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Development of a GUI-Wrapper MPX for Reactor Physics Design and Verification

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1. Introduction

More recently but for a few decades there has been a lot of interest in the graphical user interface (GUI) for engineering design, analysis and verification purposes. For nuclear engineering discipline, the situation would not be much different.

The advantages of developing a GUI-based computer program might be sought from two aspects; a) efficient verification of geometrical models and numerical results from designers' point of view, and b) quick-hand and independent verification of designers' works from regulators' point view.

The objective of this paper is to present a GUI-wrapper program named as MPX, which is intended to be efficient but not heavy. The program was developed, originally to treat the CANadian Deterium Uranium (CANDU) reactor core and lattice geometries and analysis results such as power distribution, but now its application range has been and could be expanded to treat more generic features including PWR core types.

2. Computer-based Graphical User Interface Programs

There have been various software packages to treat geometries or figures for engineering on-purpose applications. GUI software packages could be divided into two broad categories from software-design point of view; a) End-user-based on-purpose programs, b) Wrappers aimed at providing a more general form of tools for mid-stage developers.

A wrapper program in the above context means, more specifically, the program which is developed to serve a more generic purpose such as providing a tool to develop an end-user program, and could be developed from lower-level software packages which are called as libraries.

There are many GUI libraries for engineering purposes. Among them most popular libraries could be OpenGL, GLPlot, PLplot, wxWidget, VTK, DISLIN, etc., and they are also based on even smaller libraries. When surveying the above kind of libraries, a more recent trend is that those libraries try to support printing out the result not only on screen like X-window, Windows-generic window but also on various file formats such as ps, pdf, jp(e)g, png, gif for very high-quality publishing formats. In the meanwhile, there are also some handy and popular wrappers, which are inter-compiled within script-based languages such as Perl, Python, Tcl, Java, Ruby, etc.

In the present work, the PLplot library has been chosen to develop the MPX wrapper program through a wide range of literature survey and toy experiments.

3. Development of MPX; a GUI-Wrapper

2.1 Summary of PLplot Library

PLplot is a cross-platform software package for creating scientific plots written basically in C language. As the other GUI library package, the PLplot core library can be used to create standard x-y plots, semi-log plots, log-log plots, contour plots, 3D surface plots, mesh plots, bar charts and pie charts, etc.

A number of compiled and interpreted languages such as C/C++, FORTRAN and Java have access to PLplot.

The PLplot device drivers support a number of different file formats for non-interactive plotting and a number of different platforms that are suitable for interactive plotting. PLplot is free software primarily licensed under the LGPL.

2.2 MPX Development and Capabilities

MPX was developed using the C++ language originally to plot CANDU-related model geometries and analysis results directly using input or output of commercial physics codes such as WIMS-AECL (for lattice calculation) and RFSP (for neutronics calculation). Presently the MPX program has been modified to accommodate more general structures including PWR core geometries but there should be further development work to make it more generic.

The present plotting capabilities include: a) CANDU lattice and core models, b) PWR related square and rectangular lattice geometries, c) Printing tables and 2-D scientific figures, d) A few types of 3-D scientific figures, and e) Scientific-diagram related figures under development.

Figure 1 and Figure 2 show a 37-E NU fuel lattice geometry extracted directly from the WIMS-AECL input file and a core geometry including control devices from the RFSP output file, respectively. Figure 3 and Figure 4 show a 2-D density plot and a 3-D contour plot from a code output. Figure 5 shows arrays of hexagonal shapes with some normalized powers in a

few hexagonal assemblies, and with some experimental object shapes, which is under development.

