imat

Integrated Maritime Autonomous Transport Systems

SINTEF

massterly
a Kongsberg Wilhelmsen joint venture

NTNU

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In 2016 the Norwegian authorities decided that Trondheimsfjorden should become a national test area for autonomous ships, and Kongsberg Seatex has, in addition to the vessel "Ocean Space Lab", the two unmanned vessels "Ocean Space Drone 1" and "2". *"The decision has been extremely important for the technology development in Kongsberg, and it was also Gard Ueland, CEO of Kongsberg Seatex, who was the initiator of the Test Area. Being able to get out and test our sensors and systems in real life is the ultimate solution. You can come a long way with simulations in the laboratories, but here (in the Test Area) there is weather and wind, and you can see that the systems behave as you have intended",*

Geir Håøy, CEO, Kongsberg Group
(From a news article in Adresseavisen, March 19 2022, translated from Norwegian)

"Massterly's main offering to the market is ship management and crewing of unmanned vessels (or vessels with lean manning) from a Remote Operations Center. The research, testing and findings from the IMAT project have been very helpful for our planning of both the infrastructure requirements and for the operations. Land-based sensor infrastructure and information sources add an extra safety layer for autonomous vessels and may limit the need for on-board system duplication and redundancy. The collaboration with VTS centers and their decision support solutions is also vital to make autonomous vessels a reality.",

Pia Meling, Vice President, Sales & Marketing, Massterly

"Trondheimsfjorden Test Area for Autonomous Ships, a corner stone in the suite of Fjord Labs which constitute a platform for the future Ocean Space Centre (OSC). The OSC will become the most modern facility for development, testing, and validation of advanced ocean technology for the future. The concept of Fjord Labs with full-scale test facilities is really what sets OSC apart. The OSC combines full-scale labs with state-of-the-art digital simulation and advanced model tank facilities. Trondheimsfjorden Test Area for Autonomous Ships is a great asset for developing sustainable solutions for the future.",

Vegar Johansen,CEO, SINTEF Ocean

"As the leading developer of maritime domain awareness and VTS solutions, the IMAT project has given Kongsberg Norcontrol the opportunity to apply our VTS domain knowledge to the development of remote operation centres, as well as to adapt our shore-based decision support solution for MASS operations. By providing a wide area traffic picture beyond what conventional ship sensors can deliver, our systems enable remote operation centres to perform long range proactive voyage planning, and to identify hotspots and areas of likely traffic congestion more easily.",

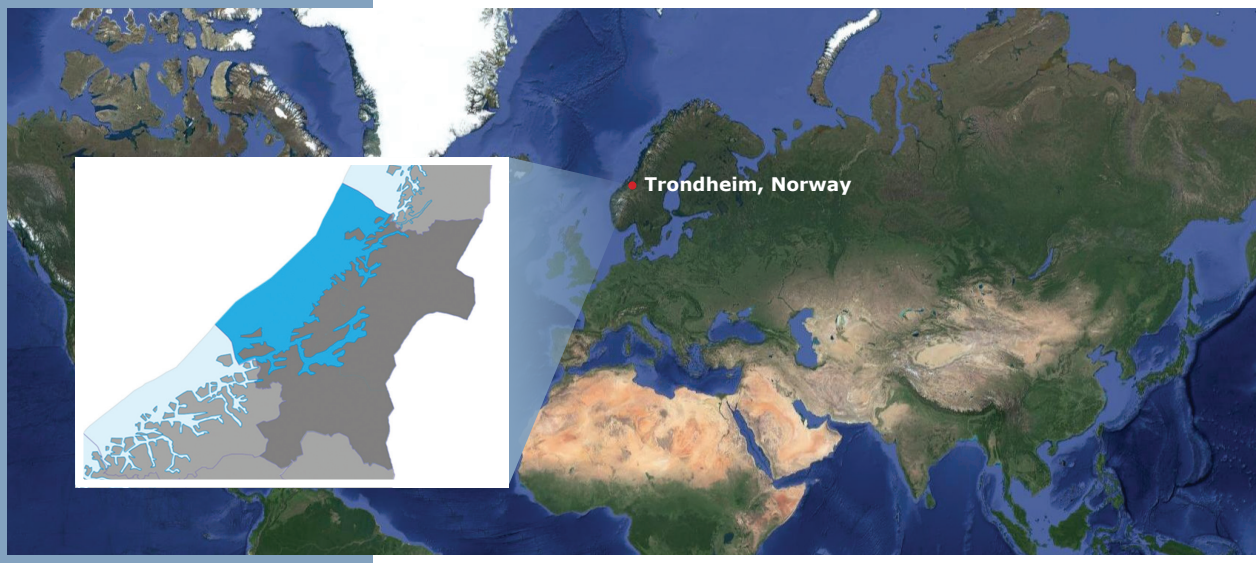
Kristoffer Ytterbø, Vice President of Technology & Products, Kongsberg Norcontrol

