Senior Design Project in Electrical & Computer Engineering

Automatic Link Establishment (ALE) Propagation and Antenna Forecasting

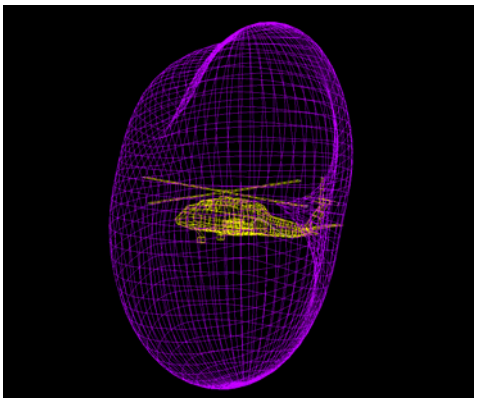
Cadets: 1/c Marlon Chichester **Advisor: Dr. McKaughan & LT Seals**

Sponsor: TISCOM

Project Background

The Coast Guard is currently installing ALE systems to upgrade the aging high-frequency (HF) communication equipment which no longer satisfies Coast Guard long-range communications requirements. Certain aircraft missions are severely limited because communications are dangerously poor in critical areas due to the propagation behavior of HF. HF propagation patterns change depending on the time of day, season, and solar activity, as well as the present configuration of the legacy HF system.

Supporting TISCOM, Academy electrical engineering students and faculty have been investigating ALE systems over the past three years. This effort has focused on assessing ALE network capabilities and determining network configurations and frequencies to best meet the post 9/11 needs of the Coast Guard and the nation. In a separate modernization effort, TISCOM is currently overseeing a significant upgrade and expansion of HF communications in Alaska. This expansion, and the Academy's efforts with ALE are being combined in this project.



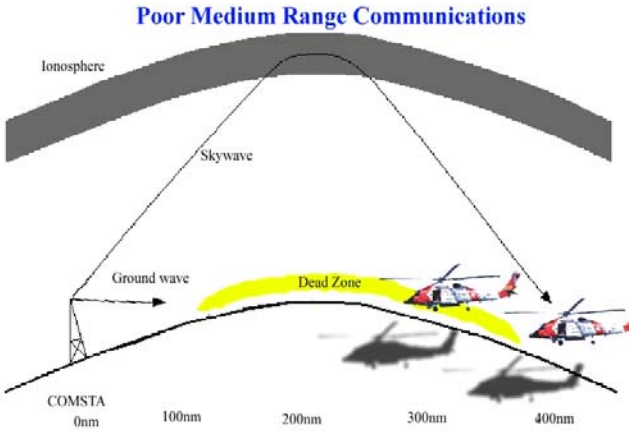
Typical horizontally polarized antenna radiation pattern the Coast Guard HH-60 Jay Hawk helicopter at a frequency of 20.98 MHz

Project Plan

Using computer antenna modeling software I will analyze the radiation characteristics of the ALE antennas being installed at the 6 new Alaska antenna locations. In parallel with this effort, I will use HF propagation prediction software to identify dead zones and areas of concern for each Coast Guard aircraft asset operating in the Alaskan theater. The antenna modeling results will be incorporated into the propagation prediction models to determine an optimum set of ALE frequencies to use in this network..

Project Work

- Simulate the propagation characteristics of each of the 6 sites.
- Determine the areas of best coverage for each site and all dead zone regions.
- Evaluate the propagation properties for each airborne asset at each network frequency.
- Analyze the ALE network to ascertain the best ground station for each frequency and asset.
- Determine if new equipment is needed for the proper implementation of the ALE system.



Dead zone between incident and reflected wave causing poor communication

Project Deliverables

- Graphs of site propagation patterns and areas of responsibilities.
- Analysis of different frequencies and reliability percentages with various time-of-day, season, and solar activity conditions.
- List of most reliable frequencies to be programmed in the ALE network.
- Analysis of current CG ALE capable assets in Alaska.
- Proposal for coverage of dead zones.
- Alternate sites that could be used to construct ALE assets.