Time Step Logging and Model Optimization

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RELAP5-3D time step logging capability has been added which can be useful for model optimization.

Model optimization is a challenging task that can lead to a significant reduction in simulation execution time. Model optimization can have significant benefit when simulations require a long execution time, or when many simulation variations must be run for a model. The recent addition of time step logging capability provides a useful tool for identifying locations in the model that are most limiting in terms of time step response. Model improvement can then be focused on those areas which will provide the most benefit.

The time step logging capability is enabled via a configuration file. The name of the file is specified via the '-dtconf' command line option[1] followed by the configuration file name. If the file does not exist, a template configuration file is created with logging commands commented out. This can be modified to enable time step logging. Three different log file types are available that are useful for model optimization:

1. Volume stats log – The volume stats log tracks which volumes lead to the most time step reductions. The configuration file allows specification of the number of volumes printed to the log file (i.e., top 5), the frequency (i.e., every 15 s), and optionally the number of sub-items, which breaks the time step reduction reasons into the most frequent reason types (i.e., courant limit, mass error, etc.). The file is formatted as a comma separated value (csv) file which can be opened in a text editor or in a spreadsheet application such as Excel.

2. Reason stats log – The reason stats log tracks the top reasons that the time step was reduced (i.e., courant limit, mass error, etc.). The configuration file allows specification of the number of reasons printed to the log file (i.e., top 10), the frequency (i.e., every 30 s), and optionally the number of sub-items, which breaks the time step reduction reasons into the most frequent volumes for the given reason. This file is also formatted as a comma separated value (csv) file.

3. Details log – The details log provides context information for each time step reason that is logged. This file is useful for examining time step reduction reasons in more detail. The file is formatted as YAML, which is designed to be human readable in a text editor. YAML is also structured so that the information can be parsed and processed via a script if desired. YAML parsers exist for many programming languages.

The first two log files can be particularly useful for isolating areas of the model that might benefit from optimization. The details log file can be enabled if additional details would be useful. However, the

[1] Note that command line options can now be printed from the RELAP5-3D executable by using the '-?' or '--help' command line option.

details file can quickly grow very large, and should be used with caution. The configuration file allows filters to be defined that limit the logged data to volumes or time step reduction reasons of interest.

Note that the configuration file is monitored approximately every 10 seconds (wall clock time) for changes, so that logging behavior can be modified on the fly. For example, the initial configuration file may not enable any of the time step logs. However, if the simulation encounters a trouble spot where time steps are significantly reduced, the configuration file can be updated to enable logging to provide insight into the source of the time step size issues. A 'pause' command is available which halts the simulation until the configuration file is updated and the pause command removed. This can provide the time needed to update the configuration file, or to explore the simulation outputs to identify trouble spots in the model. A 'help' command can be included in the configuration file to cause a more detailed configuration help file to be writteported.

This capability is available in the previously released code product, 4.0.3, which was released in 2012.