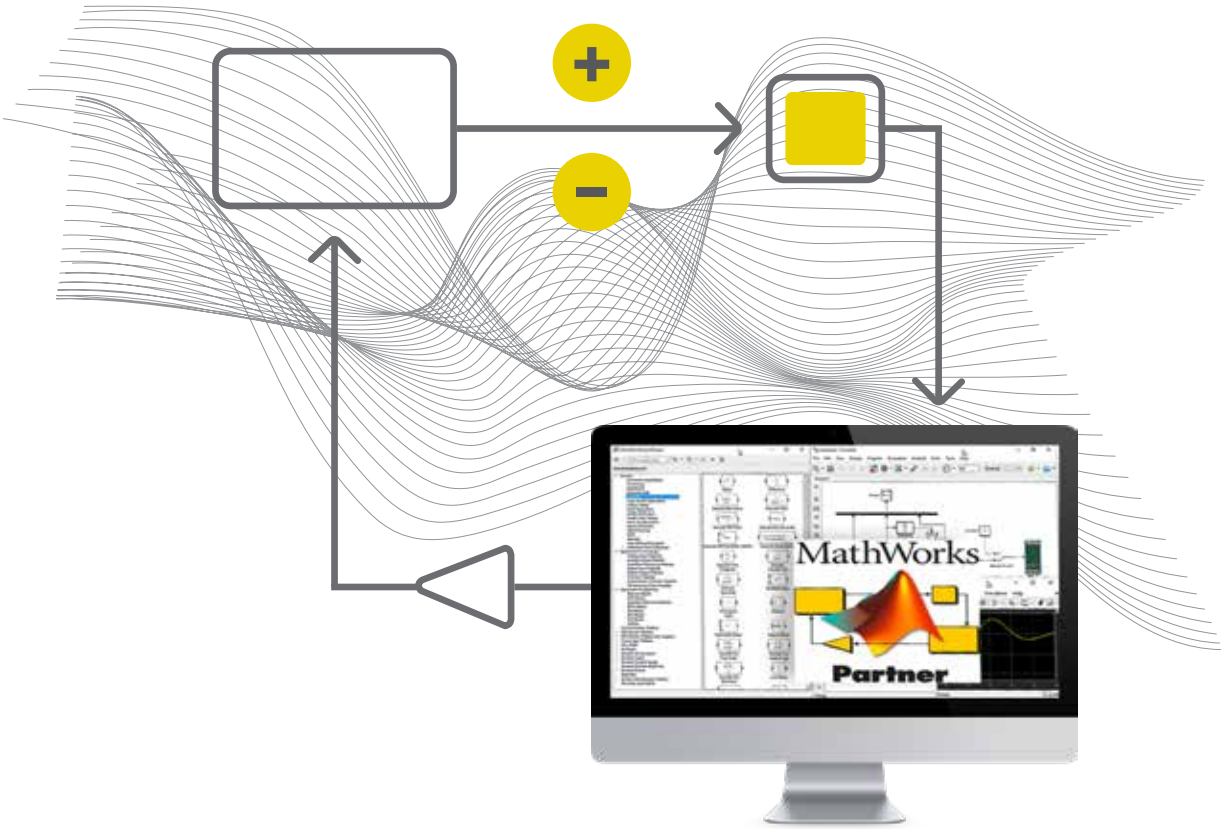
automation solutions

bachmann.

M-Target for Simulink®

For perfect simulation and model based design.



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Automatic Code Generation

M-Target for Simulink®

The MATLAB® and Simulink® product series from MathWorks, Inc. provide today's benchmark worldwide in the field of model-based development and simulation. There is hardly a research department in industry and hardly a university institute that does not benefit from the solutions that can be created.

M-Target for Simulink® enables the use of toolboxes from the product series to automatically generate executable real-time programs for the Bachmann M1 automation system. The M-Target for Simulink® solution developed by the experts at Bachmann is a tool that seamlessly integrates the software systems of the M1 automation system in the world of model-based development and simulation. All the conventional methods and extensive tool support provided by the SolutionCenter engineering system are fully available at the same time.

