Modifying input files for the Full Equations (FEQ) hydraulic model using FEQinput

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Background

The Full Equations Model (FEQ) is a computer program that solves the full, dynamic equations of motion for one-dimensional unsteady flow in open channels and through control structures. The open modular program code as led to the expansion of the applications of the program. FEQ has been used to design and operate flood control structures, delineate inundation maps and analyze peak flow impacts, and is currently being used to develop a system that uses floodplain models for real-time stream flow simulation that will aid in flood-fighting efforts.

Figure 1: Aerial view of one branch of Salt Creek, along with some parameters modeled by FEQ (black boxes). The FEQ model used by DuPage County covers hundreds of miles of river hydraulics. Aerial picture from http://maps.google.com

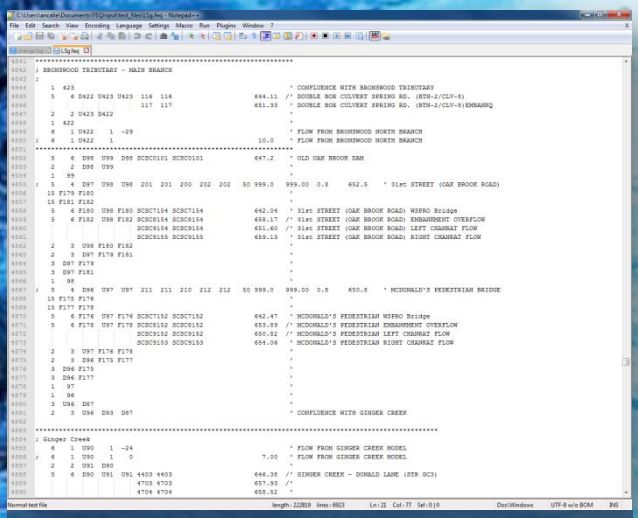

Figure 2: Sample section of an FEQ file.

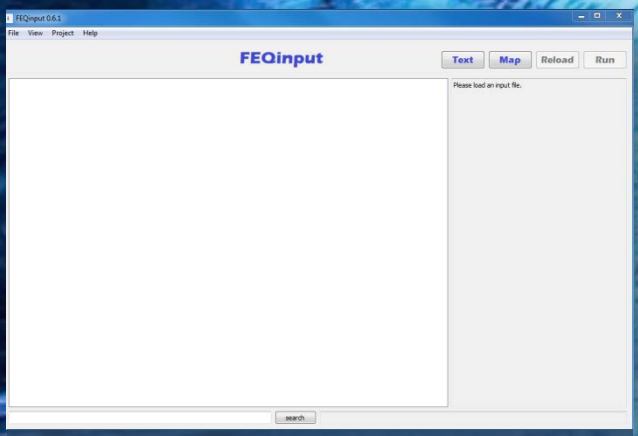

Figure 3: FEQinput interface

Introduction

Input files for the Full Equations Model are composed of text files that contain large amounts of parameters, data, and instructions written in a format exclusive to FEQ. Although documentation exists that can aid in the creation and editing of these input files, there is a steep learning curve for understanding the specific format and language of the files. FEQinput is a line editing tool that enables users to understand, modify, search, test, and save results from input files.

FEQinput provides a set of tools to help a new user create and modify input files for the FEQ hydraulic model, and for the related utility tool FEQUTL. The current capabilities of the program include: loading FEQ and FEQUTL input files into a table that interprets the contents of a given line and displays a description for a user to see; single-line and multi-line editing for the text files that updates the display descriptions; search bar that allows users to find a given string of text within an opened file; “block buttons” that allow users to easily navigate large files by jumping to a specific section of the file; “run” capability that automatically loads the input file (with the changes made by the user) into either FEQ or FEQUTL, runs the model, and displays the output of the program; ability to save new input files or modify existing ones; and links to the FEQ and FEQUTL documentation. These functionalities will be discussed in the following sections.

