NIST Cylindrical Near-Field Program Package

The programs and subroutines are written in FORTRAN 77 and reside on the attached zip file. The .exe files within the attached zip file are themselves self-extracting zip files.

I believe they adhere to the ANSI standard except that they have variable and subroutine names with more than six characters. The programs themselves reside in the Programs.exe self-extracting file. The subroutines reside in the Cylib.exe self-extracting file and in the file CPCFSUBS.F, while sample data and output from the programs resides in the Examples.exe self-extracting file. The screen graphics routine CRTPLT3.F (with its cals to AGRAFn) is specific to the Visual Digital Fortran compiler. You will need to write your own AGRAFn routines. However, you can use the subroutine CRTPLT3.DUM in place of CRTPLT3.F to bypass the graphics and run the program.

There are five programs which are described below. In addition, there

are a number of subroutines which are necessary for the operation of the

programs. It is recommended that these subroutines be set up in a library system. In this way, only needed routines will be included in the executable file for a given program. Subroutines which are needed only for a single program in the package are included with the source code for that program.

The Examples.exe file contain files which enable the user to exercise

all of the programs in the cylindrical near-field package. These files will be described below.

Laboratory data files

The sample data are in the self-extracting archive file Examples.exe. To

extract these files, execute this file which will produce four ASCII data

files which have been generated from laboratory data. They must first be

converted to unformatted files using program FMTOUNFM. These unformatted

files which may be used by the cylindrical near-field programs. Except for the first data files, all files are unformatted. It is also unfortunately true that an unformatted file produced by programs compiled with different compilers will not necessarily be compatible. The raw data files are:

DISHZ Z (main) component data for the example antenna.

DISHPH Phi (cross) component data for the example antenna.

PROBPH Phi component data for the probe used in the measurement.

PROBTH Theta component for the probe.

Program parameter and sample output files

Each program, in addition to the data file, has a parameter file which

contains information relating to the scan or antenna parameters such as number of points, point spacing, normalization constants, etc. Parameters are described in the comments included in the program listings. Output files for each run are included also. The parameter and output files for the sample runs of the programs are as follows:

CYPCOEF: The parameter file used to run CPCF5 on the on the probe far-field data to calculate the probe coefficients.

PROBPH.011: Phi component data file for the probe (unformatted).

PROBTH.012: Theta component data file for the probe (unformatted).

Note that these two probe files will be produced from the ASCII files supplied when FMTOUNFM is executed.

CPCFOUT Sample output from CPCF5.

CLPRBC The parameter file used to run CYLPRBC on the on the near-field data to calculate the probe corrected far-field

pattern of the antenna.

DISHPH.211 Phi component of cylindrical near-field data.

DISHZ.210 Z component of cylindrical near-field data

These two dish files are also produced by using FMTOUNFM.

CYLOUT Sample output from CYLPRBC.

Additional notes on programs

Each program in addition to the output file listed above produces

unformatted files which are used by subsequent programs in the data processing sequence. Some files are of an intermediate nature and are not needed by later programs. Listed below are the files which are associated with each program.

CYPCOEF

Parameter input Program asks for the name of this file.

Data input (2 files)

Nominal Phi component file (name specified in parameter file).

Nominal Theta component file (name specified in parameter file).

Data output FORT.11 phi coefficients for probe 1.

FORT.12 z coefficients for probe 1.

FORT.13 phi coefficients for probe 2.

FORT.14 z coefficients for probe 2.

Summary printout File name is CPCFOUT.

Plot data FORT.38.

CYLPRBC

Parameter input Program asks for the name of this file.

Data input (6 files)

Nominal Phi component file (name specified in parameter file).

Nominal Z component file (name specified in parameter file).

FORT.11 Coefficients for probe 1 - phi component

FORT.12 Coefficients for probe 1 - z component

FORT.13 Coefficients for probe 2 - phi component

FORT.14 Coefficients for probe 2 - z component

Data output

FORT.23 Phi component of far field

FORT.24 Theta component of far field

Summary printout File name is CYLOUT.

FMTOUNFM

Parameter input NONE

Data input File specified by user when executing file (an ASCII

file).

Data output File whose name is specified in position 41-50 of the

above input file. This is an unformatted version of the input data file.

TEDIT2

Parameter input Program asks for the name of this file.

Data input File name specified in parameter file (ASCII).

