Role of radar in implementation of the ISPS code

Vladimir Stoiljkovic, Easat, Stoke-on-Trent, UK

Introduction

The International Ship and Port Facility Security (ISPS) Code has been introduced by the United Nations via the International Maritime Organization (IMO) to address the threat to the maritime industry posed by terrorism and other illegal activities. The Code was approved in December 2002 and became a law on 1st July 2004.

Particular threats are usually perceived to come from small craft, such as rubber boats, in littoral waters.

The Code presents a standardised framework to evaluate potential risks and then assess and address vulnerabilities. It is more than a list of physical security measures and could greatly enhance information gathering for port authorities.

It should be noted that many ports will require sophisticated electronic equipment to meet the security requirements as well as enhance the capabilities to support safe navigation.

Electronic sensors

A complete operating picture of the maritime traffic is obtained by use of electronic sensors. Standard HF and VHF radio technology as well as more recent AIS technology are used for this purpose. AIS is, as many are aware, a transponder-based system being mandated by the IMO. In addition to identification and location, it can provide other important data on the vessel, its voyage, cargo etc.

Both AIS and VHF radio are co-operative systems. This implies that vessels have to follow certain rules and do their best to help port authorities generate a complete maritime picture. Obviously, these systems cannot be relied upon to track vessels which do not want to be seen. The AIS, as well as radio equipment, might not be available on a small vessel or might be even deliberately switched-off. Non-cooperative systems are needed to ensure that all the vessels are seen, regardless of their intentions.

The co-operative systems provide important data, which can assist port authorities in performing risk assessments for the port at any particular time. They play a critical role in identifying the large majority of vessels that are not considered a threat and lead to alerting authorities to potentially dangerous vessels, as seen by non-cooperative sensors.

The most commonly used non-cooperative or independent monitoring systems are: Sonar, CCTV, thermal imaging and radar. All these systems have their advantages and disadvantages. For example, sonar has a relatively limited range and inadequate resolution in bearing, whereas CCTV works well in conditions of good visibility, but has limited coverage comparing to radar and does not provide range information. Hence, the major role in monitoring of non-cooperative targets is played by radar.

There are a number of radar equipment manufacturers, who offer often a bewildering range of products. The products specifications as well as its pricing vary considerably. Although it is very tempting to reduce the cost of acquiring new equipment, very often low-cost radars do not meet security requirements.

The following section is intended as a guide to help choose the radar equipment most suitable for high security monitoring of unfriendly vessels.

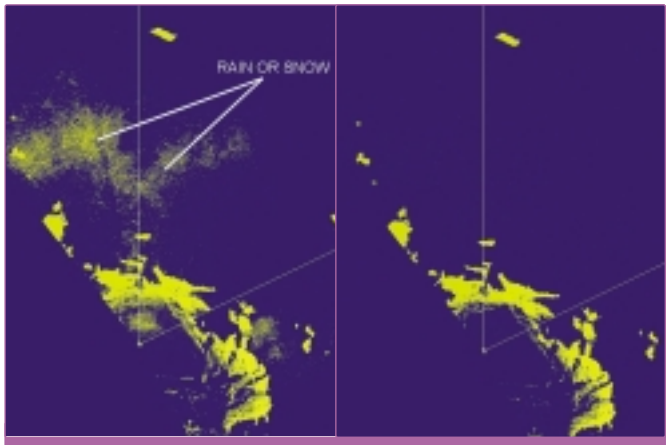
Radar sensors

Particular threats are usually perceived to come from small craft, such as rubber boats, in littoral waters. Such threats are generally low observable radar targets for several reasons: Firstly, the small physical size means that they do not produce strong reflections. Secondly, the sea itself is moving, producing varying reflections which may be mistaken for real targets. Furthermore, small craft can hide behind big vessels. Hence, standard maritime radars are not considered adequate for the high security requirements and more sophisticated radar equipment is needed.

For optimal detection of small targets the radar sensor has to have the following characteristics:

- High antenna gain to obtain reflections from very small targets;
- Low antenna sidelobes to discriminate real targets from the background interference and sea clutter;
- The ability to provide reliable performance in extended periods of severe weather by means of antenna polarisation switching and use of dual X and S bands of frequencies; and
- Narrow azimuth beamwidth to improve the resolution between adjacent targets. Narrow azimuth beamwidth also reduces rain and sea clutter.