Opening FEQ or FEQUTL input files

To open an input file, click “File” on the menu and then click on “Open .FEQ file” or “Open .FTL file” for FEQ and FEQUTL files, respectively. Not all input files will have the same extensions (.feq or .ftl), so in the case of a different extension, select to show “All Files” by using the dropdown menu on the file selection dialog (Figure 4). Once a file is opened, its path and filename will be displayed in the bottom-right corner of the program.

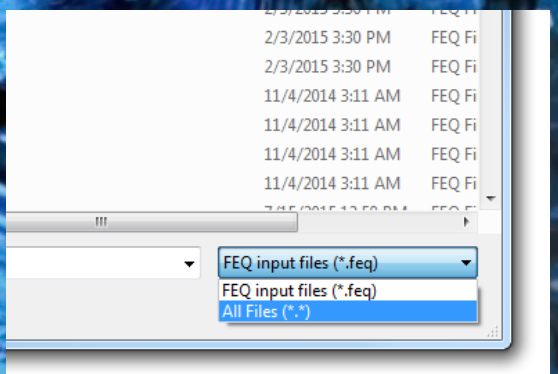

Figure 4

Reading input lines

After opening a file, its contents will display on the left-side table in the program. The table contains three columns: the number of the line, a “code” word for each line, and the contents of each line. The “code” word is a small combination of alphanumeric characters that FEQinput uses to identify and interpret the contents of a line. The code word column can help the user find lines that the program cannot read (code: “NOREAD”) and fix any mistakes within those lines.

The contents of the input file are displayed in the third column. Each line of the input file is placed on a table row. To interpret the contents of a line, the user can click on the desired line. A description of the contents of the line, along with definitions and parameters will be displayed in the text box next to the table. For a more detailed description, a link to the FEQ or FEQUTL documentation is provided in the description box. When reopening or reloading files, the table columns may shrink in size to match the size of the visible rows. The table columns can be resized by dragging the column headers.