Data output Same name as data input file with .EDT extension.

Summary printout File name is TOUT.

FORT.61 Parameter file for NORMLIZ.

NORMLIZ

Parameter input FORT.61 (or the default name assigned to unit 61 by your compiler.)

Data input Specified in FORT.61 (comes from input to TEDIT2).

Data output Specified in FORT.61.

Summary printout File name is NRMOUT.

Programs TEDIT2 and NORMLIZ are used at NIST to preprocess the raw data

acquired in the laboratory. They provide several functions which may be

useful such as normalizing data, applying drift correction from tie scan data, correcting for receiver nonlinearities and reversing alternate scans if the near-field data are acquired in a non-retrace mode. They are common to all the near-field packages, but are not necessary for operation of the programs above or for successful analysis of the sample data sets.

Use of the Cylindrical Near-Field Programs

The cylindrical near-field data processing is accomplished by two

programs, CYLPRBC and CYPCOEF. The first program calculates the probe corrected far-field pattern from near-field data taken on cylindrical surface and the cylindrical probe coefficients. The remaining program CYPCOEF is used to calculate the cylindrical probe receiving coefficients from the far-field pattern data for the probe acquired on a standard model mount. In addition, a third program NORMLIZ is included for normalizing the raw data to a certain value at a specified point and also incorporating normalization or tie scans. These notes will describe the input cards necessary to process the cylindrical near-field data and very briefly describe the program operation. The discussion will refer to equations in Yaghjian (1977).

The programs were originally written in FORTRAN IV (FORTRAN 66 with CDC extensions) and have been converted to FORTRAN 77. Provision is made to make screen plots of various arrays. The plotting routine is CRTPLT3. This routine and references to it should be deleted and replaced with a plotting routine appropriate to the system which is to be used.

CYLPRBC

This is the main processing program for the cylindrical near-field to far-field transformation. The near-field data reside in two files on logical unit 15 (file name TAPE15), the first file being data acquired using probe 1 and the second file being data acquired using probe 2. The probe coefficients are input from logical units 11, 12, 13, and 14, respectively. As our program is currently set up, all files are read with an unformatted READ statement.

Data are acquired on a cylindrical surface at points equally spaced in phi and z. Information concerning scan parameters are provided on the input file. The information on the data card formats are as follows. NOTE: except as explicitly noted, the data are in a free format, with one or more blanks as separators. All zero values must be explicitly entered and all character values in free format lines must be set off by single quotes (').

Line 1 This line contains alphanumeric information, usually the name and telephone number of the person running the program.

Line 2 All data on this card are integers separated by at least one blank

NRDATA Number of points per scan of near-field data.

NCDATA Number of scans of near-field data.

MIDROW Point number of center of near-field array in z direction.

MIDCOL Point number of center of near-field array in phi direction.

NRMOD Allows thinning input row to 1/NRMOD points by skipping points.

NCMOD Allows thinning number of input columns to 1/NCMOD points by skipping columns of data.

NPHI Number of phi points required for a complete 360 degree scan. (Not necessarily the number of input points in the phi direction

if only a partial scan.)

IC2TON Size of the zero filled array in the z direction. This

parameter may be made as large a memory will allow to decrease theta point spacing in the output array.

Line 3

DELZ z increment in centimeters (inches if ICM = 1 on Line 12).

FREQ Frequency in GHz.

DIAM Diameter of antenna in centimeters. (inches if ICM = 1).

DIST Scan radius in centimeters. (inches if ICM = 1).

STR Reflection coefficient of antenna under test (magnitude only)

AOBLOG1 20 X log of ratio of input to output amplitudes at reference point for data taken with probe 1.

AOBLOG2 20 X log of ratio of input to output amplitudes at reference point for data taken with probe 2.

Line 4 All data are floating point with decimal point specified.

AMIN Minimum azimuth angle for far-field pattern.

AMAX Maximum azimuth angle for far-field pattern.

ELMIN Minimum elevation angle for far-field pattern.

ELMAX Maximum elevation angle for far-field pattern.

Line 5

ISCAN = 'Z' if scan in z direction. (NOTE: The ' must be included)

= 'P' if scan in phi direction.

ZININT Initial value of z.

PHINIT Initial value of phi.

RELPHS Set equal to 0 (Not currently used).

DLPFF Desired azimuth increment in far-field.