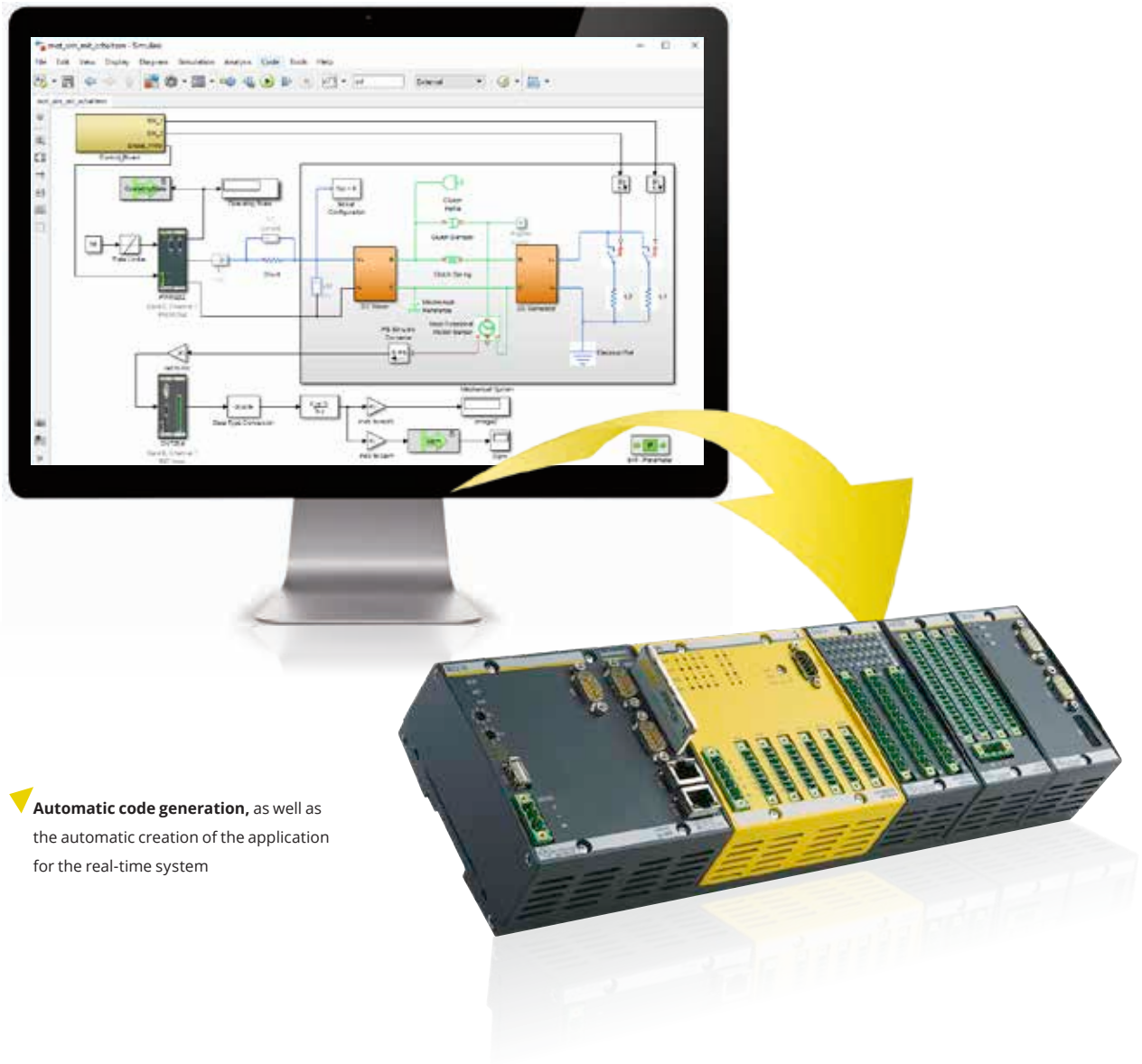
MathWorks Partner

SIMULINK Enabled MathWorks Partner

Partnership

Bachmann electronic is a product partner of Mathworks within the Connections Program. This is based on the certified qualifications of Bachmann employees, tested products and their successful use in real applications, as confirmed by several customers.

As a MathWorks partner Bachmann is able to access internal information from MATLAB® and Simulink®, early preliminary versions and development support. Jointly held seminars and trade fairs underline our successful and customer-oriented partnership.



Automatic code generation, as well as the automatic creation of the application for the real-time system

Real-time systems

For many applications, such as the high-speed motion controllers in production machines, the automation device must accurately calculate and set manipulated variables in deterministic time intervals. User programs generated with M-Target for Simulink® meet hard real-time requirements with cycle times of up to 200 µs in continuous industrial operation.

