Satellite-based maritime security

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Modern piracy, illegal fishing, and dense traffic confront maritime authorities with a growing challenge. Under a project entitled ‘satellite-based maritime safety and security’, scientists of the German Aerospace Centre (DLR) are developing innovative technologies that contribute towards protecting the oceans and enhancing the safety of navigation.

In the fields of satellite missions and Earth observation as well as navigation and communication, DLR institutes possess eminent scientific expertise and a unique infrastructure. Both these components are involved in the development of information services under the satellite-based maritime security project, security in this case implying both security from attack and safety in operation. The objective is not only to detect illegal activities on the oceans more precisely and quickly but also to warn ships of heavy seas and approaching vessels.

This interdisciplinary subject is handled by two DLR research areas, Space and Transport. The scientists involved come from four DLR institutes: the German Remote Sensing Data Centre (DFD), the Applied Remote Sensing Cluster (MF), the Institute of Communication and Navigation (KN), and the Institute of Space Systems (RY). At the same time, activities relating to security from attack form part of security research, DLR’s cross-departmental programme under which defence- and security-related research and development activities are being planned and controlled.

Setting up a GMES real-time service for maritime security

One of the key terms in the field of maritime security is GMES, short for Global Monitoring of Environment and Security, a joint programme of the European Commission (EU) and the European Space Agency (ESA). Next to Galileo, GMES forms the second pillar of the European space strategy. In the field of Earth observation, DLR is currently developing several GMES services designed to assist in the surveillance of the oceans.

Within GMES, maritime security involves a multitude of remote-sensing data products which serve to evaluate the state of the sea, to identify sea ice and oil pollution, to measure wind forces, and to detect ships. DLR’s Remote Sensing Cluster has the scientific expertise necessary for developing highly complex algorithms with which such information may be derived from radar and other data.

The cluster’s specialists are particularly interested in amalgamating information derived from various satellite data into new products with an added value. Additional knowhow is provided by the Earth Observation Centre (EOC) which leads the field in merging remote-sensing data with information supplied by the international Automatic Identification System (AIS) with which all major ships on the oceans must be equipped.

Global identification of ships by AIS satellites

Coordinated by the Institute of Space Systems, the first AIS satellites and a terrestrial AIS test area will become operational shortly. AISat is the first German satellite which permits to observe the movements of ships worldwide from space. It assists in developing and supporting leading-edge methods and processes for optimising the routes of ships as well as for safeguarding Europe’s external borders, maritime shipping routes, and maritime infrastructures. With a high-gain helix antenna, signals from maritime distress beacons (AIS-SART) may be received as well.

An ultra-modern real-time data centre

All data ultimately arrive at the ground station of the German Remote Sensing Data Centre at DLR's Neustrelitz site in Mecklenburg-Vorpommern, where up-to-date information from the high-resolution radar satellites TerraSAR-X and TanDEM-X is processed in real time together with data from ESA's ENVISAT mission. To fulfil this task even better in the future, an ultra-modern real-time data centre is being built which will provide national and international maritime users with information extracted by a highly efficient process.

Neustrelitz has set an example by demonstrating that the movement data of a ship may be acquired within 15 minutes and forwarded within the same length of time to authorities and clients with statutory powers. In a test, DLR supported the Federal Maritime Police, the German Navy, and the European Maritime Safety Agency (EMSA) under the PIRASAT project in surveying the Gulf of Aden to suppress piracy. One case in point is the successful detection and subsequent surveillance of the tanker Sirius Star after it was taken by pirates. Moreover, DLR is deploying the test version of its real-time service in three projects, DeMarine-Sicherheit (BMWi), MARISS (ESA), and DOLPHIN (EU FP7).

- Under the DeMarine-Sicherheit project, various preoperational methods were tested successfully including, for example, the detection of ships from a certain size on up (gross tonnage ≥ 300) which are obliged to register but refuse to cooperate. In addition, a system to warn of heavy seas, high rogue waves, and parametric rolling was developed which makes use of DWD model results and ESA ocean wave monitoring data.
- Under the MARISS (maritime security service) project, an initiative of the European Space Agency, DLR has concluded agreements with the Federal Maritime Police. Under these agreements, European authorities and the Federal Maritime Police have received ship-detection products derived from ERS-2 and TerraSAR-X data in a matter of 15 and 35 minutes, respectively.
- Under the DOLPHN EU project, the delivery of combined real-time data from SAT-AIS and TerraSAR-X to European authorities is currently undergoing pre-operational trials.

The more data sources are available, the better can GMES real-time data be used. Consequently, DLR scientists plan to include other international satellite systems in the acquisition of data.

Improved safety for maritime traffic

DLR is also actively involved in improving the safety of traffic on the oceans. Related activities represent the operational safety component of the satellite-based maritime security project. The background is provided by the e-navigation strategy initiated by the International Maritime Organisation in 2006, under which the DLR Institute of Communication and Navigation is participating in a project entitled Maritime Traffic Technology: e-navigation integrity (MVT-EnavI).

In areas where traffic is very dense, such as the Baltic and the North Sea, it is important that all movements of vessels be registered reliably to further reduce the risk of ships colliding or running aground. This being so, the focus is on technologies like the "integrated positioning, navigation, and time system", AIS as a communication platform, and on traffic situation assessments whose integrity must be guaranteed to ensure shipping safety.

