A PROGRAM ON MAGNET OPTIMIZATION DESIGN

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A program on magnet optimization design has been compiled to evaluate main parameters of dipole, quadrupole and sextupole. The parameters include current, resistance, inductance, power, coil parameters, weight, cost, etc. The program, its code is written in Visual C++, works with windows interface and calculates with conventional formula. The program demands the user to input the basic geometrical and electrical requirements, outputs all the results to screen and data files. The program can automatically optimise the magnetic field distribution which is mainly influenced by the pole shape with POISSON calculation to reach the design requirement.

1 Introduction

The magnet system of HIRFL heavy ion cooler-storage ring (HIRFL-CSR)[1] will be adjust when the whole project of HIRFL-CSR adjusted. A program on Magnet Optimization Design(MOD) has been compiled to optimize magnets of HIRFL-CSR, and it can also be used in the dipoles, quadrupoles and sextupoles design of other accelerator system. The program MOD, whose code is written and built with visual C++ compiler[2], works with standard windows interface, is very easy to use. User can simply input the basic geometrical and electrical requirements, then MOD calculates the main parameters of the magnet which is to be designed. After finishing calculating all the parameters, MOD will call the program POISSON[3] to optimize the magnet pole shape, and can get the best design parameters in the end.

2 Working theory

As it is well-known that there is not a systemic theory on magnet design, everybody design magnet with their own ways and mainly adopt some experiences as their guidance. MOD designs the magnet parameters with the conventional formulas, and optimises the pole shape with the well-known program POISSON.

3 Program flow chart

Since MOD works with windows interface, its usage is clear and simple. First, MOD would display a welcome picture, this would tell the user how to use the online help, and how to contact the author. After the picture disappeared, the user would be asked to choose magnet type, such as c-type dipole, window-type dipole, saddle-type quadrupole, etc., then the parameters inputting and outputting window would display in the screen. In this window, there are four areas, the note area, the input list table, the output list table, and the control area. The note area, is most important for the user to input the right parameters. Once a number is inputted, this number will be listed in the bottom of the input list table. After all the required parameters are inputted, the user can update the inputted numbers, or start calculating. The output parameters will be listed in the output list table. MOD will write all the parameters to file, and at the same time, it will
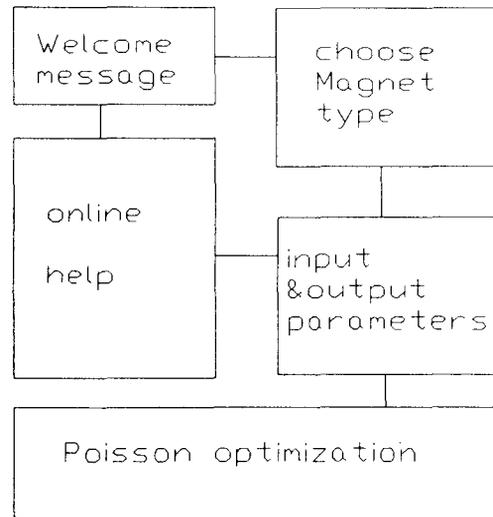

Figure 1 the program flow chart

create some files with the POISSON input file format. Then with these files, MOD calls the program POISSON to calculate with the specify numbers. POISSON will keep working until the result reach the design requirement. The final result will be displayed on screen and also written to file.The whole program flow chart is shown as figure 1.

4 An example of magnet design

The author want to explain the usage with an example. First, start the program, Choose c_type dipole, press "start" button. Input some parameters following the

