GWPat V1.0

A Guided EMField Visualizing Software

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Objective:
GWPat has been developed to provide an interactive tool for visualizing the electromagnetic fields inside rectangular and cylindrical waveguides with a personal computer. In this software both transverse and longitudinal field components are presented graphically, using colors and vectors. With GWPat the user can observe the effect of changing any of the physical or electrical parameters on the resulting electric and magnetic field distribution in any specified plane. Moreover, the software could be used to find the positions that can have slots without radiating, in case of a slotted waveguide design. A VGA monitor and mouse are required.

The Software:
The software has been written in C using Turbo C++ V3.0 compiler. The program is divided into three major files

FMAIN.H :
This file contains the mathematics part of the software. The file contains codes for the computation of the E-field and the H-field vectors in side the wave guide. It also contains the codes to plot the intensity contours and direction vectors, check the specified parameters of the waveguide and calculation of some other parameters.

CMOUSE.H :
This header was already published in my software article Smith Chart Simulator (Refer EFY *August 1999*). It contains the functions for the mouse interface. The codes for functions to initialize the mouse cursor, hide/show the mouse cursor, detecting the mouse click event, detecting the location of the mouse pointer and changing the mouse pointer are available in this file.

CGUI.H :
This file contains the Graphic user interface functions. The codes for display screen, textboxes, entering numbers in graphics mode, saving and retrieving files etc., is available in this file. These functions are solely meant for easy interaction of the software with the user.

The software can be used to visualize and study the field patterns of two types of waveguides

a) Rectangular WaveGuides (Both TE and TM modes upto 5,5)
b) Circular WaveGuides (Both TE and TM modes upto 3,3)

First the parameters of the wave guide, given below are specified through the Parameters option in the menu.

Guide Type: Rectangular Wave Guide or Circular Circular Wave Guide
Mode Type: Transverse Electric or Transverse Magnetic
Dimensions a ,b the length an breadth in rectangular case
of the Guide : a = r, radius of the guide in the circular case
Frequency of operation: This is greater than the cutoff else an error occurs
Mode numbers: This is the desired mode of propagation

Then the data is checked whether the operation frequency is above the cutoff frequency. If not a "Beep" is heard. Other parameters like cutoff frequency, impedance and phase constant are then calculated and displayed on the right side of the screen. Then the view plane is to be specified. This plane is that section of the waveguide over which the field contours and vectors are to be obtained. Three planes exist for the rectangular waveguide – one transverse Z-plane and two longitudinal X and Y planes. In the case of Circular waveguides only two planes exists – One transverse Z-plane and one longitudinal r-z plane. Once the section of the guide is specified, the field plots can be obtained from the 'display' option in the menu. The field contours and the vectors on the desired plane are plotted. The axes of the current plane plotted are displayed at the right bottom of the screen. The pattern plotted is that at the instant t=0. The intensity or the magnitude of the fields can be estimated using the legend displayed in the left bottom part of the screen. A range of blue colors is assigned to represent the E-field magnitude in dB and a range of yellow colors is assigned to the H-field. In case of the circular waveguides the Bessel coefficients are found out using the formulas

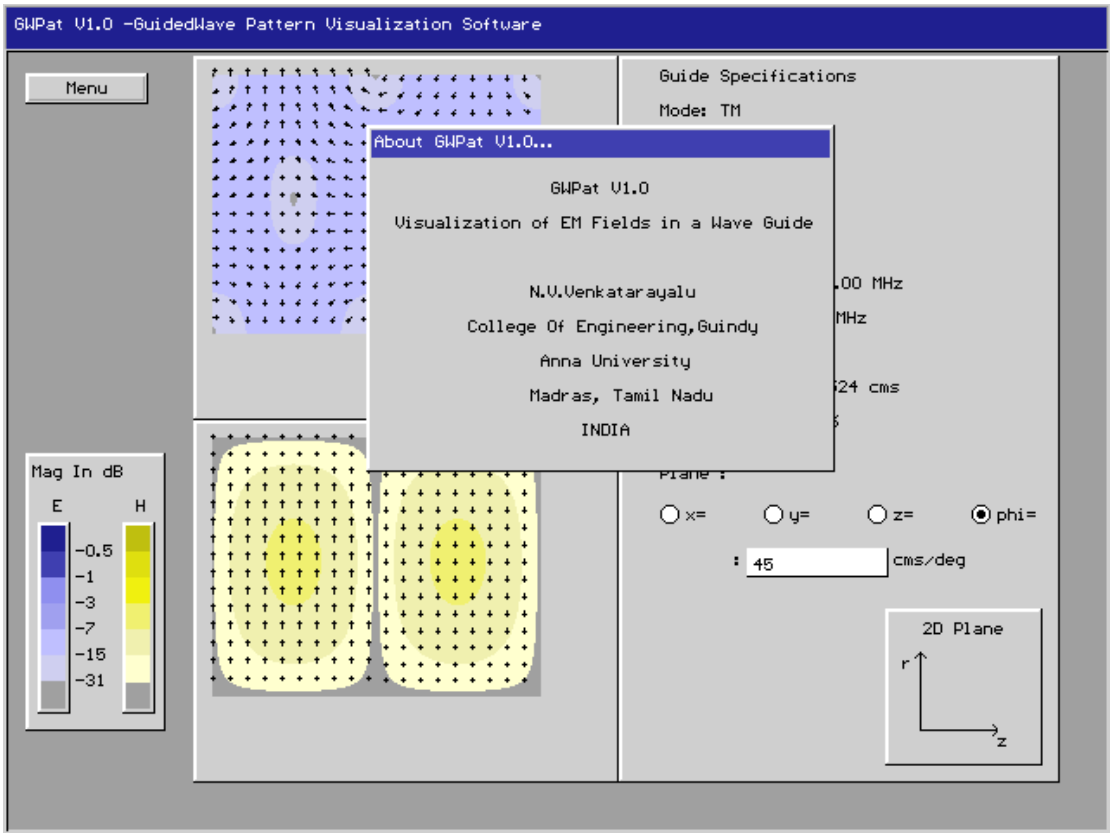
$$J_n(x) = x^n \sum_{m=0}^{20} \frac{(-1)^m x^{2m}}{2^{2m+n}\, m!\, (m+n)!}$$

