ABSTRACT

From the beginning of military warfare, it has always been extremely important to know the enemy position and hide oneself to capitalize on elements of surprise and initiative, and same is true for naval warfare. Radar is the primary instrument used for detecting enemy platforms today. Radar detects a target by clocking time taken by a known pulse of electromagnetic energy to get to the target and return. Radar cross section (RCS) is the measure of reflective strength of a target. Reducing the RCS of a platform implies its late detection, used to capitalize on surprise and initiative. RCS is also important for survivability evaluation since most modern weapons use installed radars during final engagement phase. As a result, RCS of a warship has transformed into a very important design factor for stealth to achieve surprise, initiative and survivability. Thus accurate RCS determination and RCS reduction are matters of extreme importance.

The purpose of this study is to provide an understanding RCS reduction and RCS determination methods used on warships today. In doing so, this study will discuss importance of RCS, radar fundamentals and RCS basics, RCS reduction and RCS determination methods. It will also present hindrances in optimizing RCS on warships, impact of these hindrances on navies around the world, and comment on possible remedies to these hindrances.

Keyword list: Warship, Naval Ship, Stealth, Radar Cross Section, RCS, RAM

1 INTRODUCTION

Since the beginning of the of the military warfare, knowing the enemy position and hide oneself have been objects of enormous interest and provide significant gain into achieving the elements of surprise and initiative. Same has been the case in naval warfare. In the early days, ships could only be detected through visual means. Detection depended on operating conditions such as available light, fog and rain etc. Ship characteristics such as size, shape and color scheme also played important role. The curvature of earth came into play limiting the visual horizon, making the height of a ship, decided by mast, the primary design factor for detecting enemy ships. In the era of sail ships, the first one to detect the enemy would position himself towards windward side to be more manoeuvrable, and close in until the enemy was in range of his guns. Exhaust Plume was the primary detection factor in the early era of engine propulsion. In this area, early detection was utilized to position oneself at better tactical location in battle and fire first.

Then came the radar, detection process and parameters completely changed with the invention of radar. Radar detects a target by clocking time taken by a known pulse of electromagnetic energy to get to the target and return. This energy travels in the form of electromagnetic waves. Electromagnetic waves laws were established by the year 1900. However, major developments were seen in late 1930s after the invention of cavity magnetron to transmit high power electromagnetic waves at high frequencies \[^{[1]}\]\[^{[2]}\]. Since its invention, radar has enormously influenced all domains of military warfare, including naval warfare. Radar is extensively used in military platforms during detection, tracking, classification and engagement cycle \[^{[3]}\]\[^{[4]}\].

Radar Cross Section (RCS) is the measure of reflective strength of a target, so it decides how early a target can be detected. Reducing the RCS of any military platform implies its late detection, which enables one to capitalize on surprise and initiative. RCS of military platform is also important since most modern weapons have installed radars, for use during final engagement phase \[^{[5]}\]\[^{[6]}\]. It implies that a ship with less RCS would not only be detected late, it would