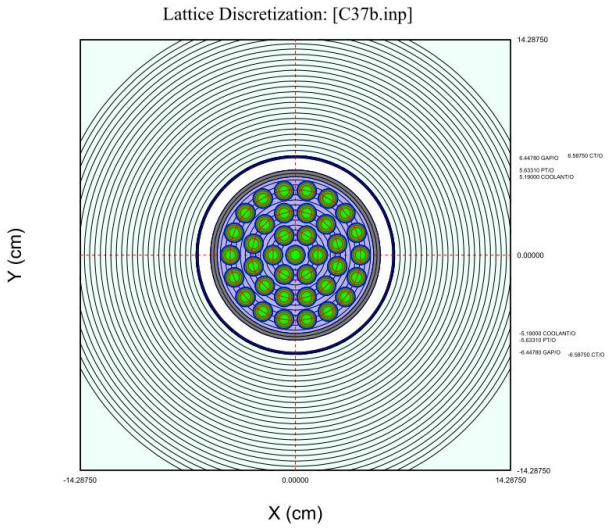

Figure 1. Lattice Discretization of a CANDU-6 Fuel from WIMS-AECL

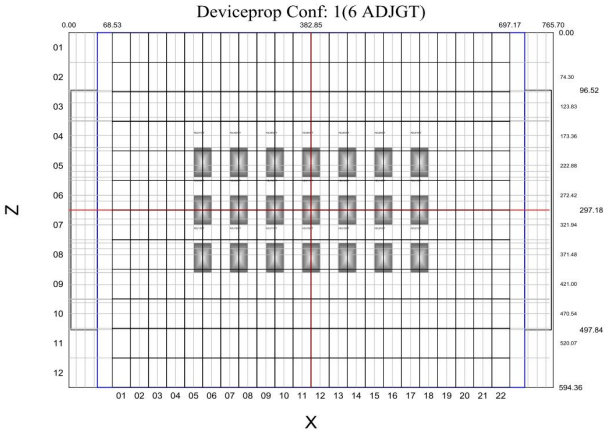

Figure 2. Arrangement of Adjustor Rods in CANDU-6 from RFSP (Plan View)

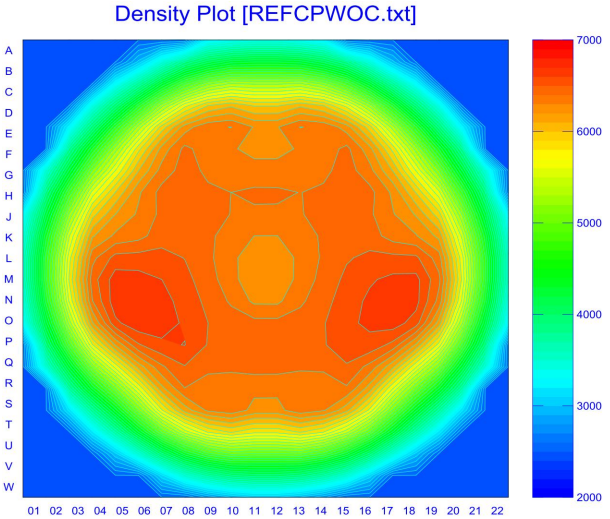

Figure 3. Two-Dimensional Density Plot of a Power Shape

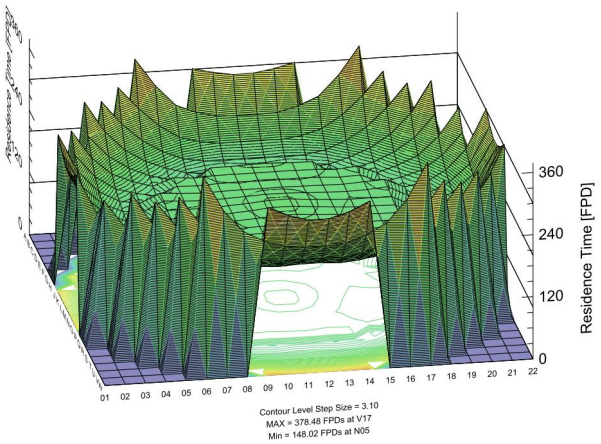

Figure 4. Three-Dimensional Contour Plot

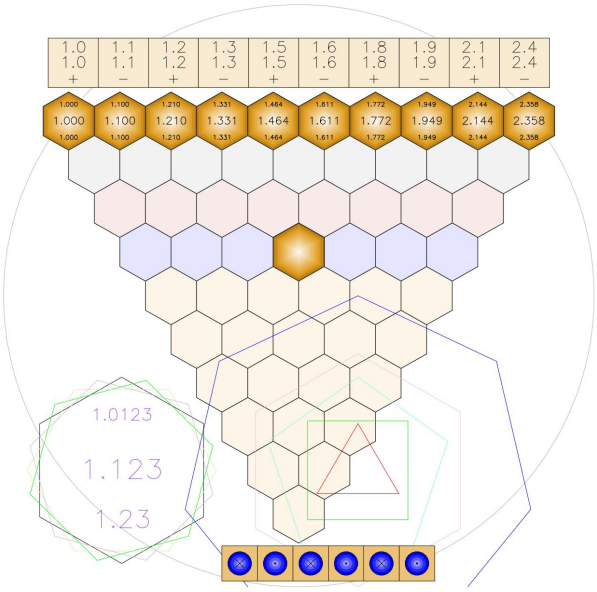

Figure 5. Experimental Figure for Hexagonal Core (Under Development)

4. Conclusions

A GUI-wrapper program, MPX has been developed based on a GUI library, PLplot, to treat reactor related geometries and analysis results.

It is recognized that the application result is very successful, specifically for its printing capability and much more for its verification capability. The application of this utility will be sought in the future with further research and development.

REFERENCES

[1] PLplot official webpage, http://plplot.sourceforge.net/