Offline simulation

During the simulation on the PC the time required for the calculation of a simulation is mostly not important. A sequence that takes 10s in real time can thus be calculated for the simulation on the computer in 1 s or even several minutes. The quality and the usability of the simulation result is not affected.

Controller Solution with Added Value

Optimized development process

1. Modeling hardware and software modules

Both the process (system) and also the closed-loop controllers and user programs are modeled in Simulink®. The large number of domainspecific add-ons for physical modeling, such as Simscape Fluids™, Simscape Electronics™ etc., enables this to be carried out directly in the descriptive world familiar to the particular process expert and thus considerably simplifies the workflow.

2. Hardware and software in the simulation

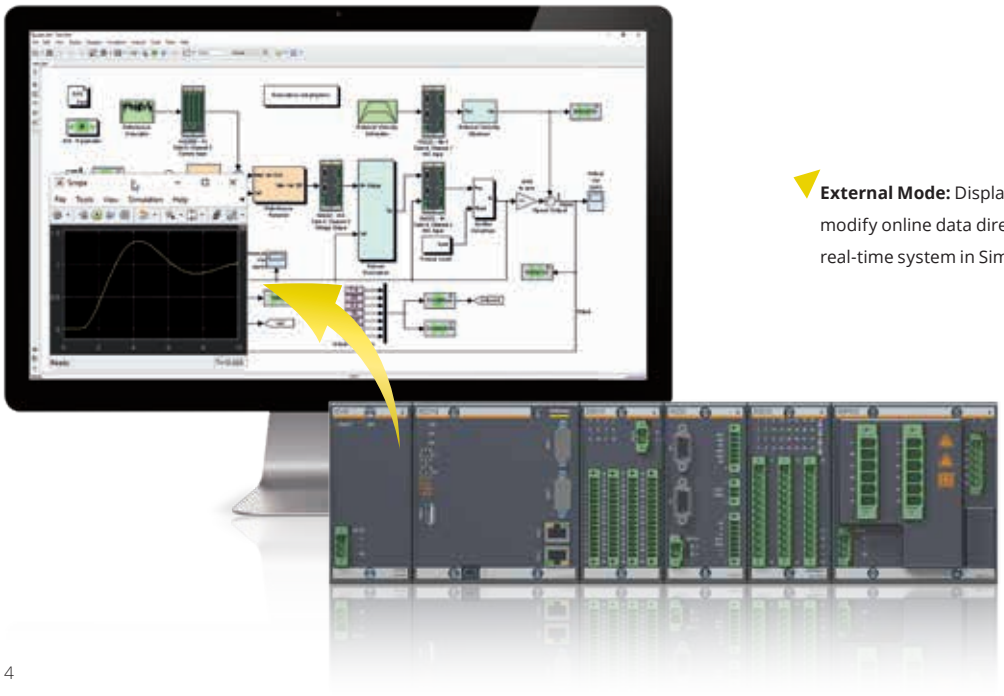
The resulting complete model is then simulated offline on the computer. Extensive tests on all possible operating states or fault situations are run through. The integration of real measuring data from the system or from similar plants in the simulation phase is a particular benefit.

Iterative model adaptions and new simulations can follow on seamlessly. The high-end processes/solvers for the numerical calculation of differential equations offer proven benefits outside of simple analytical systems. Outstanding graphical display features, such as curves, surface plots right through to controlled 3D CAD models optimize the workflow. The results of this process step (proof-of-concept) are the derivations for the sensors and actuators required as well as for the dimensioning specifications.

