5. CONCLUSIONS

Program GWVOA is a versatile and user-friendly analysis model for systems performance prediction of communications circuits that use the ground wave as the primary mode of propagation. It provides computation results with reasonable accuracy for engineering analysis.

One primary feature of this computer program is its ability to accurately predict antenna performance for certain antenna types over lossy Earth. Other antenna types can be added to the antenna algorithm. The gains of most antennas can vary radically over a lossy Earth depending on the antenna height, geometry, and ground constants. The antenna algorithm within GWVOA is believed to be accurate to within 1-2 dB depending on the actual antenna type. This accuracy is with respect to actual computations performed with NEC-3. The antenna algorithm does not agree with program NEC-3 exactly, because a certain degree of data smoothing was performed to represent the antenna behavior with simple algebraic equations and look-up tables. The model could be improved to reduce this error by further refinement of the look-up tables and equations. An antenna measurement program to verify the antenna algorithm is needed that would determine its relative accuracy with respect to measured data.

A second feature of this program is that it combines a smooth-Earth and irregular-Earth propagation loss prediction capability for homogeneous and inhomogeneous Earth into one unified and user-friendly analysis tool. Electric field strength and received signal-to-noise power-ratio are also available as outputs. A reliability prediction is available in the signal-to-noise power ratio computation. The achievable distance output option is a convenient tool for obtaining coverage contours for different signal-to-noise power ratios and reliabilities.

Recommendations for future work include the following: expanding the antenna algorithm to include other practical antenna types, verifying the antenna algorithm with measured data and using this data to refine the algorithm, and investigating further methods of speeding up the irregular-Earth propagation loss prediction method without sacrificing loss prediction accuracy.

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15. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

An automated analysis model is presented for the prediction of system performance of communications circuits that use the ground wave as the primary mode of propagation. The computer program Ground Wave for Voice of America (GWVOA) is a user-friendly program that can predict propagation loss, electric field strength, received power, noise, received signal-to-noise power-ratio, and antenna factors over lossy Earth. The smooth-Earth and irregular-Earth propagation loss prediction methods can be used over either homogeneous or mixed paths. A special antenna algorithm is integrated into the computer program for rapid prediction of antenna performance as a function of antenna geometry, ground constants, frequency, and azimuthal direction for a variety of antennas. A description of the computer program GWVOA, a discussion of its capabilities, intructions for its use, and illustrative sample calculations are included in this report.

16. Key Words *(Alphabetical order, separated by semicolons)*

ground-wave antenna model; ground-wave propagation; irregular terrain; lossy Earth; MF propagation; mixed path; smooth Earth; surface waves

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