"Successful interaction with humans could be the challenge that makes or breaks unmanned, autonomous ships. It may seem contradictory, but humans will be an integrated part as engineers, programmers, remote operators or seafarers on conventional vessels. The interaction between humans and automation needs careful design to become intuitive, safe and efficient. Situational awareness is important, which has been demonstrated in the IMAT project.",

Thomas Porathe, Professor, Interaction Design, NTNU

Integrated Maritime Autonomous Transport Systems

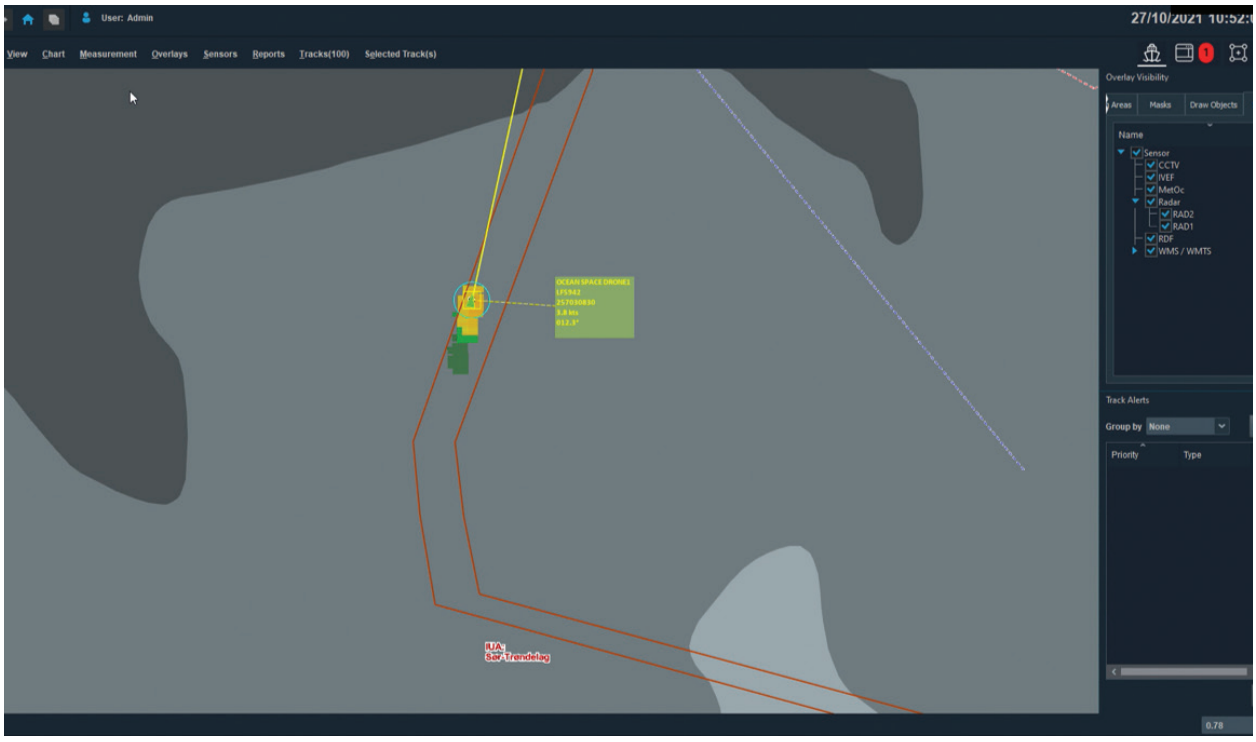
The IMAT project has developed and tested land-based sensors, communication systems and control systems which have been used as a support to the navigation and operation of autonomous vessels. The technological infrastructure is able to provide the transportation systems with increased sensor redundancy and will be an integrated part of the shorebased control centres, which shall ensure safe and efficient operations. A reliable infrastructure is crucial for a safe implementation of maritime autonomous transport systems. The main objective of the IMAT project is to define, develop, adapt and test the land-based sensor infrastructure.



