Database for Propagation Models

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1.0 Introduction:

A propagation researcher or a systems engineer who intends to use the results of a propagation experiment is generally faced with various database tasks such as the selection of the computer software, the hardware, and the writing of the programs to pass the data through the models of interest. This task is repeated every time a new experiment is conducted or the same experiment is carried out at a different location, generating different data. Thus the users of this data have to spend a considerable portion of their time learning how to implement the computer hardware and software towards the desired end. This situation may be facilitated considerably if an easily accessible propagation database is created that has all the accepted (standardized) propagation phenomena models approved by the propagation research community. Also, the handling of data will become easier for the user.

Such a database construction can only stimulate the growth of the propagation research if it is available to all the researchers, so that the results of an experiment conducted by one researcher can be examined independently by another, without different hardware and software being used. The database may be made flexible so that the researchers need not be confined only to the contents of the database. Another way in which the database may help the researchers is by the fact that they will not have to document the software and hardware tools used in their research since the propagation research community will know the database already. The following sections show a possible database construction, as well as properties of the database for the propagation research.

2.0 Objectives and Properties of the Database:

The proposed database will contain all the accepted propagation phenomena models by the propagation research community. The database will also contain some example data for each model in the database, but it will not attempt to be an extensive database by any means. This is because of the fact that the database is intended to run on a personal computer which generally has memory restrictions. Thus every user will have to use his own storage

medium for storing his experimental data. The database will be modular in form, i.e., the propagation models will be kept in modules in the database and may be accessed easily by the user without his having to know the internal working of the database. The database will have enough bells and whistles to steer the user away from making incorrect inputs, thereby avoiding the confusion that results from the output of such a run of the database. The database will have on-screen help for the user that will guide the user step by step through the procedure necessary to run the database, allowing even the novice user of the database to obtain the same performance as the experienced user.

Many times the user only wants printouts of the models included and the data that is present to be used with the models; hence, printout either to a printer or to a file will be allowed for any module of the database. The database will be flexible enough to allow the users to change the default values of the models or change the model itself (the formula), and to run the database with either the data stored in the database or with their own data. The output of the database will be in terms of graphs as well as tables, depending on the model. The software selected for the database will be such that the graphs resulting from the models will be flexible, i.e., after creation of a graph, manipulation will be allowed to fit it to their own requirements. The graphs will be able to be printed out or stored for later use.

3.0 Database Hardware and Software:

For maximum use, the database will be designed to run on a personal computer and not a work-station or a mainframe computer. Whether the personal computer be an IBM PC or Apple Macintosh, the database will work for it. A personal computer that has a clock speed of 16 MHz or more will be reasonable for this purpose. This does not indicate that the slower computers will not run this database, only that the slower-clock computers, such as 8-MHz speed, will take more time to run the database request. It is recommended that the computer have 4 MB of RAM so that the program can be properly loaded and there is enough memory space for it to work. It is also recommended that the PC should have a hard disk drive of at least 40 MB. To make the list of needed hardware complete, the setup should also have a monitor and a laser printer. The monitor may be a color monitor or just a monochrome monitor; it will not make any difference in the working of the database software. The laser printer is recommended for its clarity of printing and the control it offers in fonts, etc. However, other printers may be used.

The selection of software necessary for the database falls into two distinct categories: compiler-based software and spreadsheet-based software. Each category can do the complete job; however, there are advantages and disadvantages of each type of software. Microsoft's Professional Basic 7.1 compiler and Microsoft's Excel spreadsheet

were selected as possibilities for the database software. Following is a discussion of advantages and disadvantages of these two software.

Regardless of the PC selected, i.e., either the IBM PC or Apple, Windows 3.0 software for the IBM PC will make it operate virtually like the other. The Excel software is available for both types of computers. The Excel spreadsheet will use macros to do all the processing. The Excel macros have an impressive array of functions for the processing, as well as on-screen help for the user along with easy interactive input-output capability. It has 'message' capability also, which can be used to guide or advise the user through the steps necessary to execute the model. The Basic compiler does not have easy on-screen help capability. This capability may be created in Basic but only after extensive programming. Another problem the Basic compiler has is that it cannot use the 'mouse' to point and shoot when the program is in execution mode. The mouse is used extensively in Excel and can also be used for the input-output processing during interactive procedures.

