Senior Design Project in Electrical and Computer Engineering

LORAN and DGPS Signal Strength Calculation Software

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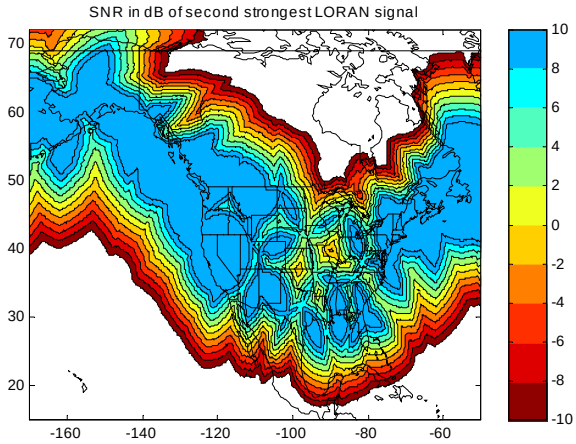
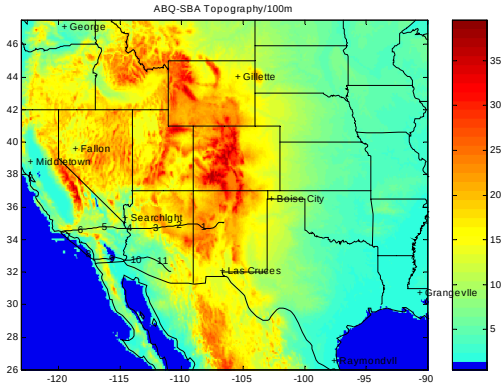
Project Goals

The project is developing software to enable the Coast Guard to better design placement, power, and carrier frequency of groundwave radionavigation systems such as LORAN and DGPS. One goal is to reduce typical signal strength prediction errors from 20 - 25 dB to less than 2 dB using better terrain models. These efforts will help to improve performance and reduce total ownership cost.

One sample output is the figure at right. Using traditional conductivity methods, signal-to-noise ratios (SNRs) of the *second*-strongest LORAN signal available are plotted. This illustrates the redundancy of nationwide coverage for a proposed system that would superimpose digital data onto existing LORAN signals.

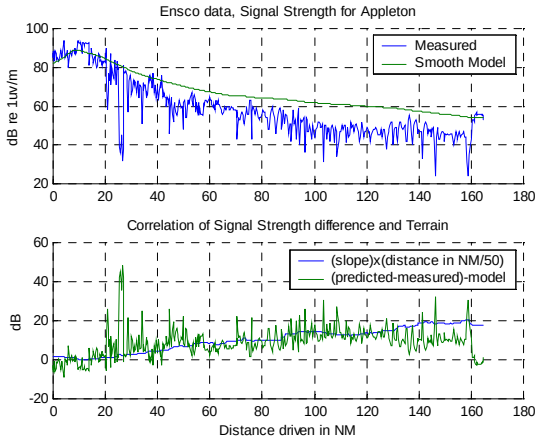




Preliminary Analysis

A similar terrain analysis is being completed for DGPS. The figure at right illustrates the correlation between the integral of average slope and differences in predicted and measured signal strength for the Appleton, WA DGPS transmitter. These results have prompted further study of terrain effects. An "effective" conductivity that incorporates a correction for rugged terrain is a promising approach.

Another DGPS coverage concern, the effect of skywave interference from adjacent beacons on the same frequency, is also being studied.

Improving Terrain Models

Groundwave signal strength is traditionally modeled as a function of spherical spreading and surface conductivity (Millington's method). However, with highly detailed terrain databases now available (shown at left), models that incorporate the effects of terrain can more readily be developed and tested. An aircraft test path is shown from Albuquerque, NM to Tucson, AZ. LORAN signals received over rugged and smooth signal paths during this flight showed a strong correlation with the integral of average slope.