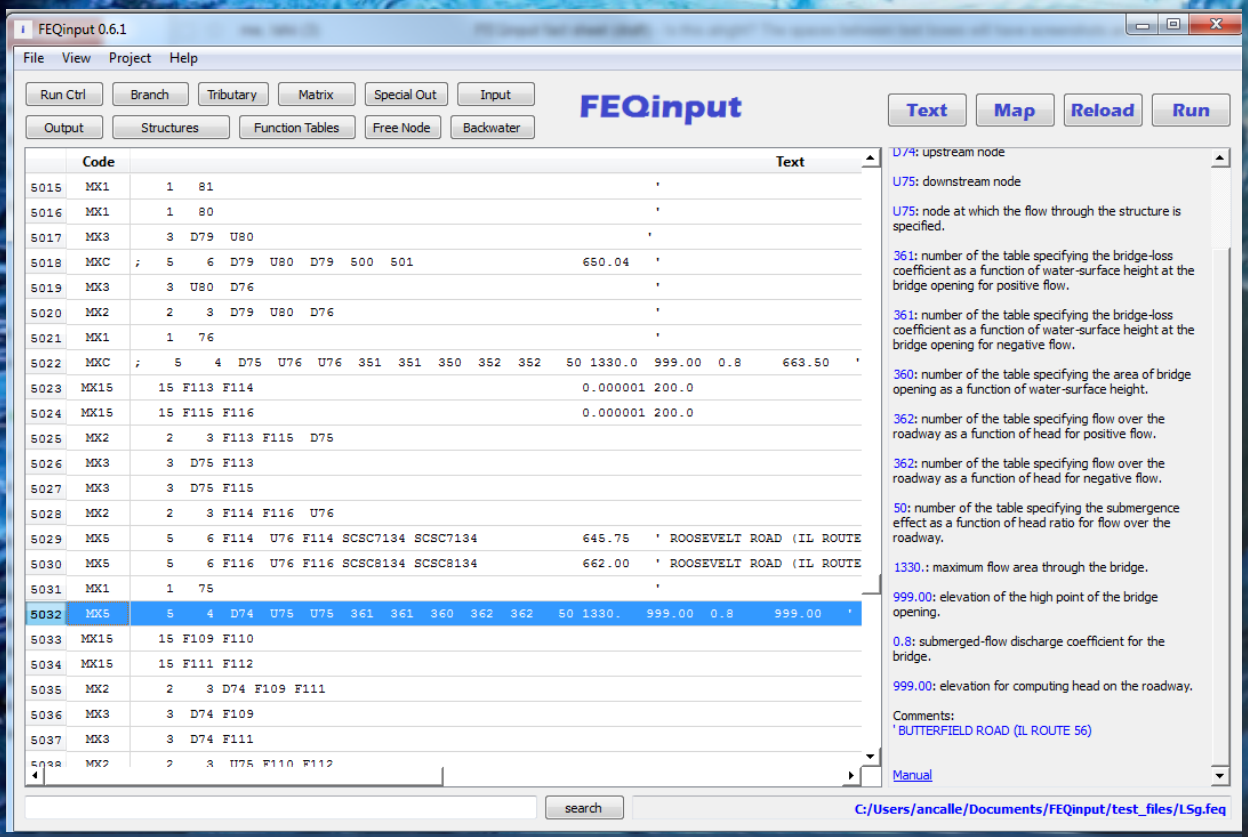

Figure 5: FEQinput interface with opened file. The left side displays the input file, while the right panel displays definitions and interpretations of the selected (blue) line.

Navigating and Searching within input files

While some input files can be as short as a few hundred lines, other files can range between thousands and tens of thousands of lines. To expedite navigation through these files, FEQinput includes options, in addition to using the scrollbar or arrow keys, to navigate within input files. For FEQ files only, the program provides navigation buttons on the top left corner of the window. When clicked, these buttons navigate to a specific section of the input file. If the input file does not contain a section, the button for that section will be disabled to avoid confusion.

Another way to navigate within the input files is to do a Search. The search bar (located at the bottom left corner) provides an easy way to find a desired line of input, such as: section headers, parameters, or comments. To use the search bar, type the desired phrase to find and click on "search". A dialog with extra options will open with the option to "search within a block" (for FEQ files only). This option limits the search to only a specific section of the file. The search is not case-sensitive.

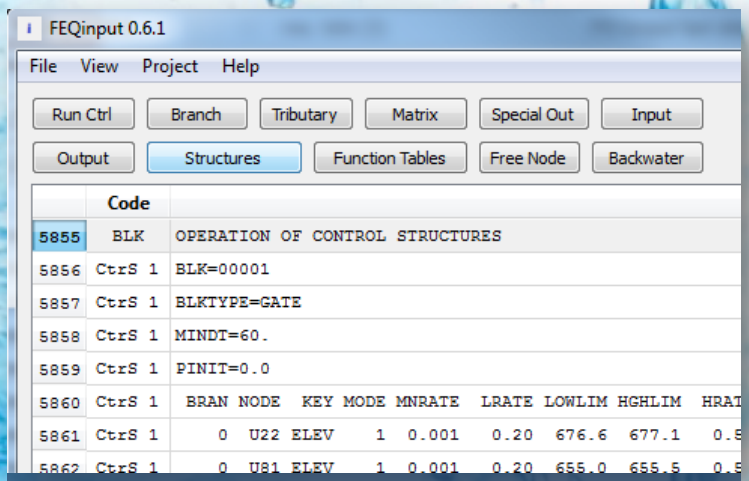

Figure 6: Navigation buttons. This feature is only available for FEQ files (not available for FEQUTL files).

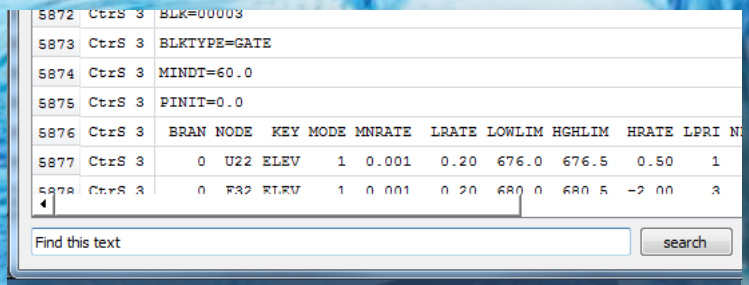

Figure 7: The search bar is located on the bottom left corner of the program window.