Line 6 Col. 1-80 An identifier for the file which contains data taken with probe 1. Columns 71-80 of this line must with the fifth 10 character word in the ID record of the data file.

Line 7 Col. 1-80 An identifier for the file which contains data taken with probe 2. Columns 71-80 of this line must agree with the fifth 10 character word in the ID record the data file.

Line 8 Col. 1-80 An identifier for the file which contains probe

coefficients RPHI1. (Probe coefficients for phi polarized probe.)

Line 9 Col. 1-80 An identifier for the file which contains probe

coefficients RPHI2. (Probe coefficients for phi

polarized probe.)

Line 10 Col. 1-80 An identifier for the file which contains probe

coefficients RZ1. (Probe coefficients for z polarized probe.)

Line 11 Col. 1-80 An identifier for the file which contains probe

coefficients RZ2. (Probe coefficients for z polarized probe.)

Note on lines 8-11 - These lines have been included in anticipation of

implementing a search feature. Currently these files are FORT.11 ... FORT.14 or the default file names assigned by the compiler in use for units 11 to 14.

Line 12 A control card for setting certain parameters which affect program input or output. Currently, only two features are implemented.

ICM set equal to 1 if z-increment, antenna diameter, and scan radius are given in inches.

IAMP set equal to 0. (not used)

IPHS set equal to 0. (not used)

MXAMP set equal to 1 if plots and printed far-field cuts are through the main component beam maximum. Otherwise plots and printed

cuts are through El = Az = 0.

INRM set equal to 1 if normalizing output to 0 dB.

IBNG set to 1 if printing out cylindrical mode coefficients. (not currently implemented)

CYPCOEF

This program calculates the translated cylindrical receiving coefficients for the probe from the far-field pattern of the probe using the asymptotic formula of Yaghjian (1977), section 4.2.1. Output files to logical units 11 through 14 (FORT.11 to FORT.14).

The raw data are acquired on a model mount by scanning in theta

(latitude) while stepping in phi (longitude). Theta varies from -90 to +90 degrees while phi varies from 0 to 180 degrees. The nominal boresight of the probe is generally coincident with the line theta = 0. Raw data are the insertion loss between the probe and source antenna normalized to a value of 1 at the reference point (the direction at which the gain is specified on line 5 of the parameter file).

It is assumed that probe 2 is simply probe 1 rotated by 90 degrees. For this reason, only one set of far-field patterns of the probe (two components, however) is required to calculate both sets of probe coefficients. If two different probes are used (as in the case of a dual port probe), the program should be run once with each of the two patterns and the appropriate files from each run then used with CYLPRBC.

The polarization properties (axial ratio and tilt angle) of the source antenna used for the measurement should be available. This data is used to determine the true polarization of the probe for all angles of the far field. For accurate polarization correction this source polarization correction is necessary.

The dimensions of DATAY and B2 must be large enough to accommodate the data set. The program checks to be sure that enough storage has been reserved and will issue an error message if enough storage is not allocated.

The parameter file for this program provides information concerning

parameters of the input data, parameters of the near-field cylindrical scan with which the probe coefficients are to be used, and other data relating to the program control. We begin with the parameter file format. Note – unless specifically noted to the contrary, all numerical fields are free format. Each data value must be explicitly specified and separated by one or more blanks.

Line 1 Col. 1-40 This card contains alphanumeric information, usually the name and telephone number of the person running the program.

Line 2

NROW Number of theta data points to be used per scan in actual

processing. This number includes both the effect of skipping data at the beginning of the scan (NSKIPR) and also the effect

of using some evenly spaced subset of the input data (NRMOD).

NCOL Number of phi points to be used per scan in actual processing. This includes the effect of using some evenly spaced subset of the input data (NCMOD).

DELP Spacing of processed data in phi (degrees). If multiple spacing is used, DELP = (measured spacing)\*NCMOD.

DELT Spacing of processed data in theta (degrees). If multiple

spacing is used, DELT = (measured theta spacing)\*NRMOD.

FREQ Measurement frequency in GHz.

ARMIN Minimum theta value for plots.

ARMAX Maximum theta value for plots.

ACMIN Minimum phi value for plots.

ACMAX Maximum phi value for plots.

Line 3

NROWD Number of theta points per scan in input data.

NCOLD Number of phi points per scan in input data.

