Development of an Auto-Validation Program for MARS Code Assessments

Young Jin Lee, Bub-Dong Chung

Korea Atomic Energy Research Institute, Dukjin 150, Yuseong, 305-600 Daejeon, Korea
yjlee1@kaeri.re.kr, bdchung@kaeri.re.kr

1. Introduction

MARS (Multi-dimensional Analysis of Reactor Safety) code is a best-estimate thermal hydraulic system analysis code developed at KAERI.[1] It is important for a thermal hydraulic computer code to be assessed against theoretical and experimental data to verify and validate the performance and the integrity of the structure, models and correlations of the code. The code assessment efforts for complex thermal hydraulics code such as MARS code can be tedious, time-consuming and require large amount of human intervention in data transfer to see the results in graphic forms. Code developers produce many versions of a code during development and each version need to be verified for integrity. Thus, for MARS code developers, it is desirable to have an automatic way of carrying out the code assessment calculations. In the present work, an Auto-Validation program that carries out the code assessment efforts has been developed. The program uses the user supplied configuration file (with ".vv" extension) which contain commands to read input file, to execute the user selected MARS program, and to generate result graphs. The program can be useful if a same set of code assessments is repeated with different versions of the code. The program is written with the Delphi program language.[2] The program runs under the Microsoft Windows environment.

2. Auto-Validation Program

The Auto-Validation program performs and generates graphs for the code assessment inputs. The Graphics User Interface is used for in selecting the Code executable, in selecting the V&V configuration files (*.vv), in submitting the V&V calculations, and in generating resulting graphs. The V&V configuration files need to be prepared by the user of this program and contains such information as the input file name, directory to contain the outputs, plot file names, graph plot details, etc that are needed to generate the assessment result graphs.

2.1 Program Structure

The Auto-Validate program consists of following functional sections:
1) MARS code selection section.
2) .vv configuration file selection section.
3) .vv configuration input parsing section.
4) .vv configuration input processing section.
5) TH code (MARS) execution section.
6) Graph generation section.

Each section is programmed with the Graphic User Interface to make it simple for the user to run the auto-validation process.

2.2 Program Execution Procedure

A snapshot of the program is shown in Figure 1. When the program starts, the user must select the MARS executable file using the "openfile" dialog. Then the user navigates through the directory structures of the computer using the "DirectoryListBox", and select the directory where the .vv configurstion files reside. All .vv configurstion files in the current navigated directory are displayed in the "CheckListBox" with the check enabled by default. The user can examine any .vv configurstion file by clicking its entry in the "CheckListBox". If any V&V file is checked, the "Start V&V" button is enabled. The user can click the button to start the V&V calculation sequence.
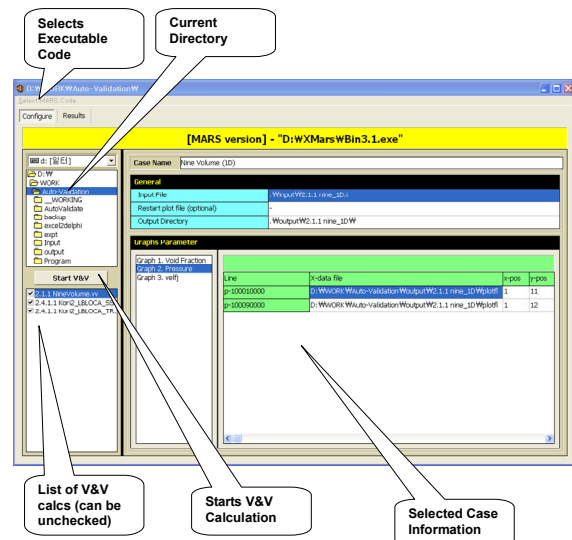

Figure 1. Snap-shot of Auto-Validate Program

2.3 V&V Input

The entries in the .vv configurstion file consists of 1) information required for running the MARS code such as file names for input, output and the restart-plot, 2) command lines to activate other programs, 3) configurations for the graphs such as the number of graphs, graph formats, number of plots in the graph, and data sources. The V&V file inputs are in free format but

