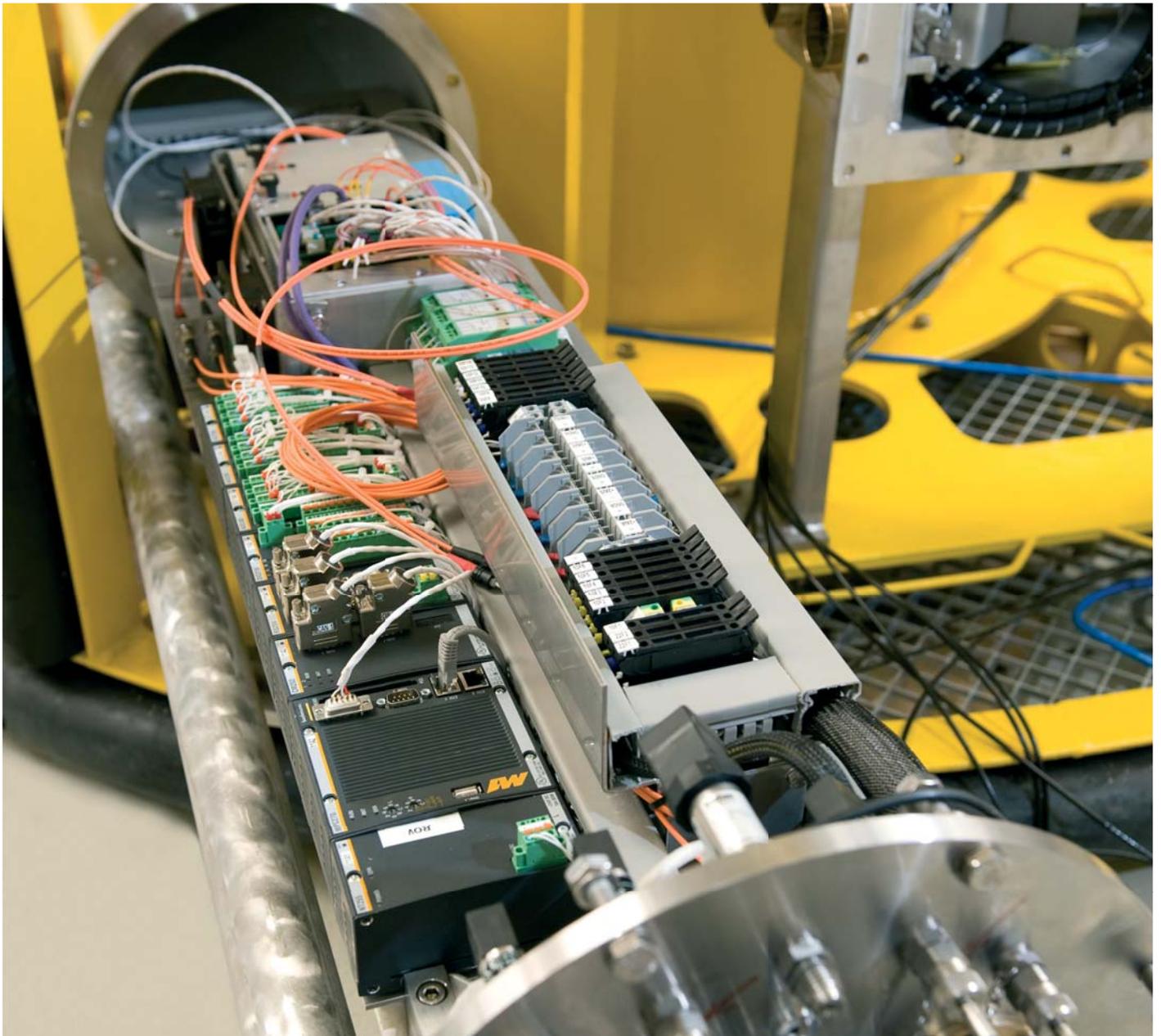




1000 meters beneath the sea

Bachmann controller in diving robot



bachmann.



The Dutch company, Seatools b.v., offers complete solutions for nearly all underwater industrial applications. For several years the company has been employing the Bachmann M1 automation system in its installations. Before the customized individual solutions are constructed, they have already proven their functionality in extensive simulations in the company's development center in Numansdorp, a few kilometers south of Rotterdam (the Netherlands). In addition to the robustness of the system, the Seatools developers particularly appreciate M-Target for Simulink®, with which they generate the program code for the Bachmann controller, saving time and working directly from the familiar simulation environment.

Among the most remarkable developments from the Dutch innovation center are excavator systems for precise excavation at depths of up to 1000 meters (Grab Excavation System GES), measuring systems for precise placement of tunnel segments underwater (Tunnel Segment Measurement System TSMS) or the unmanned monitoring and control system (Remotely Operated Vehicle ROV) for precisely maneuvering fill material pipes. The Rotterdam company is the world leader for the latter application. In the past several years, it has supplied more ROVs to offshore and deep-sea excavation companies than any other manufacturer.

Exact filling on the sea BED

The rock dump vessel La Boudeuse of the Luxemburg Jan de Nul Group, one of the market-leading companies in excavation and earth and stone moving in the ocean, is likewise equipped with a robot from Seatools. The La Boudeuse holds up to 4600 tons of rocks. Via a movable down pipe they are precisely piled at a depth of up to 200 meters, e.g. as a protective wall for subsea pipelines against the effects of currents. The controller system of the ROV is directly connected to the maneuvering unit of the ship. It takes over the dynamic positioning of the downpipe along a predefined path, without the necessity for any manual intervention. »The exact positioning of the bulk material is extremely important,« ways Arjen Klop, Director Sales & Marketing at Seatools. After all, this protects offshore foundations reliably against undermining, for instance.