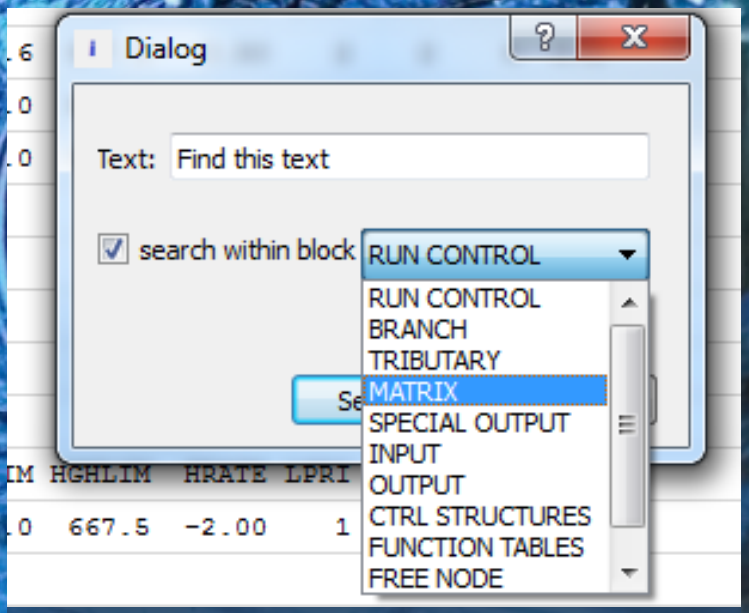

Figure 8: Search dialog with "search within block" option.

Modifying input files: single-line editor

Additional to helping the user understand the contents of an input file, FEQinput also allows the user to modify the file and see how the modifications will be interpreted by FEQ or FEQUTL. This can be done in two ways. The first is to edit a line directly in the display table. To edit a single line, the user can double-click on it. After modifying the contents of the line, the changes will be interpreted when pressing enter and selecting the line again. If the line does not provide the required or expected results (for example, when inserting or removing comments), the user can click on the "Reload" button (located at the top right corner, or by selecting from the menu Project >> Reload, or by pressing CTRL+SHIFT+R), which loads the edited input file again, to display the correct information on the display box. This single-line edit functionality is good for first-time users, or to modify simple parameters. It is important to note that because the FEQ format alternates between using spaces, variable types, headers, and code words as part of the formatting parameters, when editing a line, the user should keep in mind the position, number of characters and variable-type of the object to edit within the line.

