Development of An Automatic Verification Program for Thermal-hydraulic System Codes

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1. Introduction

As a project activity of the capstone design competitive exhibition, supported by the Education Center for Green Industry-friendly Fusion Technology (GIFT), we have developed a computer program which can automatically perform non-regression test, which is needed repeatedly during a developmental process of a thermal-hydraulic system code, such as the SPACE code.

A non-regression test (NRT) is an approach to software testing. The purpose of the non-regression testing is to verify whether, after updating a given software application (in this case, the code), previous software functions have not been compromised. The goal is to prevent software regression, whereby adding new features results in software bugs [1]

As the NRT is performed repeatedly, a lot of time and human resources will be needed during the development period of a code. It may cause development period delay. To reduce the cost and the human resources and to prevent wasting time, non-regression tests need to be automatized.

As a tool to develop an automatic verification program, we have used Visual Basic for Application (VBA). VBA is an implementation of Microsoft's event-driven programming language Visual Basic 6 and its associated integrated development environment, which are built into most Microsoft Office applications (In this case, Excel) [2]

2. The algorithm and structure of the AVPT

In this section the algorithm and structure of the automatic verification program for thermal-hydraulic system codes (AVPT) will be described.

2.1 The algorithm of the AVPT

The algorithm of the AVPT is shown in Fig. 1. The AVPT tracks directory names and input data names, which are needed for a NRT, from the Excel sheets. Then the AVPT generates the input batch files and the input configuration files automatically. Each input batch file contains commands related to drawing a comparison graph with output data files and the input configuration file. Each input configuration file contains data related to legend, line color, and others for the graph. In the comparison graph, output data of old version of the code, output data of current version of the code, and reference data will be shown concurrently. So the code can be verified graphically whether it has not been compromised.
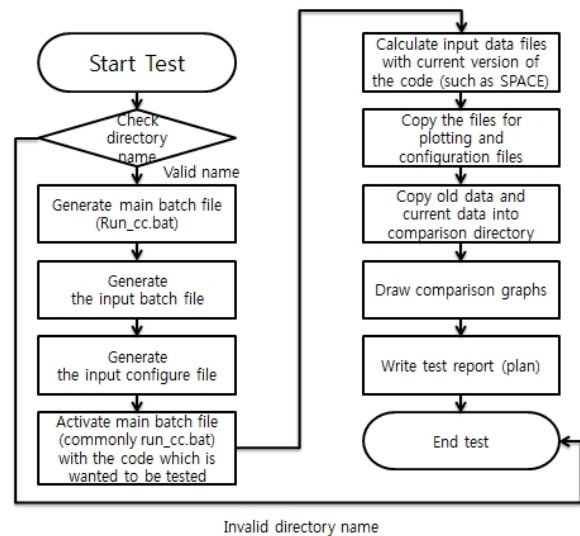

Fig. 1. The flow charts of algorithm of the AVPT. (Left side's blocks are processes of VBA parts and right side's blocks are processes of the batch files and the configuration files.)

2.2 The structure of the AVPT

The AVPT consists of two major modules, each of which has several procedures. Each module carries out different role in the AVPT.

2.2.1 Module 1 (Open and close)

The Module 1 has procedures which carry out the basic role of the AVPT. This module starts (or terminates) the program and makes (or deletes) the starting menu.
This module consists of 5 procedures;
- Auto_Open
- Auto_Close
- Initialize
- DeleteMyMenu
- MainMenu

Procedures 'Auto_Open' and 'Auto_Close' are commands which can make the AVPT starts (and terminates) with Excel simultaneously [3] Procedure

'Initialize' and 'DeleteMyMenu' prevent from making overlapped starting menu and activate the starting menu. Procedure 'MainMenu', which is in procedure 'Initialize', makes a button, which starts a NRT and is named 'Generation_Run_CC', at dropdown list (Fig. 2.).

Fig. 2. 'Generation_Run_CC' button at the menu of Excel

2.2.2 Module 2 (Main body of the AVPT)

The module 2 carries out main role of the AVPT. This module generates the batch files and the configuration files, which are needed for a NRT, depending on data entered on a spread sheet by user (for example, a directory name where output files will be stored, a color of the data line, a legend for the graph, minimum and maximum values of output data etc.). Then it carries out a NRT with one-click, from executing current version of the code to drawing comparison graphs and making report (plan).

The module 2 consists of 6 procedures currently;
- Generation_Run_CC
- Directory_Name
- Write_Batch
- Plot_Batch
- Plot_Cfg
- Start_Code

Procedure 'Generation_Run_CC' is the core procedure which consists of the others procedures. Procedure 'Directory_Name' is related to the names of directories which are used for a NRT. Users can define the names as they want. If an invalid name is entered or nothing is entered, all processes will be terminated until valid name is entered. Procedure 'Write_Batch' generates a batch file which performs the current version of the code, draws the comparison graphs, and performs a NRT. Procedures 'Plot_Batch', 'Plot_Cfg' generate the batch files and the configuration files a NRT process needed. Procedure 'Start_Code' starts main batch file (default name is 'run_cc.bat') automatically.

3. Test of the AVPT

We have chosen three sample input data files, and carry out the test of the AVPT. Those sample data are from the SPACE code input data and we will use the SPACE code. In this test we can show how the AVPT works.

Figure 3 shows the result of the AVPT test, where the output of the old version of SPACE, the output of the current version, and the reference data (MARS-WaterOverSteam_A.dat) are compared.[4] Through this figure, we can easily find out whether the results of the new version have not been compromised. All test processes for a number of the base input data will not require any more human resources and are carried out automatically. This can reduce the time, the cost, and the human resources for a NRT significantly.
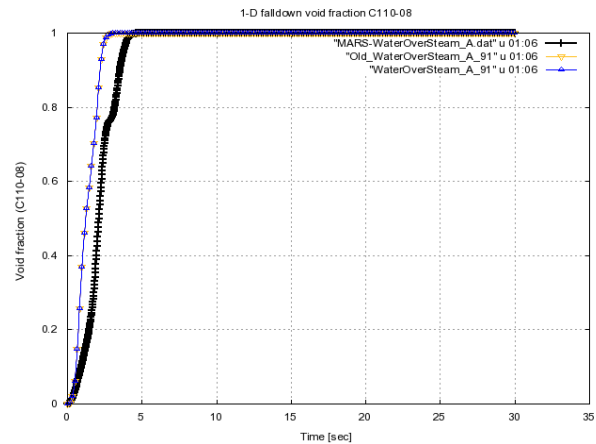

Fig. 3. A example of result graphs which are driven from a NRT.

4. Conclusions

We have developed the AVPT, which can perform non-regression test automatically. It can significantly save time and human resources for a code development.

The program has been tested, showing that it works as intended. However, for practical applications of the AVPT, additional functions will be desirable, such as a function for automatic writing a comparison report.

ACKNOWLEDGE

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