SAFELY THROUGH THE FOG

Bachmann solves closed-loop control tasks on ships

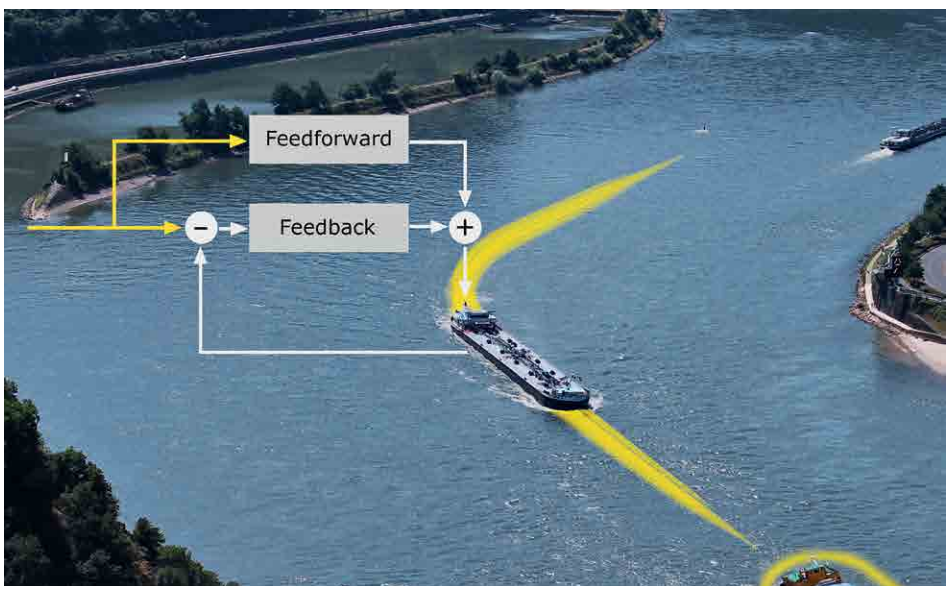
The requirements placed on a ship's crew are extensive and also extremely demanding. Today many of these tasks can be taken over by state-of-the-art technology so that the crew can concentrate on the more essential tasks. The Institute for System Dynamics at the University of Stuttgart is developing for this high-performance closed-loop and open-loop control concepts, which are also suitable for the automatic track keeping for inland shipping. For this Bachmann electronic supplies the M1 automation system, thus offering a highly available solution that is certified for maritime applications.

A wide range of closed-loop control tasks are involved on a ship. In order to relieve the work for the ship's master on the bridge, even complex tasks such as automatic track keeping or maneuvering control, which require a high degree of precision, can only function reliably with sophisticated technical systems. The M1 controller from Bachmann offers here the ultimate in performance and reliability: As it already comes with the certification needed for the sector, it is ideally suited for applications in the demanding shipbuilding industry.

Wide range of functions skillfully bundled

A number of different concepts for shipping have already been implemented with Bachmann hardware at the Institute for System Dynamics of Stuttgart University. These are marketed under the blanket name '3G Navigation', a company founded within the framework of the Technology Transfer Initiative TTI (see box). "The drive control for example is being used daily on five cruise liners and six more will be implemented in the next few months," explains Alexander Lutz, founder of '3G Navigation' and research associate at the Institute for System Dynamics. Between two to four diesel engines, each with a rudder propeller, are individually controlled here by separate drive controllers.

These are distributed in two control cabinets in the engine room and control center. A Bachmann MX213 processor module forms the core of the automation solution, and is equipped with various digital and analog I/O modules as well as a CAN module. "We have installed these elements in the control center. Even in the engine room with high temperatures and severe vibration, the M1 system is the ideal solution. Here we use the robust DA3284-C CAN module," explains Alexander Lutz. Functions such as the monitoring of the universal drive shaft or teleservice are also provided. "The open structure of the Bachmann controller is a real benefit to us here.



Precision: Using the results of the position calculation, the track keeping system is able to detect deviations from the ideal course. From this the control algorithm forms manipulated variables for the rudder and keeps the ship on track.

» Our tasks need maximum computing power. Bachmann also offers the openness of the M1 system and optimum availability. «

Dr. Ing. Alexander Lutz,
Founder of 3G Navigation and research associate
at the Institute for System Dynamics
at the University of Stuttgart

The number of interfaces available makes it possible to implement special functions on diesel engines without any additional effort, such as the J1939 diagnostic interface," Alexander Lutz emphasizes. All systems are tested from top to bottom at his institute prior to installation on a ship. For this the engineers have a hardware in the loop simulator (HIL) at their disposal.

State-of-the-art navigation

The latest project is the implementation of automatic track keeping on a Bachmann controller. "As a higher-level closed-loop control module, the track keeping function enables the automatic guidance of a ship along nonlinear tracks or lanes," Alexander Lutz explains. The navigation system basically has to detect where it is, where it wants to travel to and control the rudder system accordingly. "An intricate problem, since rivers take a winding course through the land and their frequent fast currents present a real challenge, particularly when there is shipping in the opposite direction," explains Alexander Lutz.

