

Radar detection of small targets

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Introduction

There is a growing interest in the resources needed to enable Port Authorities to successfully implement the International Code for the Security of Ships and Port facilities (ISPS) code. The code advocates the appropriate use of technology to prevent security threats.



Figure 1. All maritime traffic must be monitored for security reasons.

In order to obtain a complete operating picture all maritime traffic must be monitored as it enters, exits and passes through the area of coverage. All vessels must be identified, clearly specifying their position, cargo, intent etc. Standard HF and VHF radio technology as well as the more recent Automatic Identification System (AIS) technology is used for this purpose. AIS systems in particular, have shown great promise in reducing or even eliminating the task of mundane and error-prone transfer of information between vessels and Port Authorities.

Both AIS and VHF radio are cooperative systems. This implies that vessels must 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 that do not want to be seen. Non-cooperative systems are needed to ensure that all vessels are seen, regardless of their intentions.

The most commonly used non-cooperative or independent monitoring systems are sonar, CCTV, thermal imaging and radar. All of these systems have their advantages and disadvantages. For example, sonar has relatively limited range

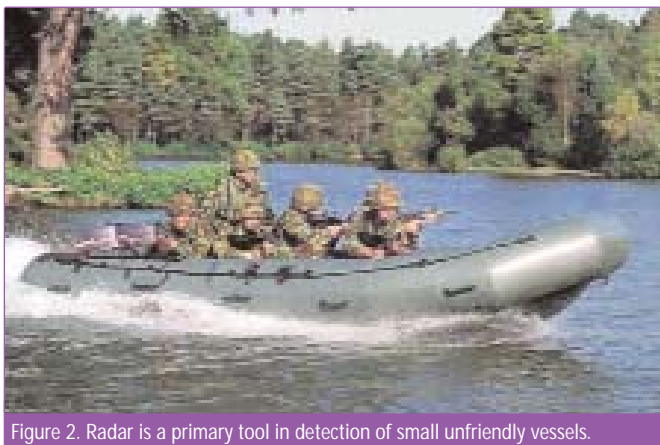


Figure 2. Radar is a primary tool in detection of small unfriendly vessels.

and inadequate resolution in bearing, whereas CCTV works well in conditions of good visibility, but has limited coverage compared 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 often offer a bewildering range of products. The products' specifications as well as their pricing vary considerably. Although it is 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

For optimal detection of small targets the radar sensor must 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 polarization switching and use of dual X and S bands of frequencies;
- Narrow azimuth beamwidth to improve the resolution between adjacent targets. Narrow azimuth beamwidth also reduces rain and sea clutter;
- 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.



Figure 3. Quality radar equipment must provide reliable performance in severe weather conditions.

Radar detection and tracking

For some time now, modern radar systems have 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 track and detect 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 in fixed radar stations can be quickly recognised, and the illegal traffic directed outside of the existing

coverage areas. The radar coverage areas can also be extended, and continuously changed by the use of transportable radar stations. In this way, the detection zones can be made unpredictable, hence their employment increases the probability of preventing illegal activities.

Portable radar stations are housed inside equipment containers that can be moved around by helicopter or 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, with power generators, air-conditioning and radio communications. The radar stations employ magnetron based transceivers, Frequency Modulated Continuous Wave (FMCW) transceivers, or a combination of both.

Summary

It has been concluded that the use of radar sensors is a primary tool in the 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 a security threat. A careful choice of radar parameters is very important for the detection and discrimination of small targets. The overall performance of the surveillance system is mainly dependent on the quality of the radar sensor.

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.

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