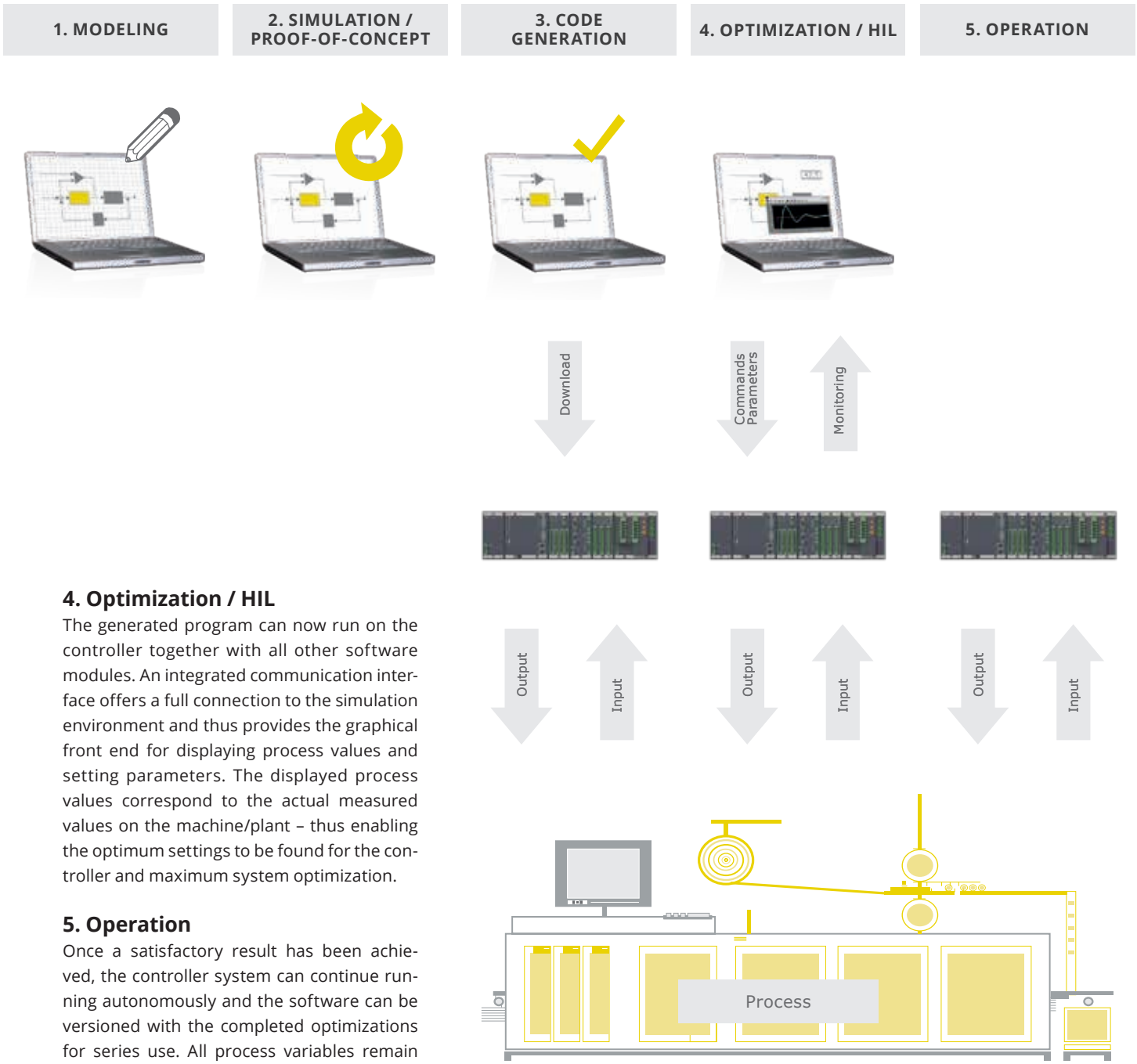
3. Code generation

In this step the process model is separated from the actual open-loop or closed-loop controller section. Automatic code generation is then carried out at the click of a mouse and the application for the realtime system is created automatically. This is loaded directly from Simulink® into the controller.

It is also possible to create and run function block libraries for C/C++ and IEC 61131 directly in the Bachmann controller system. Bachmann thus currently offers the best possible integration of Simulink® with a controller system that is available on the market.



External Mode: Display and modify online data directly from the real-time system in Simulink®



4. Optimization / HIL

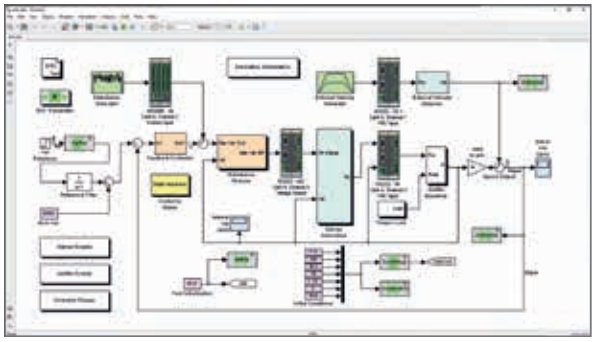
The generated program can now run on the controller together with all other software modules. An integrated communication interface offers a full connection to the simulation environment and thus provides the graphical front end for displaying process values and setting parameters. The displayed process values correspond to the actual measured values on the machine/plant – thus enabling the optimum settings to be found for the controller and maximum system optimization.

