Senior Design Project in Electrical and Computer Engineering

DGPS Antenna Modeling

Cadet 1/c Jon Young | Advisor: Dr. McKaughan | Project Sponsor: USCG C2CEN

Project Background

The Differential Global Positioning System (DGPS) augments the GPS system by broadcasting differential corrections to a local area. This system was declared FOC by the Coast Guard in May 1999. Several antenna problems have occurred, including insulator disintegration and outages in bad weather. The Coast Guard RF Working Group was created to address these problems. The Academy contributes technical expertise in antenna performance and modeling to this group.

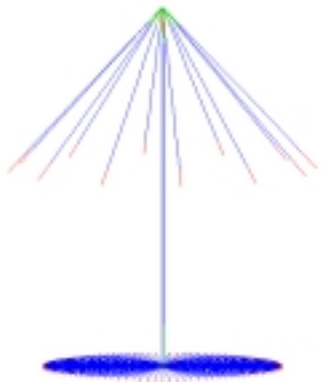

Fig 1: NECWIN model of DGPS antenna. Note Top Loading Elements (TLEs) and Ground Radial System

Project Goals

This project will model and analyze different DGPS configurations and provide recommendations to the RF Working Group. Using NECWIN, a powerful antenna modeling application, characteristics of actual antennas can be predicted. These predictions will be compared to an actual installed antenna in order to confirm the theoretical measurements. This should result in more efficient and supportable antennas, thereby providing better coverage and service to maritime and other user communities at lower cost.

REACTANCE vs. FREQUENCY FOR 3 TLE LENGTHS

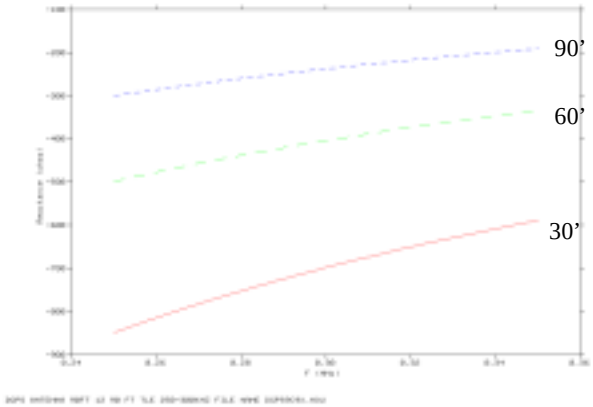

Fig 2: Example impedance plot for 90' tower with 12 TLEs

Sample Project Results

Results include impedance plots for antennas 90, 120 and 150 feet in height with 3, 6, 9 and 12 TLEs of 30, 60, 90 and 120 feet length. Figure 2 is a typical plot. The analysis shows that in general, the greater the length and more TLEs, the more efficient the antenna is. This is because as TLE length increases, reactance values become less capacitive. However, a point exists at which increases in TLE lengths yield no further improvement in performance in terms of radiation resistance. This suggests that there is an optimal TLE length for each configuration.

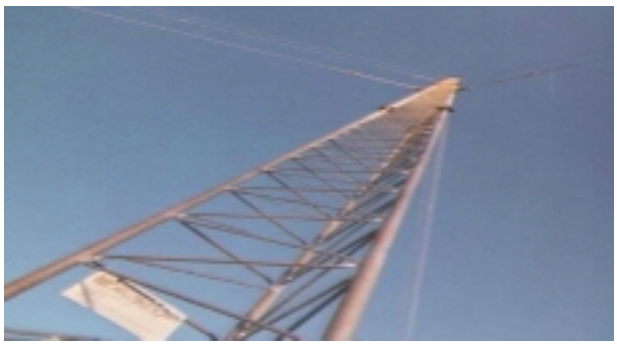

Fig 3: DGPS tower at Kenai, Alaska.