NRMOD Data point multiple in theta direction to be used for data

processed.

NCMOD Data point multiple in phi direction to be used for data

processed.

NSKIPR Number of data points to skip in theta direction. (Often we can scan from -100 to 100 degrees rather that -90 to 90 and then

skip the required number of points. This alleviates problems with starting transients in the rotator.)

Line 4

IC2TON Length of zero-padded array in z-direction. Usually this array is padded to the next integer power of 2 greater than the number

of z-points in the near-field array. This must agree with the value of IC2TON specified for CYLPRBC.

THET0 Initial theta value for probe far-field pattern. (for that

portion of raw data to be used)

PHI0 Initial phi value for probe far-field pattern.

DIAM Diameter of test antenna in centimeters. (inches if ICM = 1 on card 6) This diameter must be the same as specified on line 3

of the parameter file for CYLPRBC.

DIST Near-field radius in centimeters (inches if ICM = 1). This scan radius must be the same as specified on line 3 of the parameter

file for CYLPRBC.

DELZ Near-field z-increment in centimeters. (inches if ICM = 1). This increment must be the same as specified on line 3 of the

parameter file for CYLPRBC.

Line 5

AXRP Axial ratio of probe in dB.

TLTP Tilt angle for probe polarization ellipse in degrees.

GP On-axis power gain of probe in dB.

REFLA Amplitude of probe reflection coefficient.

REFLP Phase of probe reflection coefficient in degrees.

AXRS Axial ratio of source antenna used to measure probe pattern in dB.

TLTS Tilt angle of polarization ellipse for source antenna in

degrees.

PHSNRM Phase normalization factor used to normalize relative

phase between the two ports. Usually set equal to 0

for the y port.

SENSP Polarization sense for probe ('LEFT' or 'RIGHT').

SENSS Polarization sense for source ('LEFT' or 'RIGHT').

Line 6

IAE set equal to 1 if source corrected azimuth and elevation

components of probe pattern already exist on file.

ICM set equal to 1 if test antenna diameter, scan radius, and z-increment for near-field scan are given in inches.

NORNT set equal to 1 if calculating coefficients for a single

of the probe. set equal to 2 if calculation coefficients for two orientations of the probe. If the probe is y polarized, the coefficients are put in FORT.11 and FORT.12. If the probe is x polarized, the coefficients are put in FORT.13 and FORT.14.

Line 7 Col. 1-80 An identifier for the file which contains the nominal theta component of the far-field pattern of the probe.

Columns 71-80 of this card must agree with the fifth 10 character word in the ID record of the data file.

Line 8 Col. 1-80 An identifier for the file which contains the nominal phi component of the far-field pattern of the probe.

Columns 71-80 of this card must agree with the fifth 10 character word in the ID record of the data file.

Line 9 This card reads the file ID word to be written on the

various intermediate and output files.

Col. 1-10 File ID for source corrected theta-phi component data.

Col. 11-20 File ID for Az-El components of probe 1.

Col. 21-30 File ID for cylindrical probe coefficient files for probe 1.

Col. 31-40 Not used.

Col. 41-50 File ID for Az-El components of probe 2.

Col. 51-60 File ID for cylindrical probe coefficient file for probe 2.

Col. 61-70 Not used.

Col. 80 IREAD - If this column is set to 1 separate 80 column ID cards are read to specify which already existing files are to be

searched for.

APPENDIX

Changes and improvements to the cylindrical package with the conversion to PC/FORTRAN 77 format.

It is no longer necessary for the dimensions to match the size of the data set. As long as the memory reserved is greater than or equal to

that required by the specific data set, the program will execute

successfully.

The program checks to see that the probe coefficient data are compatible with the parameters specified by the program.

The number of modes required has been changed from 1.1ka where a is the minimum cylinder radius to the more commonly used ka + 10. For smaller number of modes (<100) this leads to the requirement for a few more modes to be calculated.

Inputs to the parameter file are now mostly in free format eliminating the need for placing information in exact columns.

Most three branch IF statements have been changed to IF THEN ELSE

constructs.

The output has been somewhat streamlined (CYLPRBC only).

A sample run with input data and output produced by the programs is

supplied with the program.

Update 2/20/93

CYPCOEF has been modified to allow calculation of coefficients for

dual polarized probes.

A minor error in the source correction has been corrected.