

FURUNO

Full Ahead with FURUNO

Digital Transformation



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Achieve safer and more efficient autonomous ship operation with Furuno's innovative technology

Towards the Digital Transformation of the Shipping Industry

Over the last few years, the shipping industry has seen a rapid increase in the use of cutting edge digital technology to visualize operational status, on-board and off-board navigation, and engine systems.

Based on the most recent advancements in marine electronics and communications technologies, Furuno is developing new technological innovations to achieve safer and more efficient autonomous ship operations.

Challenge the Invisible

“Challenge the Invisible” is one of Furuno’s business themes, which we achieve through the following three approaches.

- A “Recognition Support” system, which makes use of marine electronic equipment and unique sensor technology to provide a better understanding of surrounding situation.
- A “Decision Support” system that analyzes collected data and helps the operator avoid dangerous objects based on enhanced situational awareness.
- A “Operation Support” system that automatically controls the route and speed in accordance with the avoidance plan, in order to achieve zero marine accidents.

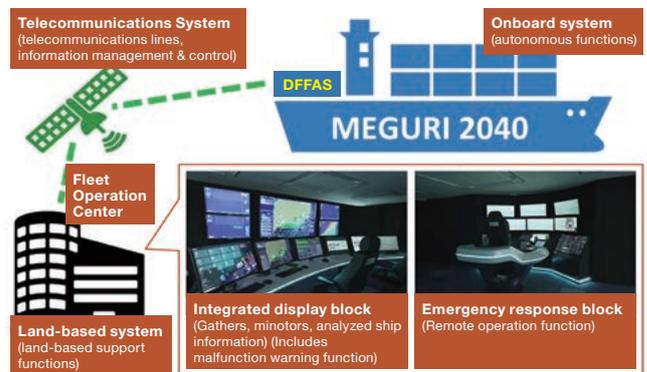
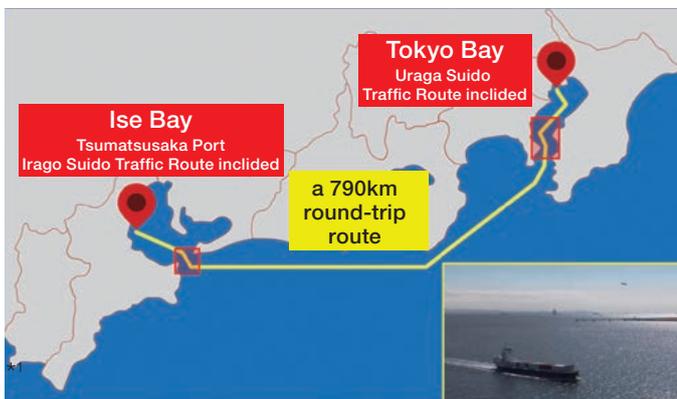
The future of the shipping industry as we envision it



Furuno is contributing to the field trials and build-up of related technologies for autonomous navigation by leveraging the technical expertise we have accumulated through the development of marine Radar and wireless communication. Furuno is one of the five companies chosen to participate in this consortium program.

“Creating the Future of Fully Autonomous Ships - A Grand Design by a Group of Experts” project (Japan Marine Science Inc. and 21 other companies)

The DFFAS (Designing the Future of Full Autonomous Ship) Consortium*1 conducted a demonstration test of full autonomous navigation between Tokyo Bay and Ise Bay (about 790 km round trip) from February 26 to March 1. During this trial, a voyage including offshore navigation, bay navigation, coastal navigation, and berthing manoeuvres (between Tokyo Port and Tsumatsusaka Port) was successfully completed by an autonomous navigation system using a container ship "SUZAKU". This container ship was equipped with an autonomous navigation system, telecommunication systems, and anomaly prediction functions with the help of a fleet operation Control Center which could operate the ship by satellite and land signals.



The DFFAS Consortium is led by Japan Marine Science Inc., and includes Bemac Corporation, Eizo Corporation, Furuno Electric Co., Ltd., Honda Heavy Industries Co., Ltd., Ikous Corporation, Japan Hamworthy, Co. Ltd., Japan Marine United Corporation, Japan Radio Co., Ltd., Kinkai Yusen Kaisha Ltd., Mitsubishi Research Institute, Inc., Mitsui Sumitomo Insurance Company, Ltd., Miura Co., Ltd., MTI Ltd., Nabtesco Corporation, Nihon Shipyard Co., Ltd., Nippon Yusen Kabushiki Kaisha, NTT Communications Corporation, NTT Corporation, NTT Docomo, Inc., NX Shipping Co., Ltd., Pluszero Co., Ltd., Sanwa Dock Co., Ltd., Sky Perfect JSAT Corporation, Sunflame Corp., Suzuyo Marine Co., Ltd., Tokio Marine & Nichido Fire Insurance Co., Ltd., Tokyo Keiki Inc., Weathernews Inc., and YDK Technologies Co., Ltd.