$$J_n'(x) = J_n(x)*n/x - J_{n+1}(x)$$

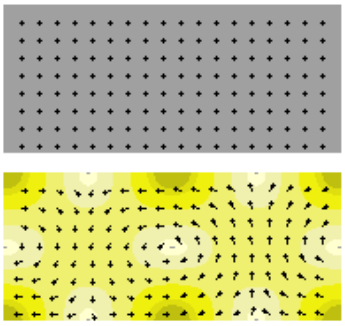
Some circular coordinate system to rectangular coordinate system conversions and vice-versa are involved in case of the circular waveguides. Once the field pattern of the required plane is obtained, the data entered can be saved as a file. Only the global structure containing the guide parameters is stored and hence the file size is only 84 bytes. Any saved file can be retrieved by the open option in the menu. The program can be terminated either clicking the 'Exit' option in the menu or by pressing the ESC key.

Example file: TE10.emg
Specifications:
Rectangular Waveguide
Transverse Electric Mode of propagation
a = 1.00 cms
b = 0.50 cms
m = 1
n = 0 (Since TE mn = TE 10 in the present case)
Frequency = 20000 MHz
After entering the above values in the parameters dialog box press Ecs and now choose the plane of observation. Click on any of the radio buttons on the right side of the screen to specify the constant of the plane and click on the textbox near it to enter the constant value. Shown below is the output for y=0 plane(Choose 'y=' radio button. Enter '0' in the text box). Similarly any other plane can be observed.

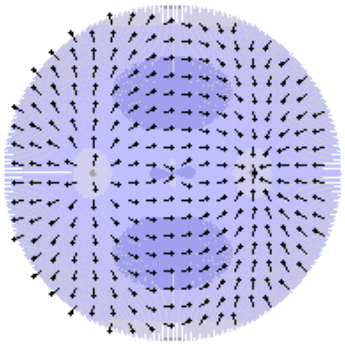
Note:
The Borland Graphics Interface file EGAVGA.BGI and the font file LITT.CHR are to be include in the source code directory for proper compilation and execution. To run the software under DOS the mouse driver has to be installed.

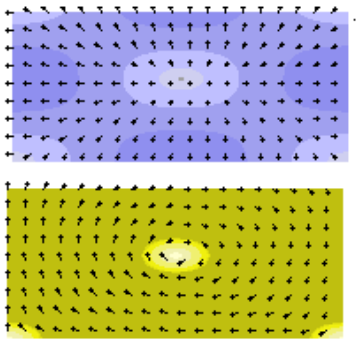


The sample outputs for various modes of rectangular and circular waveguides at various planes.

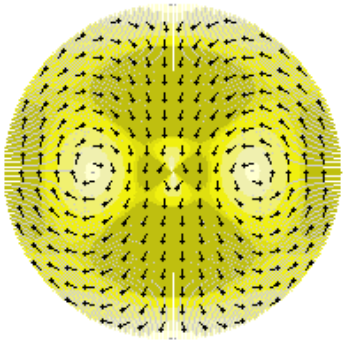


TE 10 y = 0





TM11 z = 0.5 cms



TM 11 z = 0.928cms