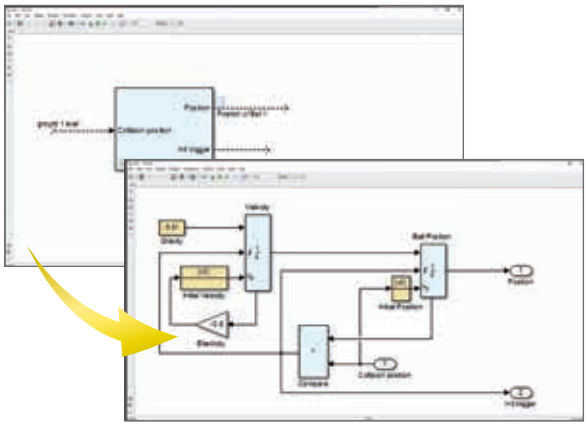
5. Operation

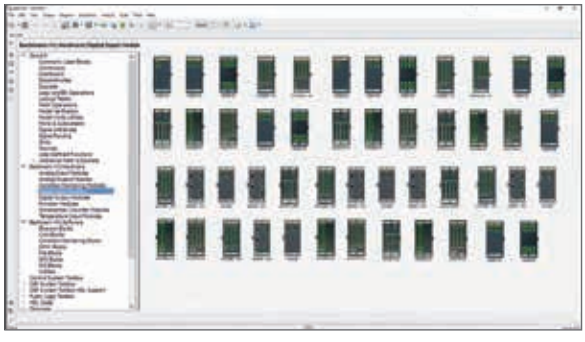
Once a satisfactory result has been achieved, the controller system can continue running autonomously and the software can be versioned with the completed optimizations for series use. All process variables remain fully available for use by other software modules (local visualization, plant networking, historization etc.).

Fully Integrated Engineering

Reduced complexity in engineering







Block-oriented structure

In Simulink® the models are defined by means of blocks and the links between them. These blocks contain input and output variables and internal parameters.

Ready-to-use arithmetic, logic, flow control and advanced mathematics function blocks are already offered in the basic functionality of Simulink®. The connections between the blocks here are far more than 1:1 variable relationships – these can represent entire vectors or matrices.

Any hierarchy

New blocks – so-called subsystems – can be formed from any group of connected blocks at the click of a mouse. This ensures a better overview and reduces complexity. The degree of nesting possible here is virtually unlimited – the display level can thus be adapted to the user's specific requirements. The reuse of hierarchical/encapsulated systems saves costs and time.

Parameter interface

Working with the block parameters, i.e. with the internal parameters of the Simulink® blocks, is particularly efficient in M-Target for Simulink®. These can not only be set in Simulink® itself offline and online, but can also be shown in the variable interface (SVI) of the generated software module.

In this way, these parameters can be changed online independently of Simulink® via any visualization, via a recipe or another software module (e.g. PLC program).

I/O modules integrated

A comprehensive library of M1 signal modules is provided as Simulink® blocks as the interface to the actual process. When the generated code is run, the Simulink® application can thus access hardware modules directly and work with their data.

The specific properties of these modules, such as resolution, quantization or delay times can furthermore be included in simulation mode. Already in the early phase of offline simulation this leads to considerably more reliable results.

Variable interface

All application programs and function modules in the Bachmann controller system offer a standard variable interface for reciprocal data exchange irrespective of the source code base (C/C++, IEC 61131). This standard variable interface (SVI) is also fully available in the form of blocks for Simulink® applications.

Unrestricted communication to other applications, diagnostic or visualization systems is therefore possible as a standard feature.

In-house source code

Any of the user's existing source code in C and C++ can be integrated directly in the block models. Already developed and tested algorithms can thus be integrated, thus protecting any investment already made.