the inputs must be entered sequentially. Comments can be added at any location in the file using the '*' as the denoting character. Figure 2 shows a sample of the .vv configuration file

```
*----------------------------------------------------
* Case Title
*----------------------------------------------------
   Nine Volume (1D)
*----------------------------------------------------
* Files and Directories
*----------------------------------------------------
   .\input\2.1.1 nine_1D.i       * Input Filename
   -                             * Restart Plot Filename
   .\output\2.1.1 nine_1D\       * Output Directory
*----------------------------------------------------
* Number of Graphs
*----------------------------------------------------
   2
*-- Graph_1 -----------------------------------------
   Figure 2.1-2 Void Distribution for Nine-Volume Problem (volume 1)
   0.0      10.0      5           * Minimum/Maximum No. of Intervals x
   0.0      1.0       5           * Minimum/Maximum No. of Intervals y
   time (second)                  * x-title
   Void Fraction                  * y-title
   1                              * Number of lines
   .\output\2.1.1 nine_1D\plotfl  * data filename
   void-100010000                 * plot name
   1      1.0       0.0           * x-data pos, x_a, x_b
   2      1.0       0.0           * y-data pos, y_a, y_b
   line  black   solid   1        * plot type,  color,  style, skip

*-- Graph_2 -----------------------------------------
   Figure 2.1-3 Void Distribution for Nine-Volume Problem (volume 3)
   0.0      10.0      5           * Minimum/Maximum No. of Intervals x
   0.0      1.0       5           * Minimum/Maximum No. of Intervals y
   time (second)                  * x-title
   Void Fraction                  * y-title
   1                              * Number of lines
   .\output\2.1.1 nine_1D\plotfl  * data filename
   void-100030000                 * plot name
   1      1.0       0.0           * x-data pos, x_a, x_b
   4      1.0       0.0           * y-data pos, y_a, y_b
   line  black   solid   1        * plot type,  color,  style, skip
```

Figure 2. A sample .vv configuration file

2.4 V&V Output

The output of the Auto-Validation program is a set of result graphs generated and formatted acoording to the commands in the .vv configuration files. The graphs are generated in Enhanced Windows Meta File (.emf) format. Windows meta file format was chosen because it saves the graph information in vector format rather than in raster format. This is advantageous when the graph is imported into a word-processing program as the graph resolution problem does not occur. The emf files are saved in the directory specified in the V&V configuration file. Figures 3~5 shows samples of the V&V output graphs.

3. Conclusion

A program to automatically carry out the code assessment problems has been developed for the MARS code. The program uses GUI in almost all aspects of its functionality to greatly simplify the user efforts. The user specifies various parameters such as the MARS input file, graph formats, pre-process programs etc. in the V&V configuration file. The program reads in the configuration file and carries out the calculations and generates the result graphs according to the inputs in the V&V configuration file. The program has been applied to some assessment programs and has been demonstrated to work well. It is expected that the Auto-Validation program will be a helpful tool for the MARS developer in that the general code assessment can be greatly simplified with a common set of V&V input files for various developmental versions.
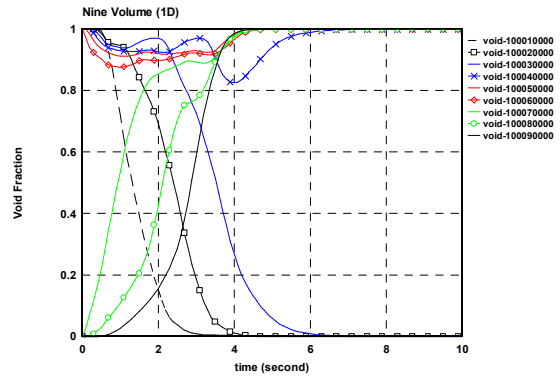

Figure 2.1-x Void Distribution for Nine-Volume Problem

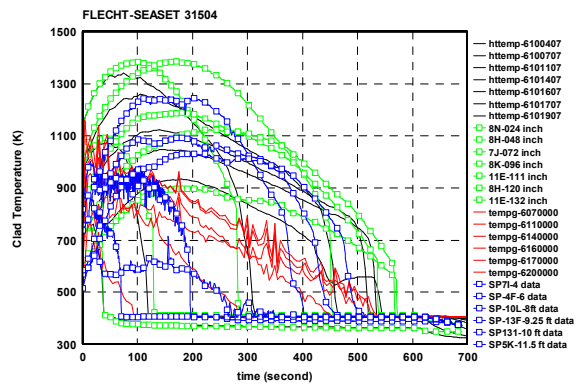Figure 3. Sample 1 of V&V Output Graph

Figure 2.2-xx Rod Surface Temperatures

Figure 4. Sample 2 of V&V Output Graph

REFERENCES

[1] "MARS 3.0 Code Manual", Korea Atomic Energy Research Institute, KAERI/TR-2811/2004.
[2] "Developer's Guide : Delphi 6 for Windows", Borland Software Corporation.