The automation system has to offer the appropriate level of power since complicated mathematical models process information from GPS, radar, turn indicators and other relevant ship data into logical rudder commands. Alexander Lutz summarizes: "The core of the calculation is a model-based closed-loop control concept that combines the ideal route with the knowledge about the ship's behavior. In this way, the ship follows the set track precisely and does not move in an uncontrolled fashion on the river."

More efficiency, more safety

The benefits of automatic track keeping are obvious: The advance calculation of movement variables enables rudder operation to be kept to a minimum. This also reduces the fuel required. "However, automatic track keeping offers an impressive benefit in terms of safety: The ship's master can concentrate fully on waterway traffic," Alexander Lutz explains. "Any disturbing water reflections, thick fog or blinding lights in the night are finally no longer a problem."

In order to provide the ship's master with a constant overview, a map showing the waterway and the river bank in appropriate colors combined with the current radar image, is displayed on the monitor. The route through the channel, the shipping lane, is shown in black. The set course, composed of the lane and a possible lateral offset, are overlaid in red. Additional information, such as river kilometers and speed, is shown at the side of the screen. ▶▶

Technologie
Transfer
Initiative

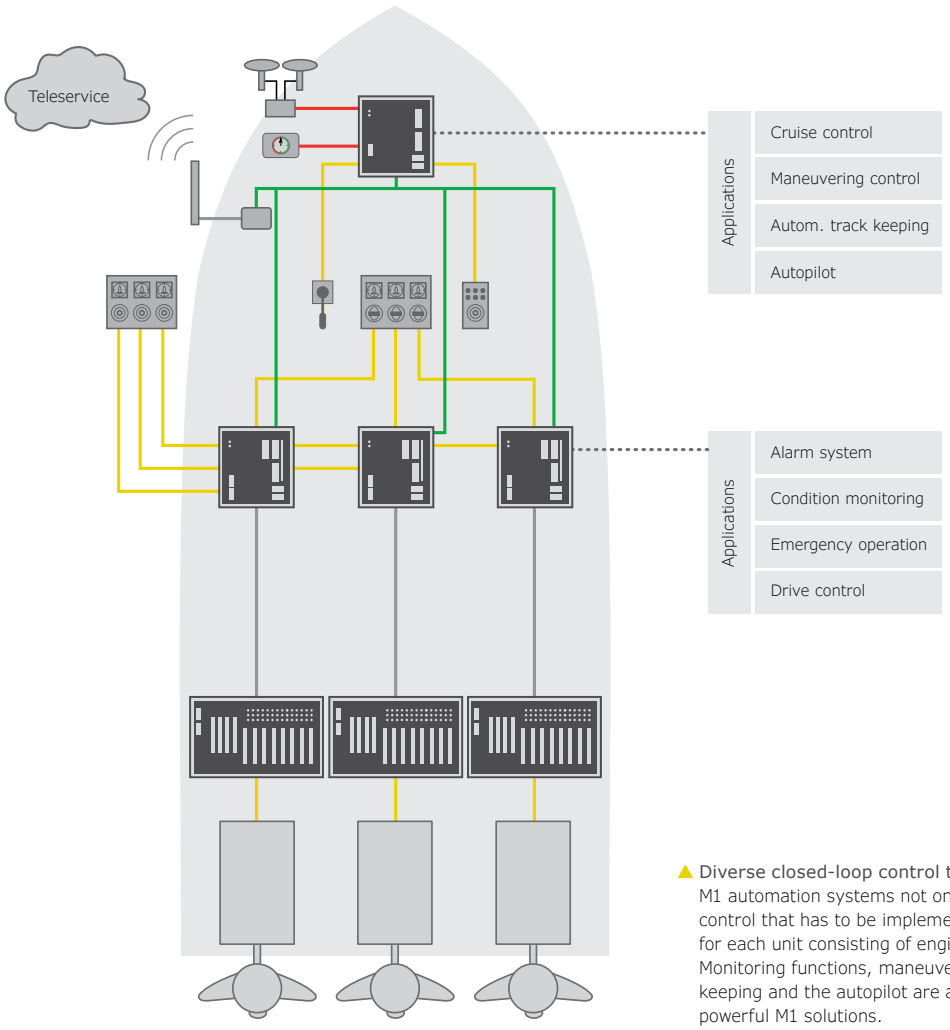
'3G Navigation' is part of the Technology Transfer Initiative (TTI) of Stuttgart University. Under the cover of TTI GmbH, small independent companies can be formed with their own cost center. '3G Navigation' was brought to life in November 2010 with the objective of marketing automation concepts for shipping that were developed at the Institute for System Dynamics.

↗ www.tti-stuttgart.de

▶▶ Saving fuel

This can also be combined with the cruise control system currently under development. This regulates the engine speeds for minimum fuel consumption. For example, the speed is reduced if the ship encounters increased resistant due to shallow river sections. "In such cases, higher engine speeds result in virtually no increase in speed. It only increases fuel consumption," Dr. Lutz explains.

"We are currently working on transferring the automatic track keeping system to a separate Bachmann controller," adds Alexander Lutz. "We are also certain here that we can combine maximum computing power with total flexibility and optimum availability."



▲ Diverse closed-loop control tasks on a ship: M1 automation systems not only handle the drive control that has to be implemented separately for each unit consisting of engine and propeller. Monitoring functions, maneuvering control, track keeping and the autopilot are also controlled by powerful M1 solutions.