Computers at the Helm

Sailing the Rhine in the dead of night challenges even an experienced helmsman. **Ernst Dieter Gilles** and his team at the **Max Planck Institute for Dynamics of Complex Technical Systems** in Magdeburg have developed a navigation system to give boatmen a better view in situations like this.

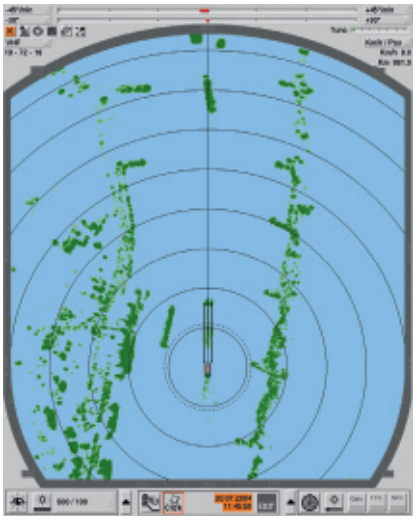
TEXT **TIM SCHRÖDER**

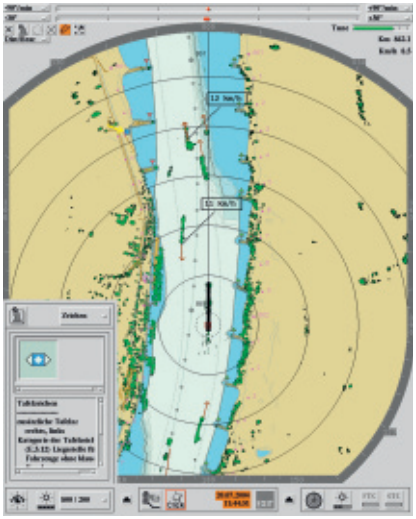
For aircraft in the sky and container vessels at sea, autopilot has long been a standard feature. Just set the switch to automatic, and both plane and ship proceed to steer themselves. Very soon, a similar autopilot will also be guiding barges on their journeys up- and downriver. In the past, such a prospect would have been inconceivable. After all, a river is not like an ocean where you can just set a course, open the throttle and proceed full steam ahead.

Rivers wind their way through landscapes. Strong currents obstruct a vessel's progress, forcing bow or stern to drift off course. All of this makes it hard for an autopilot to stay the desired course. In recent years, however, Ernst Dieter Gilles, Founding Director of the Max Planck Institute for Dynamics of Complex Technical Systems in Magdeburg and a research scientist at the University of Stuttgart, has developed an integrated navigation system that will soon be ready for its market launch. The guidance system is the product of nearly 25 years of meticulous work and a host of doctorates and theses.

Rush hour on the Rhine: The integrated navigation system steers a ship reliably even in such tricky situations.

Photo: iStockphoto





left | A weight off the captain's shoulders: He can confidently leave the instruments in the hands of the computer. The machine steers the ship safely around the bend – even in the dead of night.

right | Where am I? A radar image alone (left) is difficult to interpret. Combined with GPS data and a digital map it gives the captain a good overview of the ship's position (right). This navigation aid is already being successfully marketed – and also forms the core of the autopilot for ships.

Photos: Institute for System Dynamics, Stuttgart, Max Planck Institute for Dynamics of Complex Technical Systems/in-innovative navigation GmbH (2)

Using GPS data and a radar image that is automatically compared with a digital river chart stored in the onboard computer, the system knows exactly where it is. The computer then uses this knowledge to steer the ship, even around tight curves with fast-flowing currents. It does take a lot of technology – including a GPS receiver for satellite navigation, a radar system, a turn indicator for recording the turning motion of the vessel, and a mobile radio receiver to update water depth data. And of course it also takes intelligent mathematical models that know what to do if the current drags at the hull or there is traffic coming the other way.

The mathematical models take in data from the GPS, radar or turn indicator and use it to calculate appropriate rudder commands. These models are loaded with the ship's parameters, its size, draft, mass, and even how the hull behaves in a current. Thanks to the computer technology, the ship not only remains on course, but can even automatically avoid oncoming traffic or overtake slower vessels.

"A navigation system like this really can make the skipper's job easier, especially when the river narrows," says Gilles. Or at night. In the dark, the helmsman is sometimes faced with hundreds of lights – buoys, the navigation lights of other ships, and lights on shore. With tired eyes, it's hard to distinguish between them. Even in fog, the radar-assisted autopilot safely steers the ship.

IRONCLAD SAFETY CONCEPT

The first trial versions of the navigation program employed only radar and GPS as orientation aids. The current version also incorporates data from the AIS – the Automatic Identification System, a new global standard in marine navigation. This requires ships to be equipped with an AIS transponder that automatically transmits the position of the vessel, its current speed and its direction of travel. The AIS provides the pilot computer with important information from other vessels on the river to compare with its own radar data – an ironclad safety concept.

Recently, Gilles and his colleagues have been testing the inland waterway autopilot on a river cruiser and a Dutch training ship on the Rhine – with great success. The navigation, overtaking and avoidance functions work perfectly.

For some years now, Gilles' first spin-off company innovative navigation has been offering a combination of GPS, radar and digital charts as a navigational aid that enables barge masters to track their position at night and in the fog. Several hundred packages have already been sold, including in the Netherlands, which accounts for the bulk of shipping on the Rhine.

With the new complete navigation system capable of steering a vessel on autopilot, however, Gilles is writing a fresh chapter in the inland waterways story. The system will be marketed by a second University of Stuttgart spin-off. Gilles, meanwhile, now retired as a university teacher of system dynamics and control engineering, is upholding the family tradition: his father was a boatman in the town of Kaub on the Rhine. ◂