Furuno led the technical development group for the autonomous navigation system and technical development group for the emergency response system that contributed to the success of this demonstration test.

▶ Autonomous Navigation System

(APEXs: Action Planning and Execution System for full autonomous)

We led the team that developed the autonomous navigation system (APEXs: Action Planning and Execution System) that performs the voyages (from one port to another) as planned while preventing collisions based on information obtained from onboard sensors. We are also responsible for the development of the Maneuvering Support System that plays a central role in APEXs. The Maneuvering Support System integrates target information obtained from the Millimeter Wave Radar (newly developed for the demonstration tests), X/S Band Radar, AIS, and Camera Image Recognition System (manufactured by ORCA AI) to understand the ship's surrounding conditions. In addition, it includes functions to calculate the necessary maneuver plan for collision avoidance in cooperation with the collision avoidance planning system (manufactured by Japan Marine Science Co., Ltd.) and to send control commands to the autopilot, DPS, and speed pilot to control the next movement of the ship.

▶ Remote Emergency Response System

Constituting the Fleet Operation Center (FOC), REPS ensures the safety of the vessel by providing remote support and control from shore when the autonomous navigation system deems it necessary.



Maneuvering Support System screen shot



Remote Emergency Response System

Stage1: Fully autonomous ship navigation program

Demonstration of unmanned technology on Japanese container ships and car ferries (Mitsui O.S.K. Lines, Ltd. and 7 other companies)

This unmanned operation experiment was conducted on the commercial route of "Sunflower Shiretoko" (a large car ferry) in February 2022. The ship navigated about 750 km from the port of Tomakomai in Hokkaido to the port of Oarai in Ibaraki Prefecture for 18 hours, day and night.

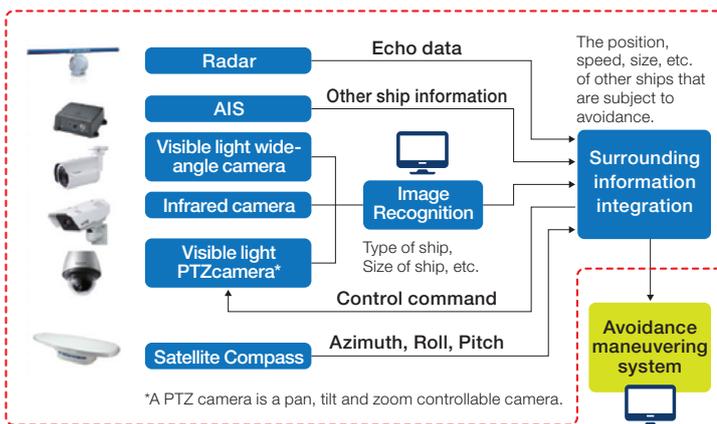
Mitsui O.S.K. Lines, Ltd, Mitsui E&S Shipbuilding Co., Ltd. Imoto Lines, Ltd. A.L.I. Technologies, Inc. MOL Ferry Co., Ltd. MOL Marine & Engineering Co., Ltd.



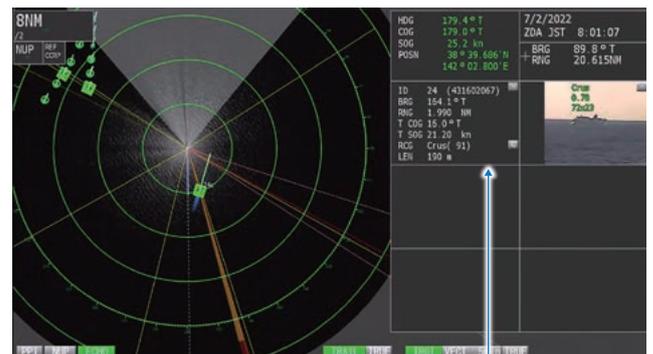
Furuno currently oversees the development of an automatic situational awareness system for the "Awareness" portion, which means that the navigators' constant watch is no longer necessary during the voyage. We are also working on the development of a Berthing Aid System that calculates the relative distance between the quay and the hull.