High-specification radar provides coverage even in severe weather conditions.



Left: Radar picture clearly showing rain and snow.
Right: By switching the antenna polarisation rain and snow disappear from the radar picture, enabling better detection and visibility of small targets.

- Wide dynamic range to detect targets in different sea conditions in different areas;
- Sensitivity Time Control (STC) for the discrimination of sea clutter and close range echoes;
- Additional sea clutter reduction capabilities; and
- Detection and tracking independent of sudden changes in target speed and course.

Radar detection and tracking

Modern radar systems have for some time now offered advanced features such as automatic tracking of vessels and geographical mapping. Geographical masks or areas can be introduced to define forbidden zones, speed limit zones, traffic separation zones etc. However, in order to detect and track small vessels trying to evade authorities, sophisticated methods of detection and tracking are required. Specialised software algorithms which ensure successful tracking even in extremely difficult weather and sea conditions have to fulfil the following requirements:

- High probability of detection;
- Low false alarm rate;
- Ability to discriminate between close targets;
- Noise and clutter suppression processing techniques;
- Stable tracking and rapid manoeuvre detection;
- Analysis of target movements to identify suspicious behaviour patterns; and
- The application of predefined alarms that respond to entry into zones or in close proximity to other targets.

Portable radar stations

The area of coverage of fixed radar stations can be quickly recognised and the illegal traffic can be directed outside of the existing coverage areas. The radar coverage areas can be extended and continuously changed by use of transportable radar stations. In this way the detection zones can be made unpredictable and hence their employment increases the probability of preventing illegal activities.

Portable radar stations are housed inside equipment containers. The containers can be moved around by a helicopter or a lorry. If a more rapid deployment of radar stations is required, the radar sensor can be housed inside a van. In both cases the radar sensors are self-contained, having power generators, air-conditioning and radio communications. The radar stations employ magnetron based transceivers, Frequency Modulated Continous Wave (MCW) transceivers or a combination of both.

Summary

The implementation of ISPS code calls for improved detection of small craft in littoral waters.

The use of radar sensors is a primary tool in detection of small unfriendly vessels.

In most cases the high quality radar data may be the only source of information indicating the position and movements of vessels posing security threats.

A careful choice of radar parameters is very important for the detection and discrimination of small targets.

*This is an updated version of the paper "Radar detection of small targets", published in **Port Technology International**, 25th edition.*

ABOUT THE ORGANISATION

Formed in 1987, **Easat** is a subsidiary of Goodwin plc, a British privately owned engineering group established in 1883. Easat is a giant exporter having its components and systems installed in over 30 countries around the world.

Easat supplies high specification radar sensors for coastal surveillance and security critical applications. The sensors combine high gain antenna technology with the state of the art transceiver equipment enabling integrated surveillance of sea and air targets.

Easat specialises in long range coastal surveillance radars. The coastal radar equipment is capable of detecting small targets at short and long ranges in severe weather conditions hence reducing the risks posed by terrorism, illegal immigration, arms and drugs trafficking, etc. Other applications include long range Vessel Traffic Management Systems (VTMS), home land security, search and rescue, fisheries management, pollution management and so on.

Radars can be configured for the detection of sea surface targets only or for combined air and sea surveillance.

The wide range of radar sensor models enables Easat to meet technical, operational and budgetary constraints by delivering tailored solutions for the coastal surveillance applications.

The radars consist of a modular family of specially developed antennas, transceivers and radar processors. Each of these is chosen from a range of high performance, proven sub-systems, either designed by Easat or built to Easat specifications.

Easat can provide customers with radar performance predictions and recommendations in the choice and architecture of radar sensor systems. These can comprise antennas, transceivers, towers, foundations, equipment cabins and other equipment necessary to provide a complete radar sensor system including full civil engineering works.

ENQUIRIES

Easat
Goodwin House, Leek Road
Hanley, Stoke-on-Trent, ST1 3NR
UK

Tel: +44 (0)1782 208028
Fax: +44 (0)1782 208060
E-mail: vstoiljkovic@easat.co.uk
Web site: www.easat.co.uk