note, such as Max fieldstrength, Min fieldstrength, Bending radius, Bending angle, working area width, working area Height, Chamber thickness, conductor height, hole diameter, Insulation thickness, Max working temperature, conductor material, steel material, etc. Then press "start computing" button, all the other parameters will be listed in the output list table. The parameters are such as Gap height, Max Current, Min Current, Max Power, min Power, weight, price, etc. This step is shown as figure 2.
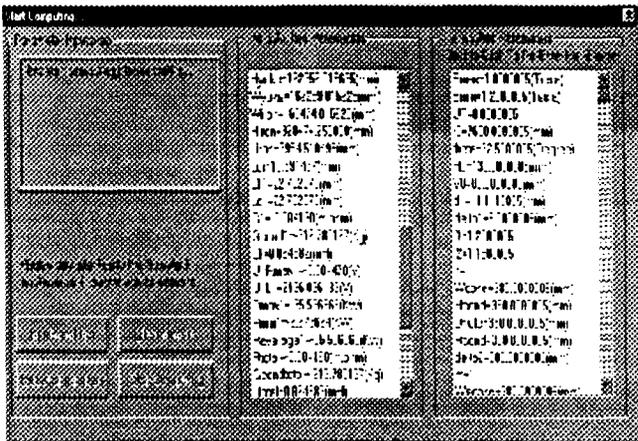

Figure 2 a window after finishing inputting all parameters

Another windows will be opened, and this is POISSON program running interface. The program will keep running for a long time, and this is relate to the precision you given to the program.figure 3 and figure 4 are just two samples.
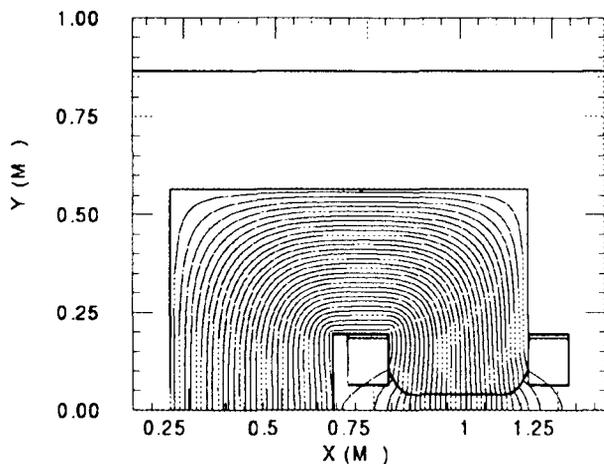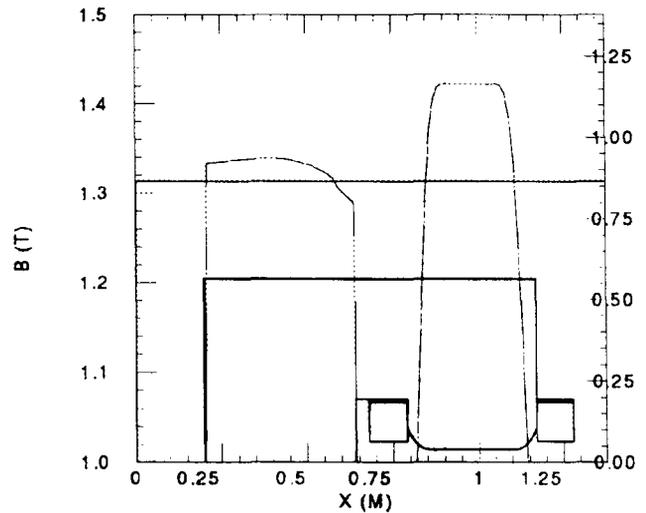

Figure 3 magnetic line distribution of CSR dipole

Figure4 magnetic field distribution of CSR dipole

5 Perfection

There are some points that need more work to perfect. First, some function of MOD are not finished at present. Second, since the program POISSON is a DOS program, that is to say, POISSON works with DOS interface, it do not has the excellence which a windows program would have. The following work is to perfect MOD. And we would add some functions to MOD, such as the glass lens design, etc.

Reference

[1] Bao-Wen Wei and Jia-Wen Xia, "HIRFL-CSR", Proceeding of the 14th international Conference Cope Town, South Africa, 1995, P354
[2] Michael J. Young, "Mastering Microsoft Visual C++ 4", May, 1997
[3] Ronald F. Holsinger, "The Cern-Poisson Program Package", Aug, 1983