Senior Design Project in Electrical & Computer Engineering

Antenna Modeling for WPB-110 Class Cutters

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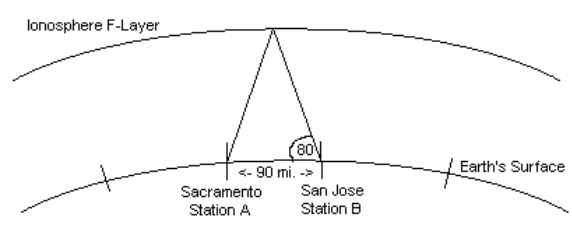
Sponsor: TISCOM

Project Background

The WPB-110 class cutter is a very important cutter in the fleet as shown by the numerous SAR cases and law enforcement operations in which it is involved. Good communication is essential for the crew of any cutter so that they may receive proper guidance from their superiors. The HF antenna is one of the main means of communication on the cutter. However because of the low take-off angle, it is unreliable within a range of 50 to 500 miles. This is because a low take-off angle creates a large skip zone. A skip zone is the area between where the ground wave ends and where the sky wave returns to earth after bouncing off the ionosphere. A ground wave is a signal that travels directly along the earth's surface. This continual contact with the surface will generally weaken the signal quickly (in this case within 50 miles). In the below picture, a sky wave with a relatively high take off angle is shown. Therefore, the skip zone is not very large. There have been many complaints from the fleet in regards to the WPB-110 class cutter's communication abilities via HF. My objective is to improve the system and eliminate these complaints. I believe that a new antenna can be made with a much smaller skip zone and better HF communication abilities in the 50 to 500 mile range.



Example of sky wave reflecting off the ionosphere

Project Plan

The project plan is to design an antenna for the 110' class cutter that will extinguish the skip zone. This antenna will be a "towel bar" antenna, and will produce Near Vertical Incident Sky Waves (NVIS). These NVIS bounce off the ionosphere quickly, allowing reception of the signal within the 50 to 500 mile range. The antenna will also have to meet all safety standards dealing with the crew's exposure to electromagnetic waves.

Project Work

Finding the right antenna to accomplish our goal will be an arduous task. First, the antenna must work with the current system, meaning that only the antennas need to be replaced. The antenna must have certain characteristics so that this is accomplished. Second, the antenna must meet safety standards. Third, the antenna must produce positive results. The magnitude of the success will be determined by studying the radiation pattern and signal strength that the antenna produces. Most of this will be accomplished through computer modeling using a program called WIPL-D. Once a few antenna models are picked, they will be studied by building the antenna on a WPB-110 class cutter model. Eventually, we plan to test my final antenna on an actual WPB-110 class cutter to see how well the antenna performs.

Project Deliverables

The project will deliver both a new antenna, and designate an area in which it will be installed. An installation area will also be found for the upcoming WPB-123 class cutters. In addition, all of the test data of the different antennas will be submitted to help validate the reason for choosing the final product. Engineering sketches of antenna placement will also be included in the final report.

Towel Bar Antenna

WPB-110 Class Cutter