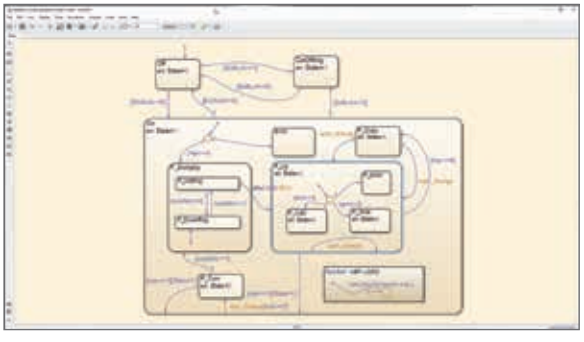
Closed-loop control made easy

The range of functions in MATLAB® and Simulink®, as well as the associated specific toolboxes such as the Control System Toolbox, System Identification Toolbox or Signal Processing Toolbox, offer solutions for demanding closed-loop control tasks. From system identification to advanced controllers (observation structures, fuzzy control, MIMO,...) right through to adaptive systems, comprehensive functions have been integrated ready for use.

The direct use of these perfectly matched options for real-time controller programming is actually quite a logical step. M-Target for Simulink® makes this possible – at the click of a mouse and without any manual coding.

Sequences and state machines

Automation not only involves the use of discrete analog signals and controllers. One of the core tasks is rather the implementation of sequences and complex state machines. And it is here that M-Target for Simulink® also provides a comprehensive solution. Besides the block diagrams from Simulink®, it is also possible to convert the state diagrams from Stateflow® easily into real-time programs. Furthermore, the same application can consist of a mixture of Stateflow® and Simulink® block diagrams.



Industry Proven Complete Solution

Seamless embedding and integrated high performance

The Bachmann M1 automation system is a comprehensive, industry-proven complete solution. All interfaces are available, from the possible connection of all industrial signal standards via fieldbuses, teleservice protocols and real-time Ethernet right through to IT protocols.