► Automatic situational awareness system

The automatic situational awareness system measures and displays positions, speed, vessel types and obstacle positions by integrating information from Radar, AIS and camera images information to the autonomous vessel operation control system to establish a safe route plan when there are other vessels or obstacles on the defined route.



- : Radar tracked target
- △: AIS receiving target
- : Camera image recognition target



A screenshot of the Automatic situational awareness system

Vessel type recognition result
Crus represents a passenger ship

Stage2: Fully autonomous ship navigation program

Demonstration of Fully Autonomous Ship Project

This program is positioned as the second stage of MEGURI2040 and aims for full-scale commercialization of fully autonomous ship technology to be realized by 2025. It is to accelerate and put into practical use of the concept achieved through "Joint Technological Development Program for Demonstration of Fully Autonomous Ship which was carried out as the first stage, in cooperation with the Nippon Foundation.

Furuno is involved in the development of autonomous navigation technologies, and the development of Fleet Operation Center.

► The Fleet Operation Center



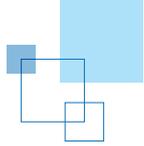
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Introducing products/technologies

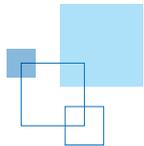
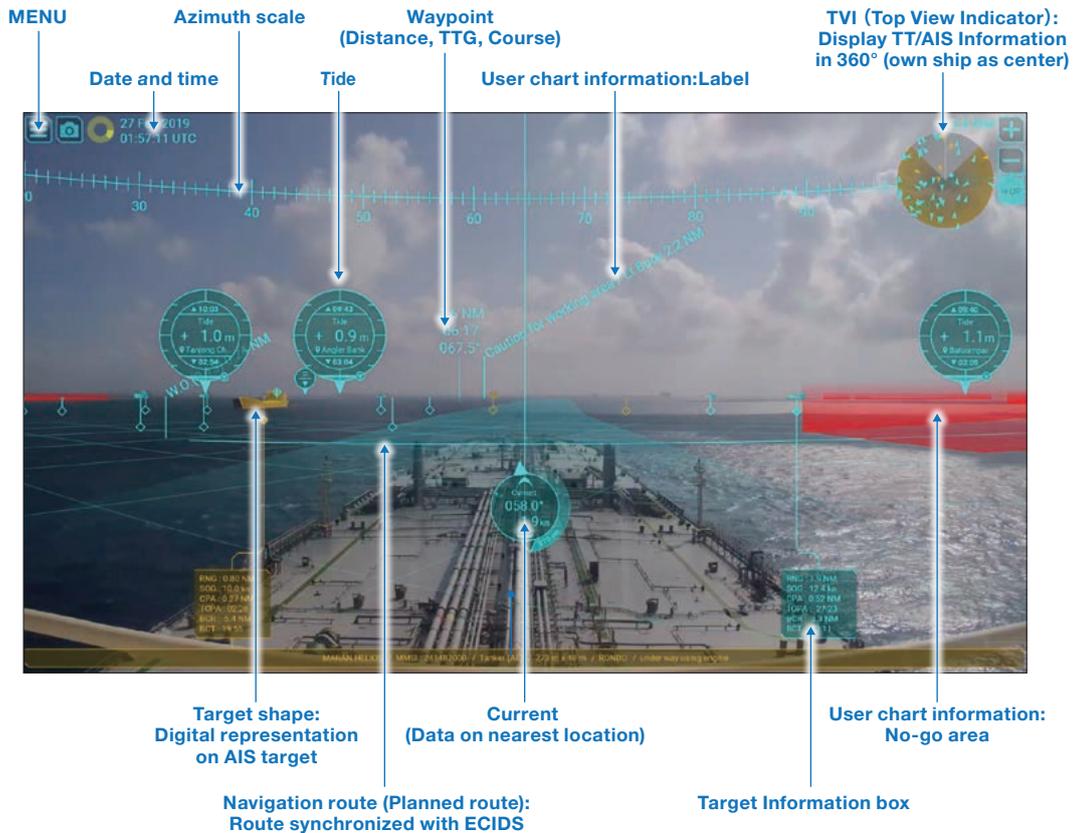
Furuno is developing new products and technologies to the future of unmanned ship navigation.



AR Navigation System

Recognition Support

The AR Navigation System is a navigation and maneuvering support system for ships that takes full advantage of Augmented Reality technology. The system uses AR technology to superimpose navigational information on images captured by a camera mounted in front of the vessel. Even in adverse weather conditions or at night when it is difficult to see, the display shows the ship's route and information on other vessels, making navigation much more peaceful, safe, and comfortable.