Since Excel is a spreadsheet, it is well suited for the plotting with minimum efforts on the user's part. With the Basic compiler, on the other hand, as though it has the plotting commands in it, it is rather difficult to use these commands to produce a quality plot. Excel's internal software produces excellent plots and also allows the users to manipulate the plots after they are produced to fit their requirements. The plot produced by the compiler cannot be manipulated by the users and thus may fall short of what the users desire in that plot in terms of the plot's presentability. A similar situation is present as far as the database facility is concerned. Excel, being a spreadsheet, is naturally suitable for the database processing, with input-output in columns. The Basic compiler does have the database capability but it falls short of many desirable qualities the spreadsheet database has. It will take a considerable amount of programming in Basic to make it equivalent to the spreadsheet in terms of ease of use for the user.

The above discussion seems to be tilting towards selection of the Excel spreadsheet for the database. However, one should be aware of some disadvantages of the spreadsheet. As the programs become larger in size, the database program is expected to become larger, and the execution of the spreadsheet becomes slower than that of the compiler program. Another disadvantage the spreadsheet has is that the user needs the spreadsheet program as well as the spreadsheet software to run it, whereas with the compiler the user needs the executable file of the program only and does not need the Basic software itself. This situation may change in the future. Also, the spreadsheet macros are rather difficult to program as compared to the Basic compiler programming, and their files input-output processing is slow.

The following table shows the advantages and disadvantages of the Basic compiler and the spreadsheet.

MICROSOFT EXCEL SPREADSHEET	MICROSOFT PROFESSIONAL BASIC
On-screen help is easy	On-screen help is difficult
Plots are easy to create and manipulate	Plots are difficult to create and manipulate
Database facility is excellent	Database facility is present but not easy to operate
Tabular form of input and output are natural	Tabular form is not easy to obtain for input or output
Plots and outputs are very impressive	Plots and outputs are not impressive in general
Execution is rather slow when program size becomes large	Execution is fast
User needs the program as well as the spreadsheet	User needs only the executable file and not the compiler
It is difficult to program and file input-output is slow	It is easy to program and file input-output is fast

The following figures show a sample of a working database. This is only a sample; the actual database will have many other options. Figure 1 shows the first window with all the options the database may have; this is the main menu of the database. The window also includes the instructions needed to select the desired option of the options available to be executed. For this example the Land-Mobile system propagation models option was selected. Figure 2 shows the sub-options available in the option selected in Figure 1. For this example, the probability distribution models were selected from Figure 2. Figure 3 shows all available options under the sub-option selected in Figure 2. Here, the simplified lognormal shadowing model was selected. The result of that selection is shown in Figure 4. This figure shows the model itself and the parameters associated with it. Figure 5 shows the default parameter values and the place for user inputs. In the same window, the possibilities of plotting the default curve with the user's own curve and supplying

the user's own data are provided. Once this step is completed, the model is computed using the data selected and the graph is plotted (Figure 6). Note that at this time, the user can use Excel's graphics capabilities to manipulate the graph until it satisfies any requirement the user may have. After completion of the plotting, the next window (Figure 7) has the print and store options for the plot as well as the database. Also in the same window, the user may select to run the model again with a different database or different parameters, go back to the main menu, or exit the database.

4.0 Conclusions:

After understanding the limitations of the spreadsheet and the compiler, it seems imperative that the spreadsheet should be selected as the software for the database. This conclusion is not surprising because spreadsheets are naturally more suitable for the database-type operations than the compiler-based software. If desired, both database software may be produced, allowing the user to select the software he desires.

AN EXAMPLE

WELCOME TO THE PROPAGATION MODELS AND DATABASE

- IONOSPHERIC PROPAGATION MODELS.
- TROPOSPHERIC PROPAGATION MODELS.
- LAND-MOBILE SYSTEM PROPAGATION MODELS.
- EFFECTS OF SMALL PARTICLES ON PROPAGATION.
- RAIN MODELS.
- RADIO NOISE MODELS.

TO SELECT THE MODEL TO EXECUTE:
BRING THE CURSOR TO THE BULLET AND PRESS ENTER OR
POINT TO THE BULLET WITH A MOUSE AND CLICK.

Figure 1. Main Menu of the Database.

