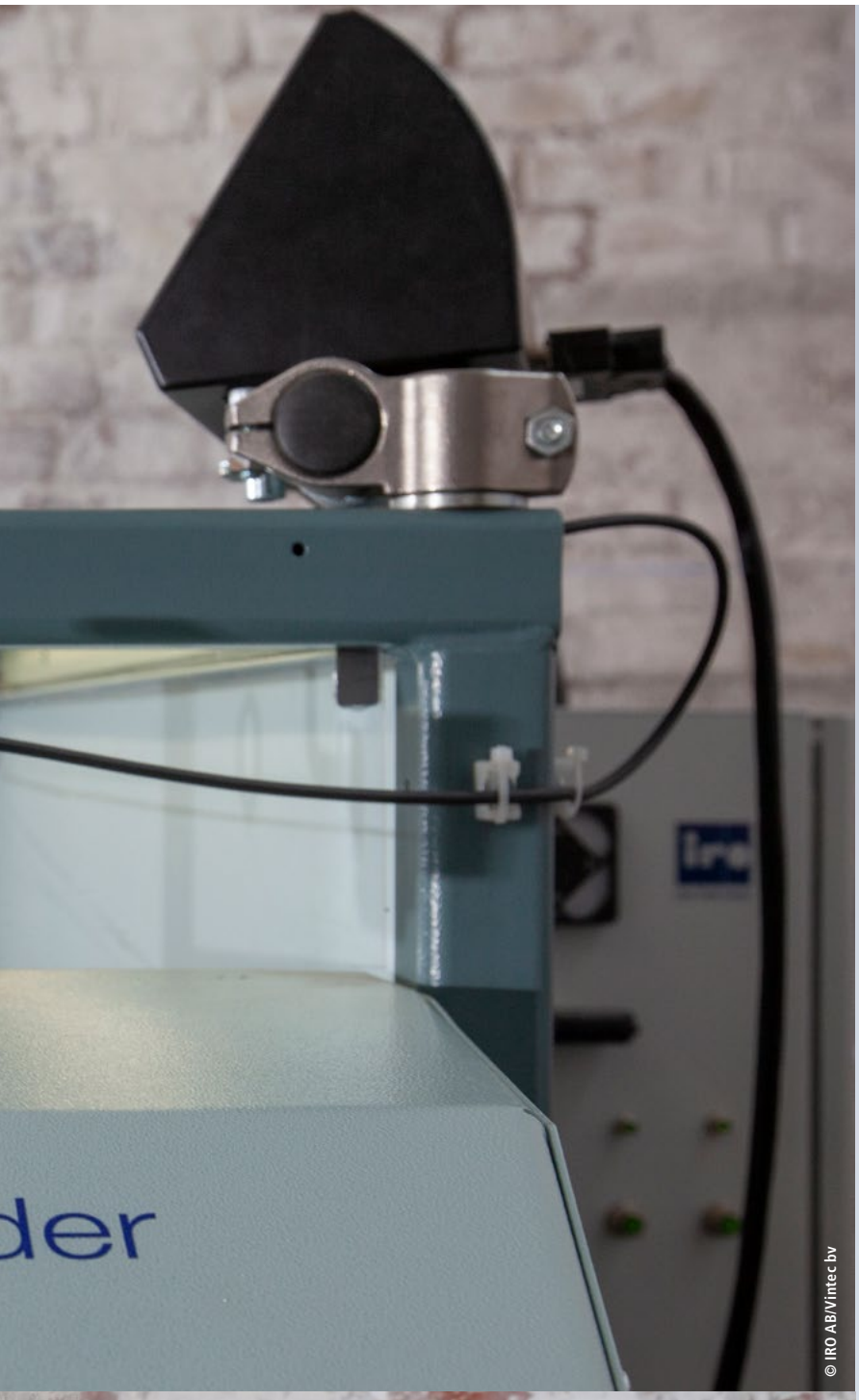
Beckhoff system benefits for RENK:
Besides the MATLAB® and Simulink® integration, the openness of TwinCAT is a key reason to use the Beckhoff system. Beyond that, the outstanding performance characteristics of Beckhoff IPCs and TwinCAT, i.e. TwinCAT Runtime with multiple tasks on multiple processor cores, enable us to integrate even large and complex models in one system. The EtherCAT industrial Ethernet system allows for decentralized I/Os on the large test stand and helps minimize the distance between sensors and digitalization of signals.