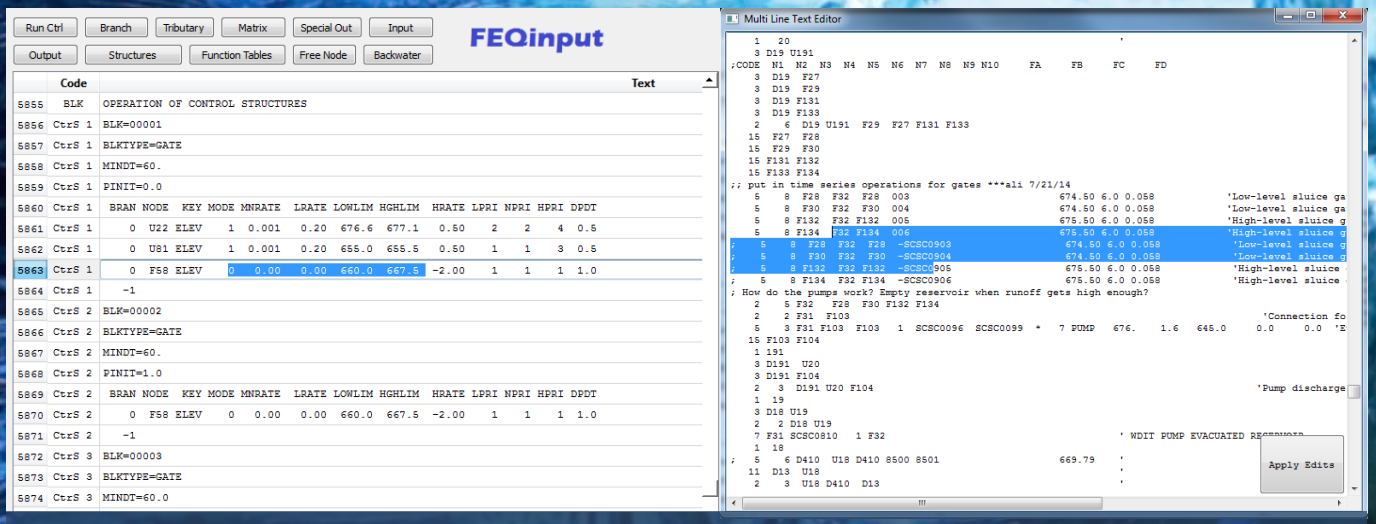

Figure 9: Editing a line with the single line editor (left) or with the multi-line editor (right).

Modifying input files: multi-line editor

The second form of editing input files is by using a provided multi line editor. This tool allows users to edit the input text file in its raw format, through a simple text editing interface. This is similar to editing a file in Windows Notepad. To load the multi-line editor, the user must click on the "Text" button in the top right corner, or select from the menu View >> Text Mode. After editing the text file using the multi-line editor, clicking on the "Apply Edits" button at the bottom right corner of the editor will load the changes into the main table to display and interpret the modified text. This function is useful for experienced users of FEQ, as well as to copy and paste large lines of text, and to add or remove lines from the input file.

Performing a model run

Once an input file is properly modified or inspected, the user can run this file with FEQ or FEQUTL by clicking the "Run" button at the top right corner, or by selecting from the menu Project >> Run, or by pressing CTRL+R. If the program runs correctly, the output of the model will open in a new window. This output is saved in the same folder as the FEQinput executable with the name "output". In order for a model to run correctly, the following conditions must be met: the FEQinput executable file should be in the same directory as the FEQ or FEQUTL executable files; and (for FEQUTL only), the executable files must be located in the same directory as the input file. The former is done in order to avoid including both FEQ and FEQUTL executables inside the FEQinput executable, which would've made FEQinput considerably slower. The latter has to be done to prevent errors from relative paths within the FEQUTL input file.

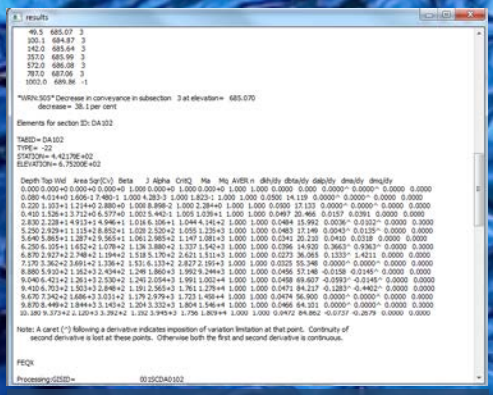

Figure 10: Sample FEQUTL output.

Saving input files

If the user is satisfied with the changes made to the input file, FEQinput can save the changes into the original file by selecting from the menu File >> Save, or by pressing CTRL+S. If the user prefers to have different files of the different versions, the program can save the changes into a new file by selecting from the menu File >> Save As, or by pressing CTRL+SHIFT+S. It should be noted that even though changes are made to an input file and the model is run or reloaded through FEQ or FEQUTL, these changes will not be written into the file until the user chooses to save the file. This enables testing of the changes prior to committing them as a user option.

Conclusion

Both new and experienced users can benefit from the capabilities of FEQinput. Different ways to edit input files give the user enough flexibility to work at any desired pace. FEQinput provides a simple and quick solution for users to work with in order to get familiarized and experienced with FEQ models.

Questions and Feedback

Questions and comments relating to the program can be directed to the developers:

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