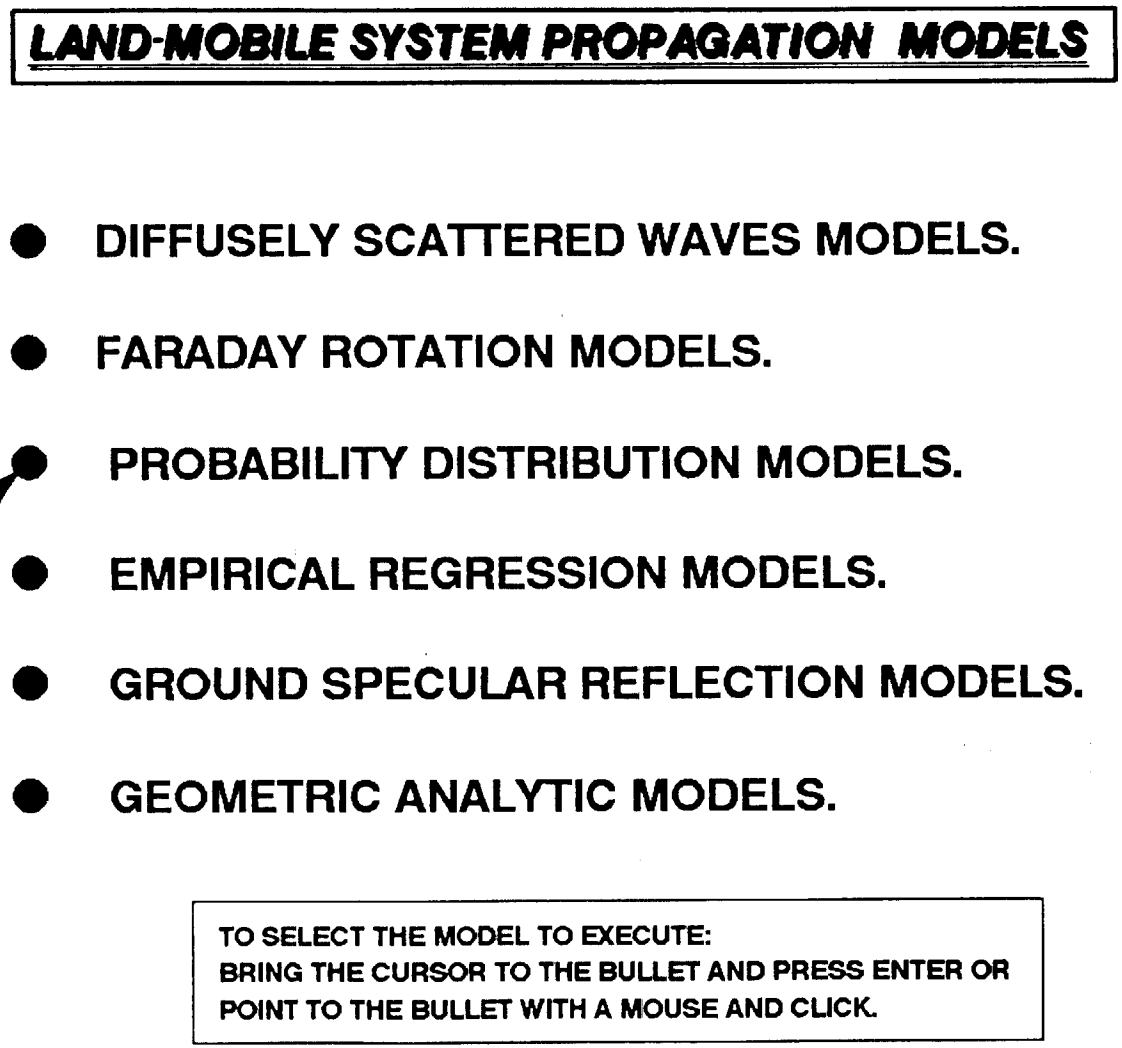

Figure 2. Available Options in Land-Mobile System Propagation Models.