DLR's real-time services are already being used by a wide range of national and international organisations. By adding further radar satellites to the system, time coverage – which is still limited – will be extended in the future.

Providing additional complementary data products describing traffic situations for official use will add to the portfolio of DLR's facilities. Data users include the Federal Office of Maritime Navigation and Hydrography, the Federal Hydraulic Engineering Institute, and the German Weather Service. In the future, the real-time data services developed by DLR will assist in mapping maritime traffic situations, thus contributing towards enhancing safety on the oceans.

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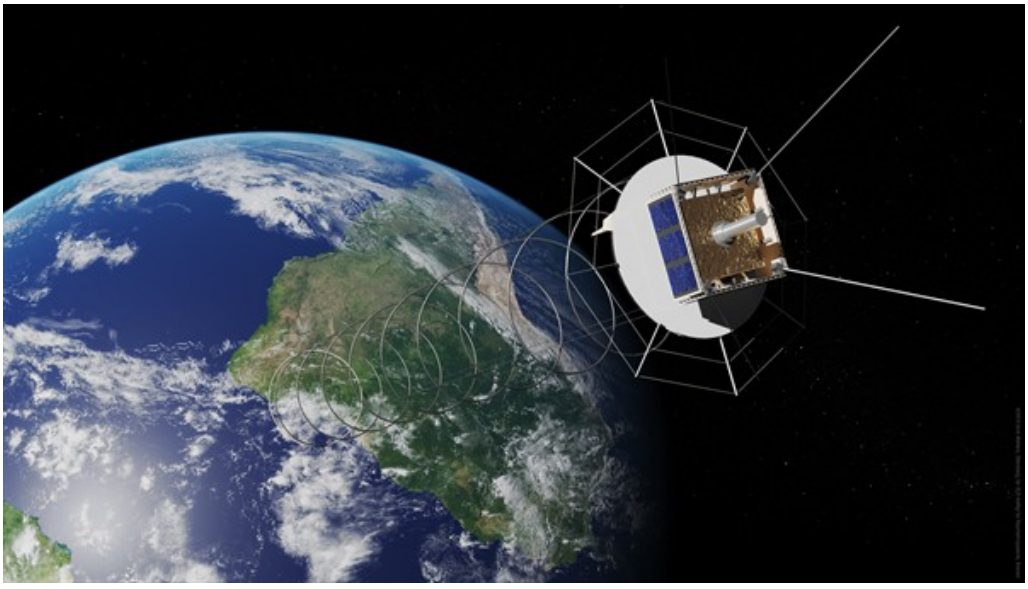
Special task force on an anti-piracy operation

Special task force on an anti-piracy operation.

Credit: Image: picture-alliance/dpa..

"AISat"



DLR´s satellite "AISat" monitoring world-wide marine traffic.

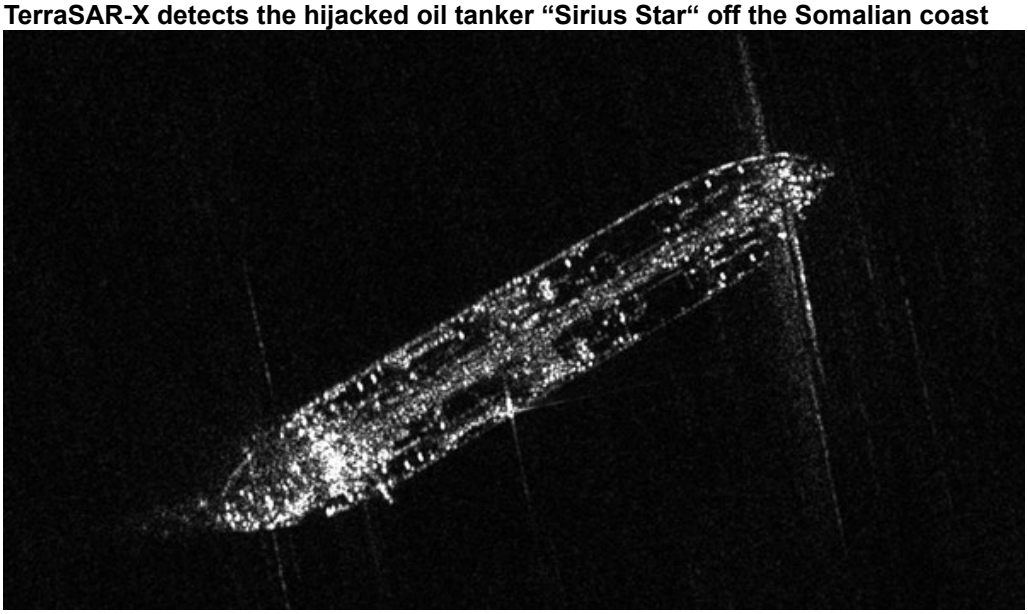
Credit: DLR (CC-BY 3.0).

"Sirius Star"

Oil tanker “Sirius Star“, owned and operated by Vela International Marine Ltd.

Credit: Image: picture-alliance/dpa..

TerraSAR-X detects the hijacked oil tanker “Sirius Star“ off the Somalian coast



TerraSAR-X detects the hijacked oil tanker “Sirius Star“ off the Somalian coast

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