Background

There is an increasing interest in autonomous transportation systems. According to the Norwegian government's national transportation plan, one goal is to be able to transfer more cargo onto keel, something which requires innovation. The MarOff, Maritim21, Hav21 and "den Politiske Plattformen" programs all agree that autonomous vessels are promising means for success. Water transport must be able to compete with land-based transport with regard to price, efficiency and regularity, and at the same time it should have an environmental gain according to the UN Sustainable Goals. Autonomous transport systems are one of the means of transferring cargo from truck to ship, but it must be documented that an autonomous transport operation can be carried out effectively, safely and with enough barriers against errors.

Ocean Space Drone 1



Test Area Control Centre at Kongsberg Seatex that operates vessels remotely. C-Scope used for monitoring, which is integrated with radars, AIS, and cameras located on shore.

The IMAT project has developed and tested land-based sensors, communication systems and control systems used as a means of support to autonomous vessels. The technological infrastructure will be able to provide the transportation systems with increased sensor redundancy, and as an integrated part of these systems the infrastructure will ensure safe and effective operations.

Test Area Control Centre

Test Area Control Centre (TACC): The Test Area Control Centre monitors and controls the installed infrastructure in the test area. The control centre can monitor activities and remotely control vessels involved in test campaigns by using the sensors and communication infrastructure. The control centre functions as a test lab for future studies of human interaction with autonomous operations. It also gives situational awareness to the operators of a test by presenting sensor data from the vessel and from the infrastructure.

C-Scope

Information Portal

Radar Pirsenteret

Camera Cluster

VDES 300

C-Scope: C-Scope is Kongsberg Norcontrol's 7th generation maritime surveillance system. It conforms with, and is compliant with, IALA VTS Standards, Recommendations, and Guidelines. C-Scope has been installed in the Test Area Remote Operating Centre. It integrates the two land-based radars with the Kongsberg Camera Cluster (onboard ship sensors) and the Kongsberg AIS base station in order to provide the complete maritime traffic picture for improved situational awareness.

The key features of C-Scope are its open architecture, autonomous services and flexibility. C-Scope's design is such that implementation of additional components will not change the basis of the system but will be a natural progression, with all information available in the same unambiguous manner for all users, without hazard.