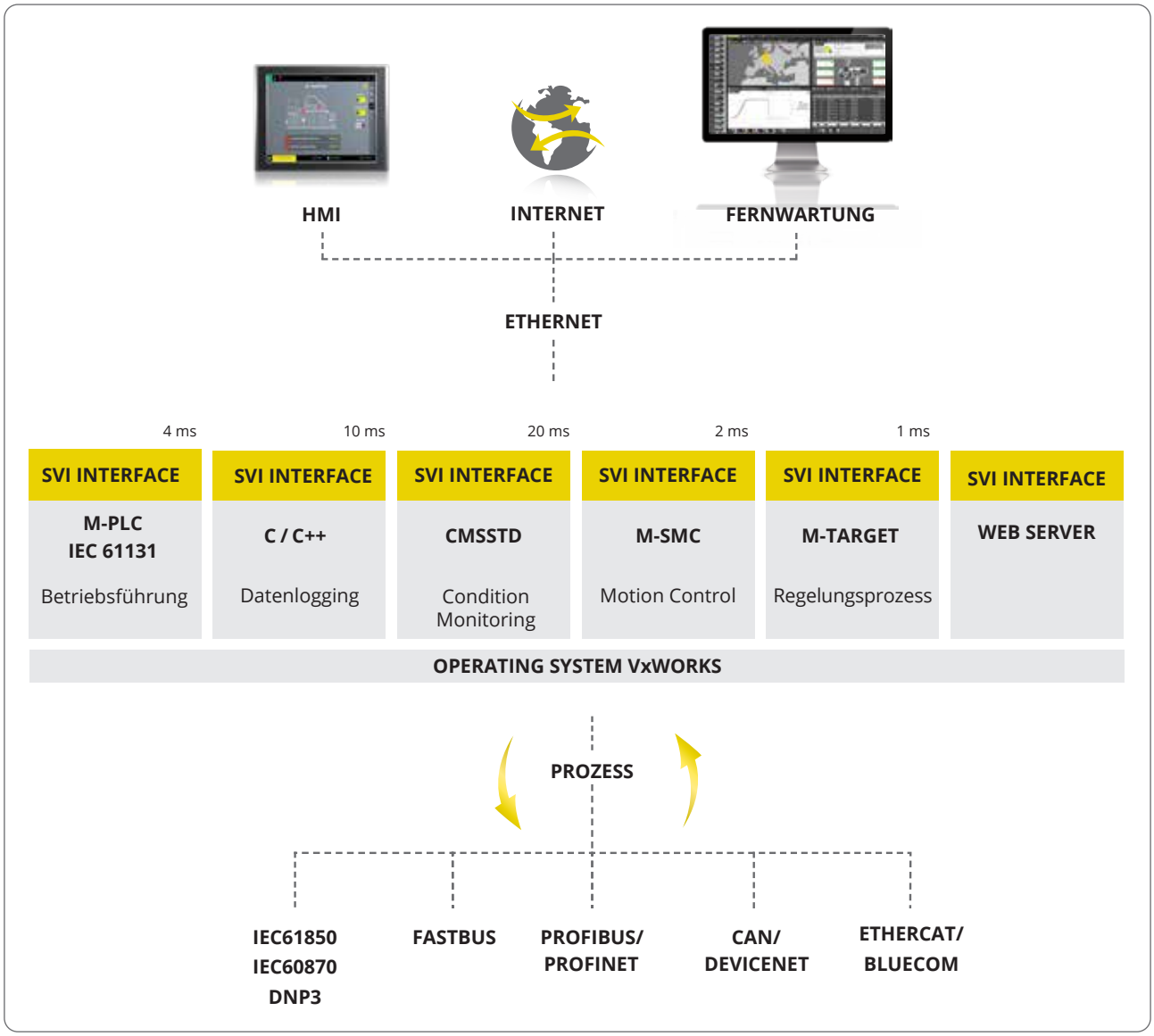
Convenient interfaces in focus

Proprietary modules for functional safety up to SIL 3 according to IEC 61508 or Performance Level e according to ISO 13849 are additional standard components of the system. All previously implemented algorithms and sequences can be reused cost effectively, thanks to the highly efficient programmability in the languages of IEC 61131-3 and C/C++. M-Target for Simulink® adds the possibilities of MATLAB® and Simulink® to the range of functions. The user does not have to decide whether to choose conventional or modelbased development – all the interfaces are provided for them both to be integrated.

The programs developed in the different languages such as C/C++ or IEC 61131 can be run simultaneously on the M1 system. The underlying operating system allows hard real-time functionality and optimum deterministic behavior. Interfaces are also provided for exchanging variable values both locally on the same device, as well as also via the network.

Thanks to the close integration in the established controller environment, the extensive tools of the Bachmann Solution-Center engineering software can be used in conjunction with M-Target for Simulink®. Teleservice functions and the local memory media for data access and storage are also provided.

Task Model of the M1 Controller



In the Language of the Solution

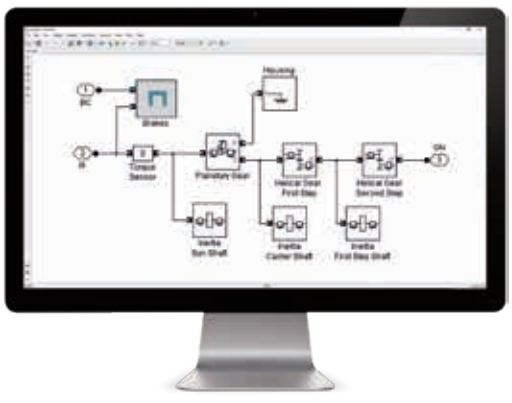
Integrated toolboxes for modeling

A major challenge of the simulation task is how to describe the reality, i.e. the process, by means of abstract mathematical methods. This is made considerably easier using the block language of Simulink® and the extensive libraries provided.

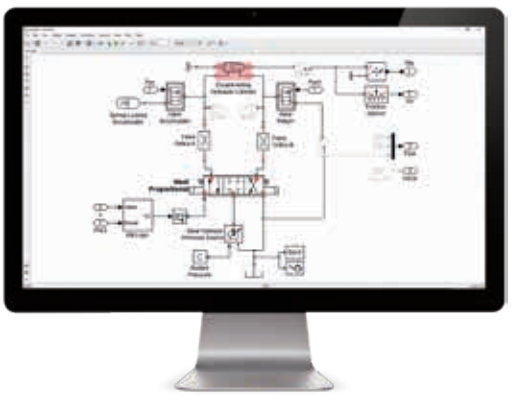
Value addition through physical modeling

To make things simpler, add-ons are available in the form of integrated toolboxes which enable the problem to be described directly in the particular physical domain. For example,it is no longer necessary to formulate the appropriate differential equation of the oscillating system for a process involving a hydraulic cylinder, a pump and a control valve. The components used are simply added to the model as graphical blocks and interconnected.