Camera Image Recognition System

Recognition Support

Using Artificial Intelligence technology, we are developing onboard cameras capable of identifying ship types, navigation buoys, and other objects. The camera will not only be used to identify objects but will also be combined with the Radar and AIS technologies already on board to achieve unprecedented object detection reliability, thus contributing to greater safety at sea without the need for human presence.



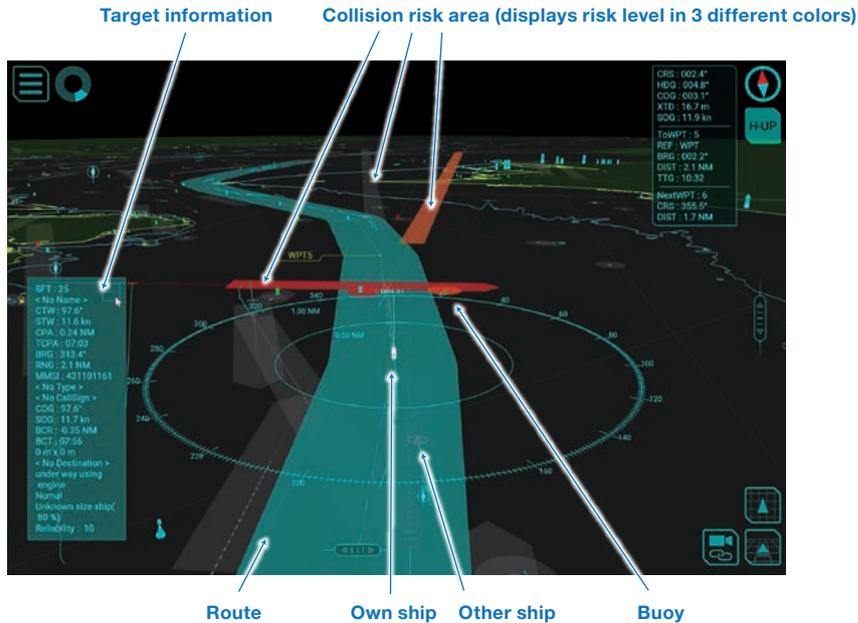
Radar display

Camera display

VR Navigation System (as known as 3D Bird View System)

Recognition Support

The VR Navigation System utilizes our unique virtual technology that provides the user with an overhead bird/third person view of their own vessel in 3D for maximum situational awareness around the vessel and safe navigation. This view mode overlays essential information such as chart information, Radar data, AIS and risk of collision areas. The height, angle, and zoom levels can be freely adjusted, allowing the user to check from all directions instantaneously to have full situational awareness in every direction at all times. It is a perfect support tool for safe route planning and collision avoidance, particularly in busy areas where dozens of vessels enter and leave ports at the same time.