Every system is unique

Every ROV is unique, being built dependently on the field of use for the rock dumping vessel. The structure depends on the maximum depth at which the fill material is to be deposited and the temperatures and flow conditions that prevail there. These determine, for example, the number of thrusters that are used for precise positioning the ROV and thus the precise orientation of the downpipe. The number of ultrasound sensors and cameras that monitor the filling of the rocks is also crucial to the system structure.

Laborious parameterization

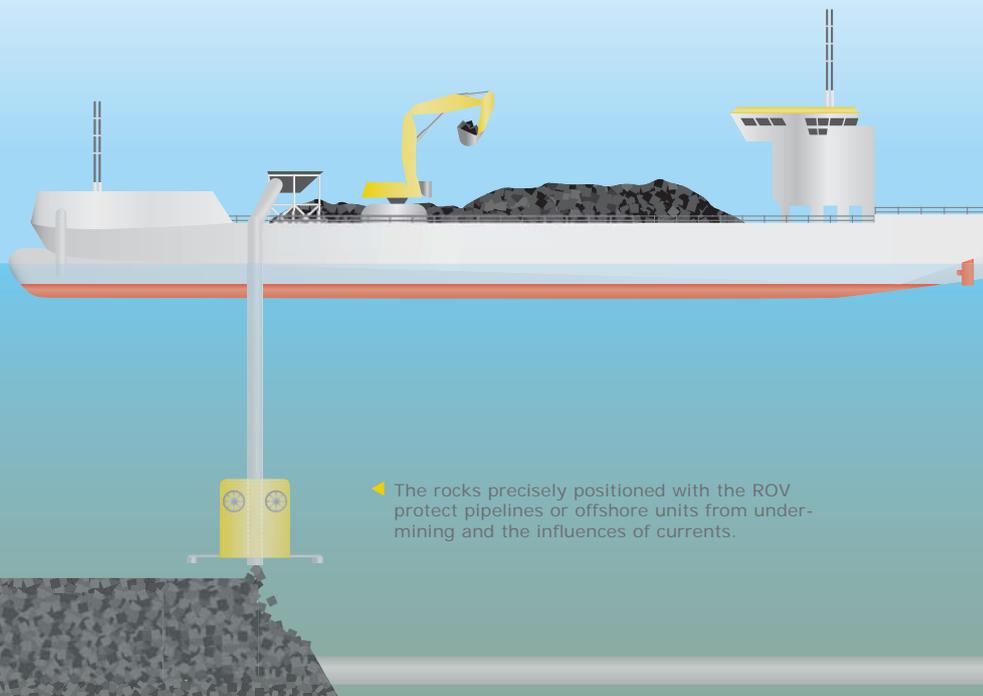
The difficulty in parameterizing each structure is estimating the behavior of the overall system under actual conditions of use. Merely the fact that the place of use may be several hundred meters below the surface of the sea implies a days-long, expensive and personnel-intensive commissioning of the system. Therefore the Seatools development team models the dynamic system in its entirety already in the design process. Thus the effects of modifications of subsystems can be assessed before they are implemented in practice. The simulation is based on two models: one model, the so-called »world model,« describes the ROV as a whole, taking into account the responses of the movable parts and valves, as well as the forces that act on the RV from the thrusters. The second model, the »controller model,« describes the complete controller system of the ROV.

Efficient simulation environment

For this, Seatools uses the Simulink® simulation environment from The Mathworks Inc. »The crucially important point for our work is that the Bachmann M1 automation system is completely embedded as a target in the Simulink® environment,« says Arjen Klop, and he adds: »All the components of the control system already exist as Simulink® function blocks, which saves time on the one hand and, on the other also ensures that the characteristics of the hardware used are correctly modeled.«

Full access: hardware in the loop

»Connecting« the two models is extraordinarily convenient. The development environment and the controller communicate by means of an automatically created communications relationship via Ethernet and the TCP/IP protocol. Process values and variables of the M1 system can be observed in dynamic operation from the Simulink® simulation environment and recorded over time. Values, regulator parameters or module parameters are written by Simulink directly to the controller during program execution. »In that way, we can adapt the parameters <online>, without having to regenerate the object code for the system,« says a pleased Arjen Klop. »Since we can model the mecha-



◀ The rocks precisely positioned with the ROV protect pipelines or offshore units from undermining and the influences of currents.

nical and the electrical behavior of the overall system together, we can describe the reaction of the actual system very precisely.«

Efficient process ensures short delivery times

Seatools customers expect short delivery times even for individual one-off systems. The automatic code generation and porting to the controller with the aid of the Real-Time Workshop® from The MathWorks and the »M-Target® for Simulink®« software from Bachmann provide a decisive advance: the time spent for porting is reduced to zero. »Moreover, we have a completely new level of safety in the implementation on the real-time system, because coding errors can be avoided,« as Arjen Klop describes the extra benefit.

Shortest possible commissioning saves money

»With this development and hardware environment, we can be sure that controller program that functions in the model, behaves as expected on the actual controller,« says the Seatools engineer. The multi-day adjustment work to adapt the system and controller to the actual working and environmental conditions belongs to the past.



▲ ROV (Remotely Operated Vehicle) for monitoring and controlling stone filling by ships at sea.

» *With M-Target for Simulink® we achieve an unprecedented speed and safety in the simulation of our systems.*

Arjen Klop,
Manager Sales & Marketing
at Seatools