Development of Pre-Operational Services for Highly Innovative Maritime Surveillance Capabilities

DOLPHIN aims at developing new tools providing effective improvements of the state of art capabilities in Maritime Surveillance with respect to users' needs, in particular by filling present Technological Gaps and by developing new algorithms and Decision Support Modules. The project involves 20 European players from all over Europe and focuses on three main Policy Areas: i) Border Surveillance; ii) Traffic Safety; iii) Fisheries Control.

Fig. 1 DOLPHIN developed new detection methods for the small, fast-moving boats used by drug smugglers. Credits: French Navy

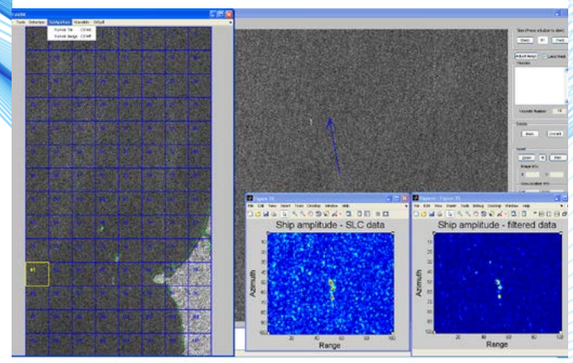
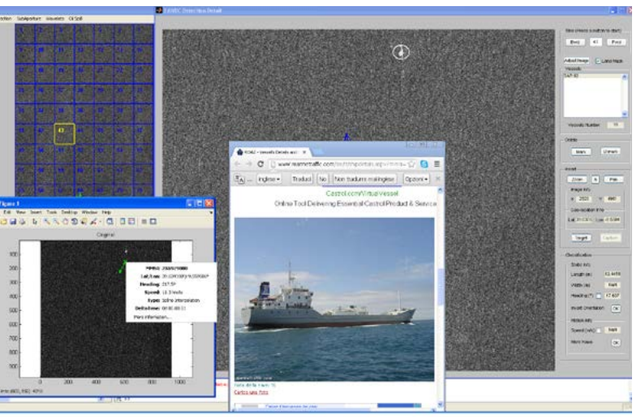


Fig. 2 Developed SAR sub-aperture algorithms were integrated in the Vessel Detection Software



Main Project Team

Paulo Alexandre Carapinha Marques	**PIA-Lx**

Funding Agencies

European Community FP7	**90,000€**
Start Date	01/09/2011
Ending Date	01/12/2014

Indicators

Journal Papers	1
Conference Papers	6
Concluded MSc	3

Two Main Publications

P. Marques, **Directional Moving Target Indication: A Novel SAR Ambiguity Function for Traffic Monitoring,** Journal of Electrical and Computer Engineering, Vol. 2012, No. 1, pp. 1 - 8, March, 2012.

P. Marques, R. A. Radius, **Velocity Vector Estimation of Moving Targets using C-Band SLC Strip Map SAR Data**, European Conference on Synthetic Aperture Radar, Berlim, Germany, Vol. 1, pp. 1 - 4, June, 2014.

PROJECT WEBPAGE URL

http://www.gmes-dolphin.eu/

GENERAL MOTIVATION AND OBJECTIVES

The European Union is committed to enhancing safety and security at sea along its maritime borders. New technologies are needed to address this challenge. The DOLPHIN project paves the way for their development.

Effective maritime surveillance is needed in order to address multiple contemporary challenges, from efficient fisheries control, and marine environmental protection, to law enforcement activities along the EU's maritime borders.

The project aims at developing key technological and operational gap-filling innovations, leading to the sustainable operational exploitation of the Earth Observation Satellites capabilities in maritime applications.

CHALLENGE

Satellite technologies provide important means to facilitate maritime surveillance. Yet the current state-of-the-art in this field of remote sensing at sea may be enhanced through the development of technologies enabling a more interoperable surveillance system.

Interoperability at sea means bringing together existing monitoring and tracking systems used for maritime security and safety, fisheries control, protection of the marine environment, control of external borders and other law enforcement activities.

The project DOPHIN explores how maritime situational awareness can be enhanced by the use of space assets that support operations carried out by civilian and military authorities such as monitoring of sea pollution, maritime traffic, and the fight against illegal trafficking of human beings and drugs.

Indeed, DOLPHIN aims at filling the identified technological gaps in current operational surveillance systems, in accordance with specific policy-driven requirements and scenarios arising from the EU. In particular, DOLPHIN will facilitate the detection of "small and non-cooperative maritime objects" by means of innovative radar satellite technologies in response to such policy needs.

Bringing together a consortium of partners with a solid background and expertise in the marine surveillance domain, DOLPHIN builds upon the achievements of previous projects in the area of GMES marine security, such as LIMES.

WORK DESCRIPTION AND ACHIEVEMENTS

The DOLPHIN project is aimed at developing highly innovative tools, bringing the maritime surveillance into new possibilities: detecting small vessels, bringing vessel classifying into operational use, building intelligence tools to recognize abnormal behaviours at sea.

The main technological step made by the Instituto de Telecomunicações team was the use of Advanced Single Channel SAR processing to better detect small and fast boats, characterization of vessel motion parameters and enhanced identification of targets on the sea. The developed algorithms were incorporated in a vessel detection software that is being operationally used in the framework of the MARISS project which includes the capability of detection and classification from different types of SAR data and allows the characterization of the detected targets in terms of time, position, size and velocity. It also provides a correlation functionality which allows correlating non cooperative detections (made through SAR imagery) with the available cooperative information (AIS, VMS, LRIT) for detection of suspect boats. The software also allows "Local Area Analysis" functionality, with the aim to perform a dedicated analysis in a local area of interest, to find potential moving and small targets. Results of this analysis largely depend on the resolution, data type, and are constrained by the physical limitations.

Other contributions made by the international team were:

- Use of sea state modelling to extract sea state and meteorological parameters from high resolution SAR images.
- Use of feature extraction and recognition to recognize man made features in imagery, detect irregularly shaped wakes produced by manoeuvring vessels, enhance ocean imagery, classify ships based on silhouettes generated from a 3D image.
- Use of multi-sensor data fusion to accurately predict the vessel tracks, icebergs, and shipwrecks, performing also accurate geo location of SAR images in which the positions of the objects of interest are detected.