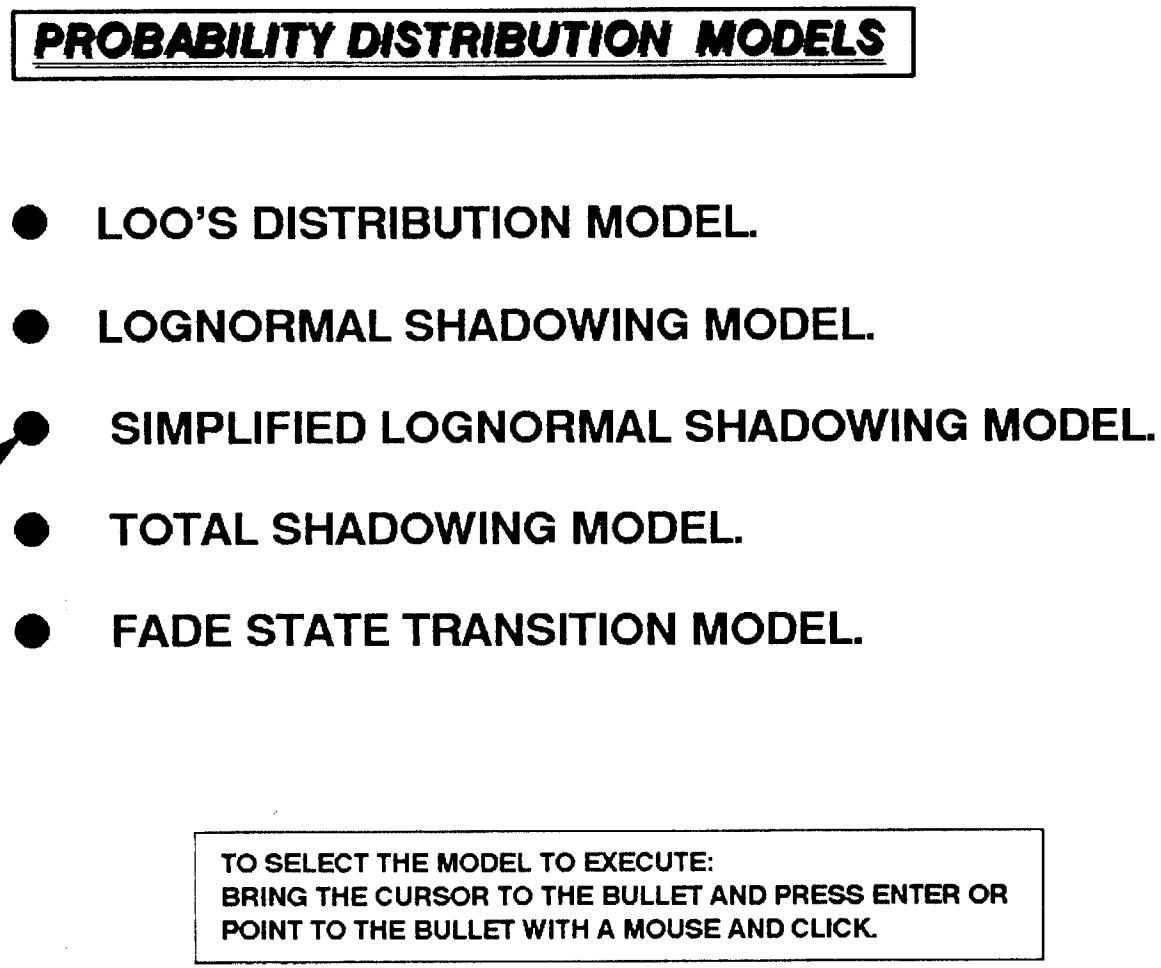

Figure 3. Available Options in Probability Distribution Models.

SIMPLIFIED LOGNORMAL SHADOWING MODEL

This model was developed by Barts et al. (1987). The probability distribution model is expressed in terms of the contributions for the "no shadowing" and "shadowing" cases in the following way:

$$P(A > A_q) = (1 - S) * \mathrm{Exp}\left[- \frac{A + 0.01\,K^2 - 0.378\,K + 3.98}{331.35\,K^{-2.29}} \right]$$

$$+ \; S\,(50 - A_q) \; \frac{(-0.006\,\overline{K} - 0.008\,m + 0.013\,s + 0.121)^{-1}}{-0.275\,\overline{K} - 0.723\,m + 0.336\,s + 56.979}$$

where

S = Shadowed fraction of the total distance

s = Standard deviation of lognormal fading m = Mean of lognormal fading

K = Line of sight to average multi-path power ratio, K = (Average multi-path power)$^{-1}$

Figure 4. Simplified Lognormal Shadowing Model.

INPUTS TO THE SIMPLIFIED LOGNORMAL SHADOWING MODEL

PARAMETER	RANGE OF VALUES	USER INPUT	DEFAULT
K	13 to 22 (dB)	?	17.5 (dB)
$\bar{K}$	18 to 21 (dB)	?	15.0 (dB)
m	-10 to -1 (dB)	?	- 5.5 (dB)
s	0.5 to 3.5 (dB)	?	2.0 (dB)
S	0.0 to 1.0	?	0.5

☐ ENTER 1 IN THE SQUARE IF THE DEFAULT CURVE IS TO BE PLOTTED ALONG WITH THE USER CURVE.

☐ ENTER 1 IN THE SQUARE IF USER WANTS TO SUPPLY HIS OWN DATA.

Figure 5. Table of Inputs and Defaults for the Simplified Lognormal Shadowing Model.