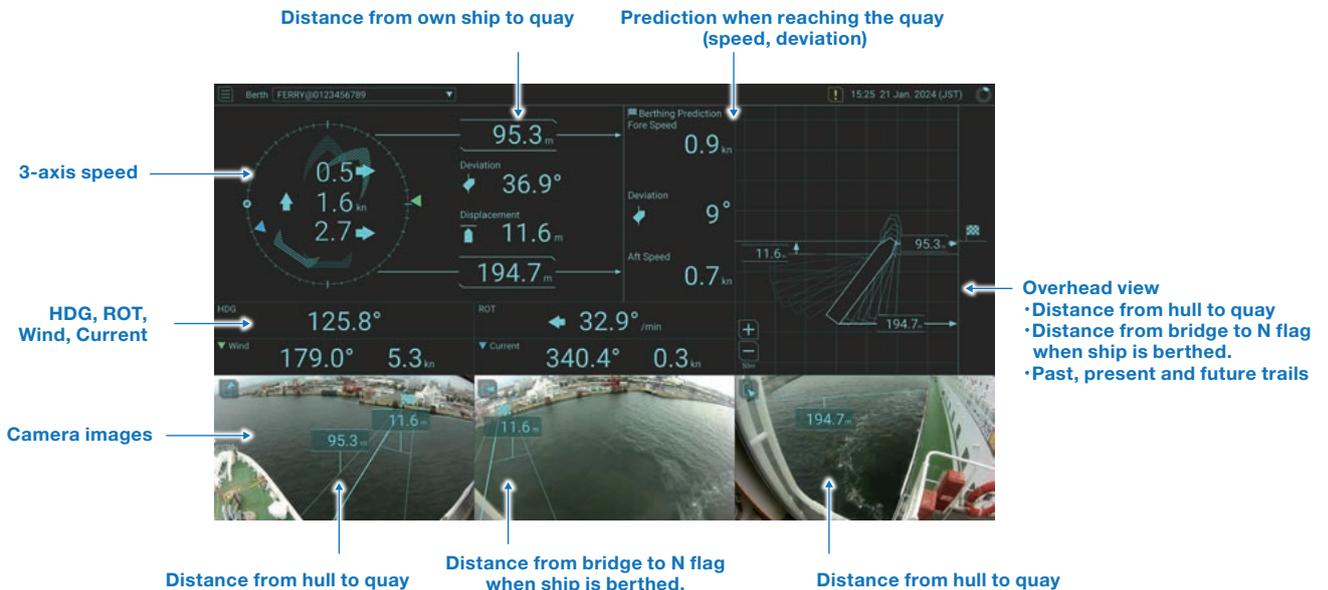


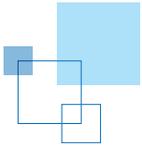
Berthing Aid System

Recognition Support

The Berthing Aid System automatically measures the accurate distance between ship and registered quay. In addition to the measurement results, conning information which are necessary for berthing/arriving maneuvers such as 3-axis ship speed (left/right (any two locations), front/back), ROT, wind direction/speed, tidal current, etc.

Providing such essential information reduces the burden on crews when maneuvering to and from the berth. Additionally, the ship's past, present, and future tracks are displayed on a bird's-eye view, and the measurement results are superimposed on camera images in AR, making it easier to understand the situation. The system also has a safety function that predicts and displays the speed and deviation when reaching toward the quay, and it will provide a visual alert if the vessel exceeds a designated threshold above the speed limit and may collide with quay.

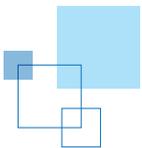
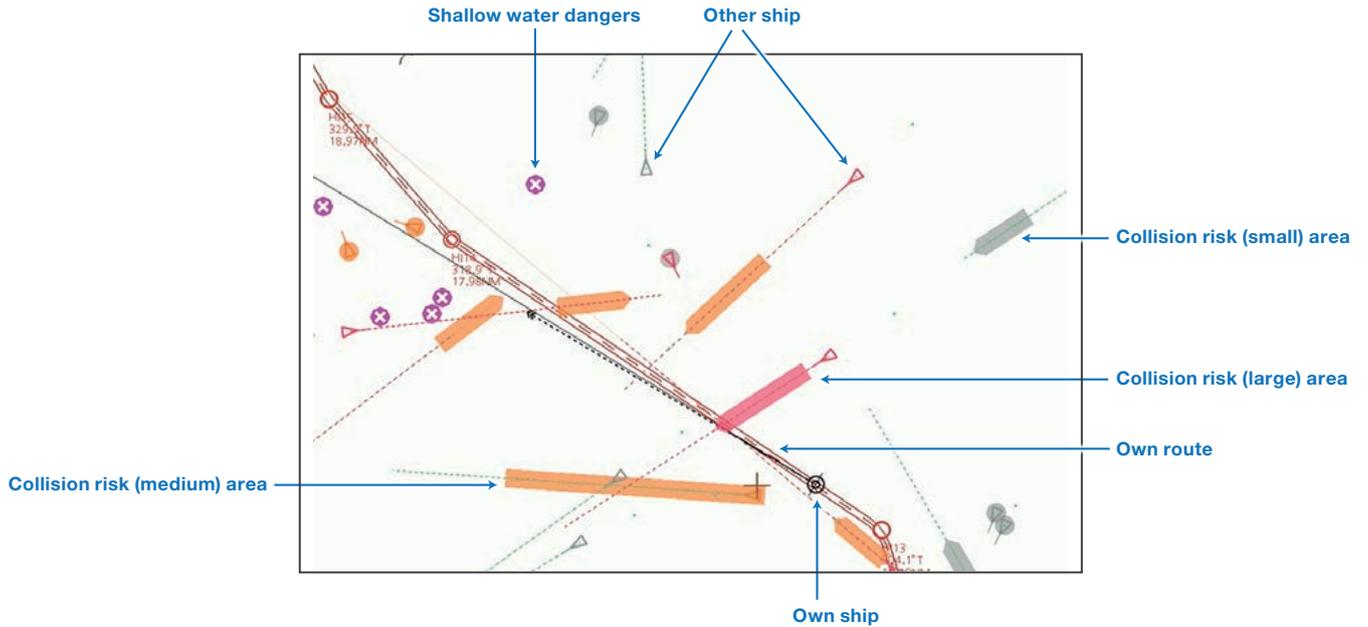