Why is Beckhoff the right partner for you?
- reputable hardware and software for industrial applications
- openness to integrate RDDS and other third-party products
- exceptional support

▶ **www.renk-ag.com**

MATLAB®, Simulink® and TwinCAT 3: references





IRO AB and Vintecc bv

The Zero Twist Feeder delivers yarn to weaving machines without a single twist. When weaving carbon fiber, glass fiber or plastic tapes, one of the worst things that can happen is a twist or a snarl.

What was the challenge?
Weaving machines work at high speeds and will pull at the bobbin at very irregular intervals. A buffer arm was used to compensate between the bobbin and the rapier. The buffer arm then delivers the exact amount of yarn to the weaving machines at the correct speed needed for the weft insertion. In production, the speeds can reach up to 850 meters per minute per insertion.

How did you solve this?
We started by making a digital twin of the machine. All software was programmed in Simulink®. The model is broken down in several sub-models, each representing an aspect related to machine building. Before IRO tested the algorithms on the actual hardware in Sweden, Vintecc ran extensive virtual simulations in Belgium to ensure that the machine would perform according to design.

How did theTwinCAT 3 Targets help you master this challenge?
The advantage of combining Simulink® with Beckhoff TwinCAT technology is that there's no need for PLC code. You can integrate the model directly into TwinCAT in detail. Any changes to the parameters, either in the model, in TwinCAT or in the hardware, are immediately carried over. All parameters are always stored safely and robustly this way. This kind of deep integration is only possible with Beckhoff.

How did the Beckhoff system in general help you master the challenge?
The AX8000 servo drives and high-performance EtherCAT communication are the perfect combination for maintaining the fast cycle times that we needed. Safety was even directly incorporated into the drives. Most of what we used – four-core IPC, drives, I/O components – is quite standard, which is the beauty of the Beckhoff system. Very few specialized technologies are necessary, and everything fits seamlessly into an overall concept.

Why is Beckhoff the right partner for you?
We can always count on the support from Beckhoff in Belgium, Sweden and in Germany.

▶ **www.iroab.com/products/ztf**

MATLAB®, Simulink® and TwinCAT 3: references

Magway

Encoder-less control of Linear Synchronous Motors powers autonomous, sustainable parcel delivery through underground pipes.

What was the challenge?
Moving our sophisticated algorithm to the lowest level possible.

How did you solve this?
Using Beckhoff's Target for Simulink®, we can deploy our control algorithms directly to an industrialized platform.

What commercial benefit could you gain?
Reduced components, decentralization, increased system availability and shorter development cycles.

How did the TwinCAT 3 Targets help you master the challenge?
In-loop debugging reduces development cycle times. Our core IP was developed in MATLAB® and Simulink®; using this directly instead of a cumbersome port allows us to keep the right tool for the right job.

How did the Beckhoff system in general help you master the challenge?
As Magway iterates and develops our suite of technologies, we are using the Beckhoff platform to centralize all of the required sub-systems in our engineering facility:

- safety to keep our research personnel safe
- motion for basic prototyping
- PLC for datalogging and general control
- TwinCAT HMI for visualizing and controlling our product
- EtherCAT for very high bandwidth and simple system expansion

Why is Beckhoff the right partner for you?
Beckhoff understands the development of innovative technologies and provides deep technical expertise. Magway is supported by teams in the UK and Germany, at all levels of the Beckhoff organization.

