Data Collection, Analysis and Model Validation of Low-Altitude Propagation for VHF Mobile Radio

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The overall objective of the work described here is to validate the performance of a high-fidelity propagation model, the Advanced Propagation Model (APM), which accounts for the effects of a spatially and temporally varying environment that includes the intervening terrain and the lower atmosphere.

In order to perform model validation, VHF signal strength data were collected over a range of terrain types (from relatively flat terrain to mountainous terrain) and distances (10 to 100 miles). In some cases, data were collected repeatedly over the same locations to gain information about measurement repeatability and the relationship between receiver velocity and small-scale fading characteristics. The beginning section of this paper describes the data collection effort and outlines a low-cost approach for collecting quality data. That approach relies upon a data collection package comprised of a laptop computer, a GPS receiver and a computer-controlled radio. Besides measuring absolute signal strength for a variety of terrain configurations, one outcome of the signal strength measurement study was to assess confidence intervals for VHF data in a mobile environment.

In addition to investigating terrain effects on received signal, the effects of atmospheric conditions were also studied. Specifically, refractivity index profiles were created from radiosonde data on days when signal data were collected, and data were collected at a location known exhibit radio ducting effects. The refractive index profiles were used as input to the propagation model as were the terrain profiles between the transmitter and receiver. The methods and resources used to generate the refractive index profiles and terrain are documented in this paper along with the results obtained.

The conclusion of this paper is that the APM model is accurate in estimating short-range, ground-to-ground VHF radio propagation. This conclusion is backed up by the close agreement between measured and modeled data for a range of operational conditions.