Risk Visualizer™

Decision Support

In extremely busy waters (such as ports entrances and exits), all vessels must make a continuous effort to watch out for other vessels in the vicinity in order to avoid a collision. Furuno's Risk Visualizer is an innovative technology that significantly reduces the risk of collision by alerting the user to potential collision areas with colored indications. This technology is based on an advanced algorithm that has studied and analyzed numerous data samples from real maneuvers and navigation data, provided by operators and navigators to obtain highly reliable predictions.

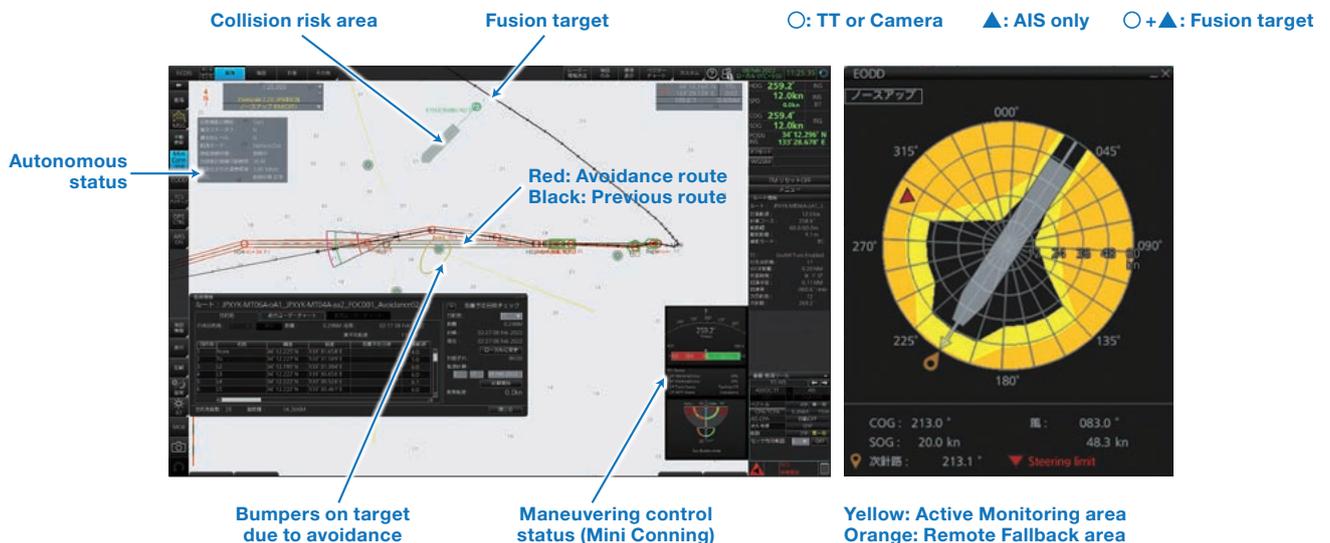


Maneuvering Support System

Decision Support

The Maneuvering Support System is a central element of the automatic navigation system in development to realize fully autonomous ships: the APExS-auto (Action Planning and Execution System for full autonomy) concept*. This unit integrates data from a multitude of different sensors to collect information accurately and identify objects around the vessel, detecting any potential risk of collision. Based on the information obtained, the Action Planning Unit calculates the best route and readjusts the course to take to avoid a collision. The route to be avoided is then automatically integrated into the current route plan, and the ship is redirected to follow the safest route via the DTC (Drive Train Controller: a group of functions that control the rudder, engines, thrusters, etc.). Thanks to its comprehensive integration capability, the Maneuvering Support System paves the way for fully autonomous navigation.

*A framework to realize fully autonomous ships proposed by NYK, MTI and Nippon Kaiji Kagaku, which has received basic certification (AiP) from the Nippon Kaiji Kyokai and Bureau Veritas. The system will achieve autonomous navigation through AI that will take over navigation-related tasks, such as information gathering, analysis, planning, and approval, which are currently performed by humans.



* Please refer to "MEGURI2040" Fully autonomous ship framework section.



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