▶ **www.magway.com**

Pratt Miller

Pratt Miller creates scalable, rapid-response solutions for high demanding motorsport applications, e.g. a race simulator.

What was the challenge?
Constantly providing unique features for our motorsport teams and pilots.

How did you solve this?
Beckhoff's large product portfolio provides hardware and software solutions that precisely meet our demands. Beyond that, a strong relationship between Pratt Miller Engineers and Beckhoff Engineers helps us tackle our racing challenges.

How did the TwinCAT 3 Targets help you master the challenge?
The TwinCAT 3 Targets support integration of the rapid prototyping and the powerful control characteristics of MATLAB®/Simulink® with the flexibility of the Beckhoff system. The possibility of interacting with the Simulink® model within TwinCAT and the variables visualization capabilities allow the Simulink® model to remain clean and easy to debug.

How did the Beckhoff system in general help you master the challenge?
Beckhoff's integrated safety solution TwinSAFE and the built-in diagnostics and features of EPP series EtherCAT Boxes allow us to significantly reduce implementation time while maintaining a high degree of safety. This is a key aspect for our pilots. The TwinCAT engineering environment in Visual Studio and EtherCAT communication provide easy integration with our software tools for data exchange.

Why is Beckhoff the right partner for you?
Because as Pratt Miller, Beckhoff continuously works to find new ways to solve new challenges.

▶ www.prattmiller.com/markets/motorsports

MATLAB®, Simulink® and TwinCAT 3: references

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Fraunhofer Institute for Wind Energy Systems IWES

The Dynamic Nacelle Laboratory (DyNaLab) inculding the hardware-in-the-loop environment supports complete and realistic wind turbine nacelle system testing up to 10 MW.

What was the challenge?
Replication of interacting loads between nacelle and rotor as well as simulations of static and transient grid events to test turbines comprehensively, under realistic conditions and in accordance with current standards and guidelines.

How did you solve this?
Hardware-in-the-loop testing in TwinCAT allowed us to run real-time simulations of mechanical and power systems.

What commercial benefits did you gain?
Providing a realistic testing environment to carry out tests under reproducible and representative conditions. This offers wind turbine manufactures unique possibilities for prototype validation and examination of electrical characteristics compliant with relevant certification guidelines and future grid code requirements.

How did the TwinCAT 3 Targets help you master the challenge?
Direct generation of TC3 runtime modules from the aero-elastic and power electronic Simulink® models without any adaption enabled us to accelerate the development process.
It also assisted in the continuous process of improving and adapting our models to meet the individual needs of our customers.

How did the Beckhoff system in general help you master the challenge?
High-performance Embedded PCs executed our models with low cycle times of 1 ms (1 kHz) and 200 µs (5 kHz) within hard real-time requirements. Distributed real-time calculations are carried out and all systems are synchronized using EtherCAT, allowing us to command sychronous setpoints to the actuators, measure and monitor the entire system and to collect synchronized measurement signals in our data storage system.

▶ **https://s.fhg.de/iwes-nacelletesting**

© Goldwind

Goldwind Science and Technology

The Goldwind 6 MW turbine offers a consistent Model Based Design approach.

What was the challenge?
Key requirements of offshore turbines are high availability and low maintenance. Therefore, being able to foresee and safely control the turbines in all possible environmental situations is a must.

How did you solve this?
Leveraging the concept of Model Based Design with Simulink® and TwinCAT, we can develop, test and verify each feature of the turbine.

What commercial benefit could you gain?
Model Based Design empowered us to develop safe and reliable control software faster and more cost efficiently.

How did the TwinCAT 3 Targets help you master the challenge?
Easy integration of Target for Simulink® into the Model Based Design process allows to efficiently create and test productive code on an industrial platform. Further, the communication capabilities of the Interface for MATLAB®/Simulink® provide all tools needed for extensive software-in-the-loop testing after code deployment on the Beckhoff controller. By the features of TE1400 and TE1410, we have a successful application of main control software designed within Simulink® not only for the 6 MW prototype turbine, but also for every mass production turbine after the prototype.

