EMERGING ASPECTS ON MODERN SHIP RADAR SIGNATURE AND INTEGRATION OF NEW SENSORS

Lt Cdr PV Kartik

The management of signature performance for modern ship platforms involves many innovative methods and procedures. The following paper addresses some basic concepts specifically focused on the electromagnetic design process for naval platforms and the need for concurrent interactions with other ship design areas.

Introduction

Signature management for modern warship design is increasingly crucial for continued existence and consequently, for its operational performance. The new generation military warship requires significantly improved ship signature as regards the absolute radar cross section (RCS) levels and the ship imaging features.

The absolute RCS level of the ship is a result of the overall integration of the scattering contributions from the ship structures. The ship imaging features imply an additional need to carefully identify and control the spatial distribution of these scattering

centres, represented as hot spots in 3D analyses of the platform. It is the improved discrimination and recognition features of new radar sensors that have made it important to know the distribution of scattering centres and its related signature properties. Accordingly, there is a need for the design of stealthy ships together with low signature imaging properties.

A ship's ability to manage its own signature according to its mission is becoming crucial to military strategies. For instance, the possibility to modify a ship signature from peace time status to war status will improve that ship's chances of survival. So, apart from designing a low RCS ship, suitable camouflaging criteria and methods must be identified to obtain the desired signature properties.

Camouflage Techniques in the Pipeline

Signature management through camouflage techniques is a formidable engineering challenge to be addressed. The basic scope of signature management is the need to reduce the possibility of a ship being classified in peacetime and thus being recognisable in times of conflict. In addition, the ability to change ship signature can be used to optimise deception techniques. These aspects will have a dramatic impact on the ship design process, necessitating a major re-think on the design philosophy. Previous experiences have clearly indicated that the most significant RCS contributions come from scattering centres localised on the superstructure. They also come from certain topside mounted equipment and combat system components - including important contributions from the antennas installed on the upper deck.

The first goal of the design process is to reduce the absolute RCS level of the ship, allowing some margin with respect to the environment RCS noise level, which is dependent on the type of the ship and its perceived missions. Such a goal requires, as a general criteria, to clean up the 3D geometry of the superstructure.

To achieve this optimisation, the approach to ship construction, sensor integration and the use of special materials plays a fundamental role. They will require the appropriate application of suitable shipbuilding technology, innovative combat system design, advanced materials design capability and novel integration processes taking into account the whole range of ship requirements and constraints. For instance, in the same EM engineering process, optimising the integration of combat system sensors can conflict with regard the optimisation of RCS and IR signatures. In order to approach these problems in the best way, industry and government departments are defining new team organisations that get involved early in the design process right from feasibility studies, with concepts such as Integrated Topside Design or Technology Mast concepts, in which the relevant new design processes are investigated.

Two main concerns are raised in such scenarios. The first is the need to identify metrics by which projects can measure the performance and the effectiveness of design alternatives to make optimised design choices. The second is relevant to the re-definition of the methods and tools needed to perform the trade off design studies. This requires innovative methodologies applied to concurrent design approach.

Stealth Frigates in the Indian Navy

The 1135.6 frigates have a much smaller radar and IR cross section than the traditional destroyers and frigates. The drastic reduction in cross section will not only reduce the acquisition range of an anti-ship missile's terminal seeker but also greatly increase the effectiveness of the ship's countermeasures against that seeker. The 1135.6 frigates is also a more automated ship, with a design goal of sixty percent of the crew of traditional destroyers and frigates. This will significantly reduce operating costs, and therefore lifecycle costs, which will produce a revolution in surface ship cost-effectiveness.

Integration of New Generation Sensors on Existing Platforms

With the advancements in Radar technology, the relevance of existing technologies is fast becoming obsolete. The replacements of the sensors onboard much before the expiry of the designed life of the system is a reality which needs to be implemented to keep the technological edge over our adversaries.

The latest sensors are being sourced from a variety of suppliers across the globe and are no longer restricted to specific countries. This increases the logistic train to be conceptualised and maintained to sustain these systems over the expected life cycle of the ship. The following issues are considered necessary for the successful integration of new sensors onboard existing platforms:-

(a) Comprehensive trials on a test platform prior series installation.

(b) Adequate training of the support staff prior to the transfer of technology and Onsite Warranty by OEM for specified duration.

(c) Adequate OBS, B&D and LTE spares.

(d) Comprehensive documentation for execution of third line of maintenance.

(e) Complete transfer of all software's embedded onto the PCBs fitted in the system.

Way Ahead

In the age of modern warfare, the likely hood of ever sighting the enemy is miniscule, thereby making it mandatory to become invisible and increasing our own radar performance. The Navy has already embarked to transform itself into a Stealth centric force with these aspects in mind and the effectiveness with which these ideas are implemented will separate us from our contenders.

****

ABOUT THE AUTHOR

Lt Cdr PV Karthik (51547-A) is an alumnus of the Naval Engineering Course , INS shivaji and is presently serving as Electrical Officer onboard INS Prabal. His past appointments have been as ALO ND&C onboard INS Rajput and as 0 i/c SAM & RFO in INS Kalinga.