8. SUMMARY

This report presents and documents a computer program that calculates the transfer function for a wideband HF channel simulator with a 1-MHz bandwidth. The program outputs the transfer function which is intended as input to the hardware HF channel simulator under development. The program's input is a set of parameters that characterizes the conditions of a particular skywave path for the HF channel being modeled.

Mathematical descriptions of the model are provided in the report. Code listing of the program is provided and complete documentation and a user's guide are included.

Graphical verification of the model is provided through plots of scattering functions for each path presented. Scattering functions relate several important parameters of the model, including delay spread, delay offset, Doppler shift, and Doppler spread. Scattering functions are also a popular method of presenting measured channels. The scattering functions allow visual verification of several of the input and computed parameters of the program. The verification indicates that the model agrees well with the expected representation of the input parameters. The exception is that an unexpected constant offset in overall Doppler frequency was found that appears to be related to filtering parameters for the stochastic input of the model. The offset is related to the sampling rate and to the Doppler spread input to the program.

A solution to the offset problem is to carefully design the digital filters for each channel rather than to use a general filter for all situations. This could be a considerable effort; however, the result would be a set of standard channels that could be used for laboratory testing and evaluation of radio systems and radio networks. In particular, the channels could be used to prove the efficacy and reliability of communications systems in support of NS/EP goals and missions in the laboratory and without the need for expensive and time-consuming over-the-air (OTA) testing.

Even with the unexpected shift problem, the verification results are in good enough agreement with the model to indicate that the hardware simulator will still be an excellent engineering tool. As such, it could be used in research and development of radio systems and networks.

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