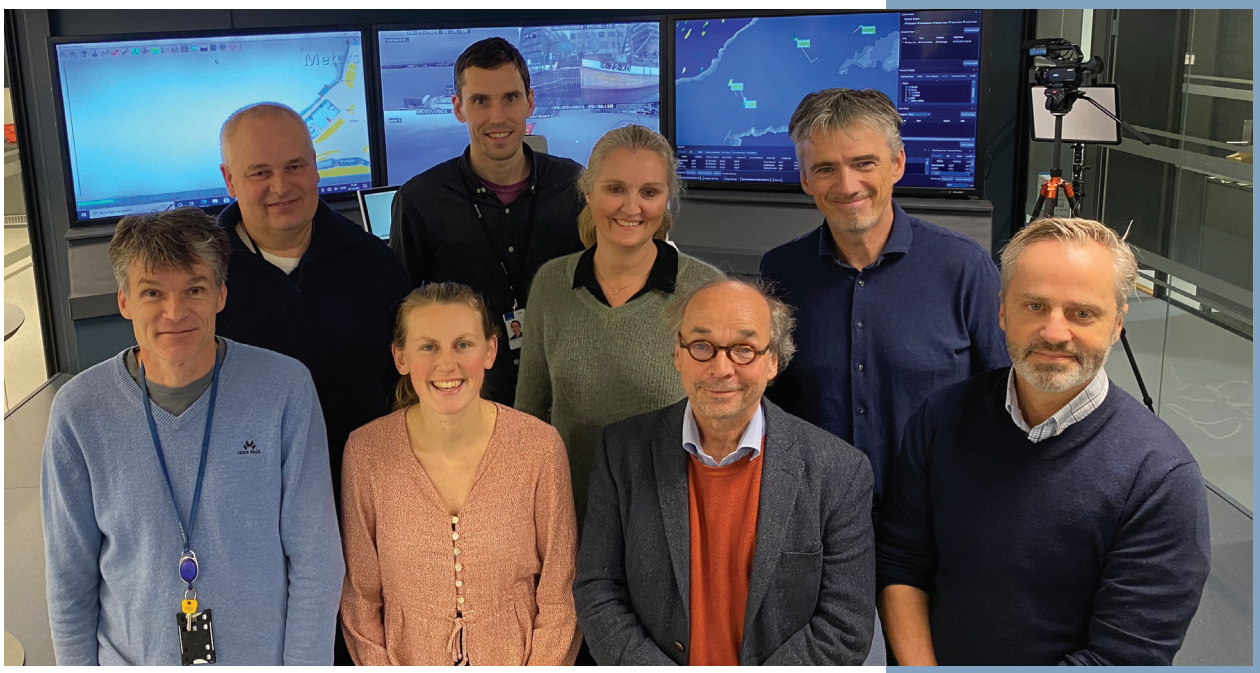
Information Portal: The objective of the Information Portal is to support users of the Trondheimsfjorden Test Area with information and functionality to assist maritime operations and to collect results from tests performed in the fjord. It is connected to sensors in the fjord, to the TACC, and to Web Map Services (WMS), providing maritime information that is of importance to safe and secure performances of a test campaign. The essential elements are to give information to assist autonomous trails for unmanned autonomous vessels, to prepare navigational decisions based on available data from the portal, and to compare results where applicable, and where the data can be shared. It is also a portal to visualize the content of resources and technology available in the test area.

Maritime Broadband Radio (MBR) Network: A closed communication network with MBRs allows broadband communication between test campaign vessels and the TACC, and between vessels in the area. The MBR is a safe and reliable communication link in maritime applications were high speed and high capacity is crucial.

Radar: Two X-band radars are installed on land in the Trondheimsfjorden Test Area, one at Trondheim harbor and one at Stadsbygda, across the fjord from Trondheim. The radar data from Stadsbygda is transmitted to the Test Area Control Centre via MBR. Data from the radar in Stadsbygda and the radar in Trondheim harbor are integrated and presented on C-Scope.

Situational Awareness: A Kongsberg Camera Cluster (KCC) is installed in Trondheim harbor. Together with Kongsberg SeaAware and Kongsberg ProximityView, this gives unrivalled situational awareness enabled by the latest in artificial intelligence and machine learning techniques in combination with traditional sensor fusion.

VDES: The VHF Data Exchange System is a two-way radio communication system that operates between ships, shores stations, and satellites. The system is developed as an international standard and is regarded as an extension of the Automatic Identification System (AIS). This new service allows up to 32 times more bandwidth compared to AIS. A Kongsberg VDES base station is available in the area.



The IMAT project team.

Ocean Space Drone 1 outside Munkholmen, Trondheimsfjorden.

https://www.sintef.no/projectweb/imat/

The project is coordinated by SINTEF Ocean and has Kongsberg Seatex, Kongsberg Norcontrol, Massterly and NTNU as partners. The project started in 2018 and was completed in 2022.

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