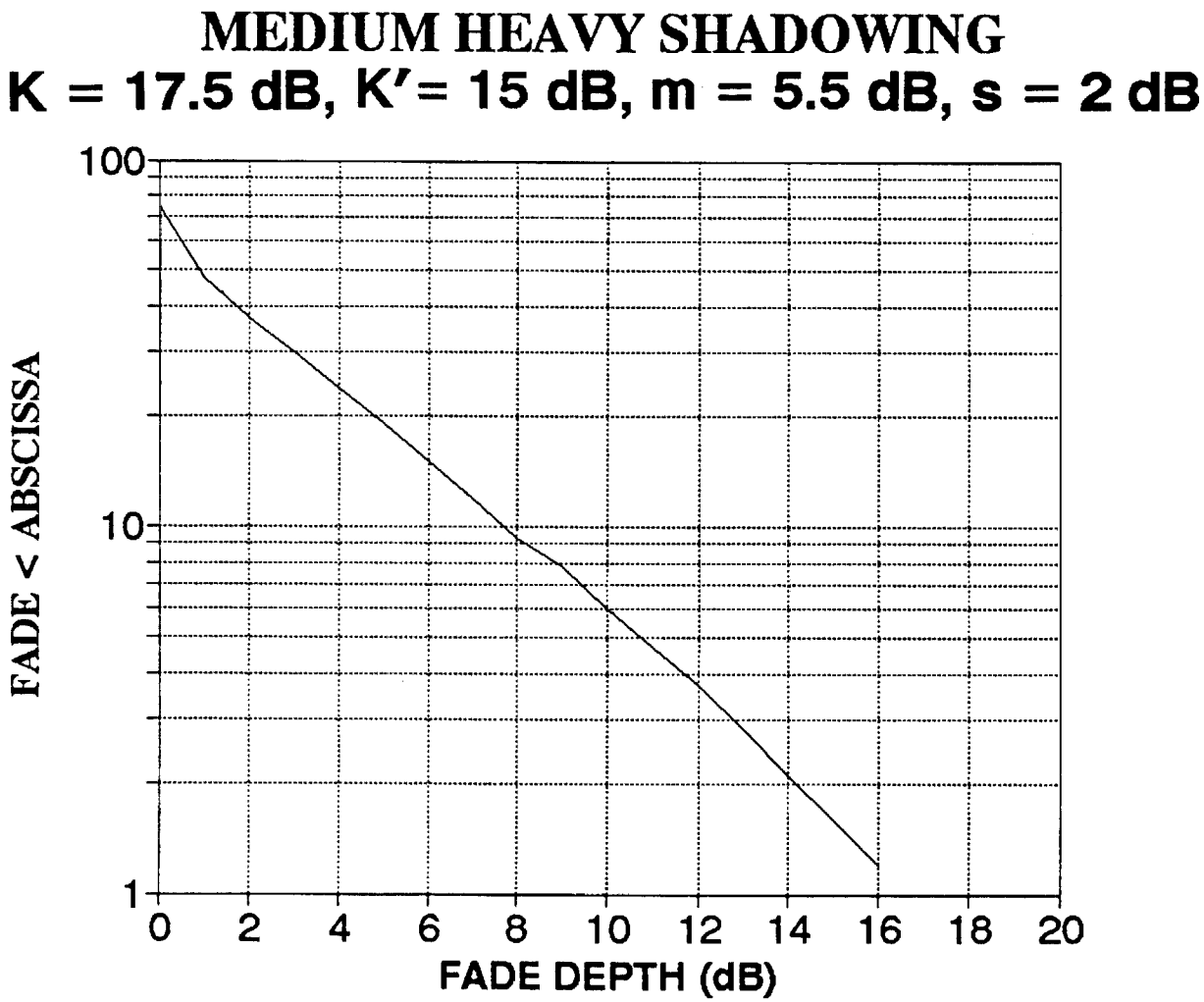

Figure 6. A plot of Fade < Abscissa Versus the Fade Depth.

SIMPLIFIED LOGNORMAL SHADOWING MODEL

CHARTS:

- PRINT OPTIONS.
- STORE OPTIONS.

DATABASES (INTERNAL + USER-SUPPLIED):

- PRINT OPTIONS.
- STORE OPTIONS.

RUN POSSIBILITIES:

- RUN THE SAME MODEL WITH DIFFERENT DATABASE.
- RUN THE SAME MODEL WITH DIFFERENT INPUT PARAMETERS.
- GO BACK TO THE MODEL MENU.

Figure 7. Print and Store Options for Charts and Databases With Run Possibilities.