M-Target for Simulink® enables the use of domain-specific physical modeling for the process models. This enables the mechanical engineering, hydraulics and closed-loop control technology experts involved to describe, develop and refine the part of the process they are responsible for with the components they are familiar with, without having to fully understand the other domains in the solution model. The consistency of the model is still retained and any changes can be tested immediately.



Simscape Driveline™: Example of a drive train system in a wind turbine



Simscape Fluids™: Example of a hydraulic positioning system with proportional valve and differential cylinder

Domain specific (physical) modeling

Toolboxes for expanding Simulink® for domain-specific modeling:

SIMSCAPE™

- enables you to rapidly create models of physical systems within the Simulink® environment. With Simscape, you build physical component models based on physical connections that directly integrate with block diagrams and other modeling paradigms.

  The basic SimScape™ toolbox provides the basis for modeling physical networks. Simscape add-on products provide more complex components and analysis capabilities.

SIMSCAPE MULTIBODY™

- provides a multibody simulation environment for 3D mechanical systems in mechanical and system engineering.

  You can model multibody systems using blocks representing bodies, joints, constraints, force elements, and sensors. The movement equations for the complete mechanical system are formulated and solved.

  You can import complete CAD objects, including all masses, inertias, joints, constraints, and 3D geometry, into your model. An automatically generated 3D animation lets you visualize the system dynamics.

SIMSCAPE DRIVELINE™

- provides components for modeling and simulating mechanical systems with rotational and translational movements. This includes gears and complete drive train systems.

  You can use these components to model the transmission of mechanical power in drivetrains, industrial machinery, powertrains, and other applications.

SIMSCAPE FLUIDS™

- provides components for modeling and simulating hydraulic systems such as presses and valves. These components help you to create fluid technology systems simply.

  SimScape Fluids™ enables you to design hydraulic control systems and create hardware in the loop (HIL) systems via the provided C Code generation.

SIMSCAPE ELECTRONICS™

- provides component libraries for modeling and simulating electronic and mechatronic systems. It includes models of semiconductors, motors, drives, sensors and actuators.

  You can use these components to develop electromechanical control systems.

SIMSCAPE POWER SYSTEMS™

- provides component libraries and analysis tools for modeling and simulating electrical transmission and distribution networks. It includes models of electrical power converters, including components for applications such as flexible AC transmission systems (FACTS) and renewable energy systems.

  Harmonic analysis, calculation of total harmonic distortion (THD), load flow, and other key electrical power system analyses are automated, helping you to investigate the performance of your design.

A Reliable Partnership

Value addition, security and investment protection

INNOVATION

- M-Target for Simulink® makes the progressive world of model-based development and simulation reality for industrial automation. Shorter development cycles and fewer risks bring competitive edge and cost savings. Innovation potential, which previously could not be realized, is brought within reach with the automation solutions of Bachmann electronic. The traditional borders of control technology are obsolete.

QUALITY AND EFFICIENCY

- The use of high quality algorithms increases product quality and plant yields and reduced reworking costs/rejects. The increasingly critical energy efficiency of machines and plants can be achieved through the use of innovative close-loop control and optimization concepts. Disciplines in which solutions with M-Target for Simulink® can exploit its strengths.

KNOWLEDGE INTEGRATION

- The display of signal paths and processes in generally understandable graphics means that process specialists, automation engineers and IT specialists are no longer isolated. The shared information display is understandable and familiar. Thousands of industrial users, universities and research centers worldwide use, know and teach the system world of MATLAB® and Simulink®. Knowledge is no longer buried in non-understandable, machine-based code but is accessible and transparent. Teams can function as a team and grow.

INVESTMENT PROTECTION

- At the same time, all standard programming models and languages of conventional automation or embedded technology are still available. Investments that have already been made and the know-how often accumulated over years are retained. Open industrial standards thus provide new possibilities for a smooth and scalable migration instead of an “all or nothing” decision.

COST EFFICIENCY

- “Getting to market faster with the better solution” – this is the basic tenet of our global age. This is where M-Target for Simulink® with the M1 automation system from Bachmann offers considerable help. Calculable investments that are inexpensive compared to their benefits pay for themselves quickly.

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