How did the Beckhoff system in general help you master the challenge?
The Beckhoff hardware and software portfolio covers all of our demands, from high-performance Embedded PCs to modular EtherCAT Terminals for any signal or subsystem fieldbus to extended software functions like condition monitoring and data logging with direct database access. And all of that is on an integrated and reliable platform.

Why is Beckhoff the right partner for you?
We believe that Beckhoff is continuously improving the features of these tools and new technologies, which will be easy for us to integrate in the future. These give us even more reasons to keep the development approach of Model Based Design.

▶ **www.goldwindglobal.com/product/6.x.html**

Beckhoff – globally present on all continents

New Automation Technology

Beckhoff implements open automation systems using proven PC-based control technology. The product spectrum comprises these main areas: industrial PCs, I/O and fieldbus components, drive technology and automation software. Product lines are available for all areas and can be used as either individual components or as a complete system solution. The Beckhoff "New Automation Technology" philosophy stands for innovative and open control and automation solutions that are used worldwide in a diverse variety of applications ranging from CNC machine tools to intelligent building automation systems.

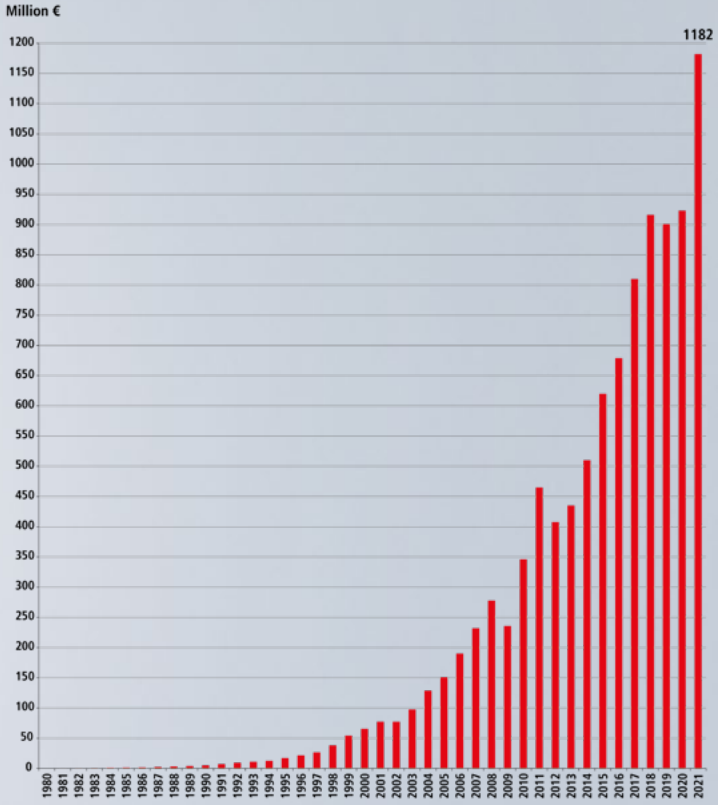
Globally present on all continents
Beckhoff is present in 75 countries, providing globally active customers with rapid service worldwide and technical support in their local language. Moreover, Beckhoff sees close proximity to customers as a prerequisite for an in-depth understanding of the technical challenges they face.

Beckhoff at a glance
- headquarters in Verl, Germany
- 1182 billion euros in global sales in 2021
- 5000 employees worldwide
- 1900 engineers
- 40 subsidiaries/representative offices worldwide
- 24 branch offices in Germany
- more than 75 distributors worldwide

(Status: March 2022)

Further information
Additional Beckhoff catalogs and flyers are available to download on the Internet.

▶ **www.beckhoff.com/media**



Sales development

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How can MATLAB®, Simulink® and TwinCAT 3 improve your engineering? Talk with us.

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