SATURN 11.6 Release Notes (11.6.03A)

SATURN 11.6.03A is the first <u>full</u> 11.6 release with the new tree handling techniques to speed up onward analysis. It superseding all beta versions made available under the SATURNnext programme as well as the last full release, SATURN 11.5.05N of November 2021.

Summary

The major change from 11.5 is the introduction of new tree handling methods, which though may have a small speeding up of the convergence within SATALL, are primarily intended to considerably make faster all later path-based analyses, such as select link, skimming, cordoning etc. There has not been, however, a fundamental change to the simulation from 11.5.05H, just relatively modest improvements. For example, the removal of a discontinuity in the handling of additional delays at V/C=1. The change should improve convergence and is likely to mean that most networks will see small differences in results 11.5.05 and earlier versions.

The update of the tree building has basically taken three forms:

One, the further expansion of using Dijkstra tree building algorithms, and a faster enhancement of that method (called **Celeste**) which, for large networks, can speed up assignment in all stages, including the convergence process. There is also a new process, **Lucien**, which as a path modification method can usefully be employed in the Area Charging process, as the diverting traffic can be treated as a diversion from the unaffected (paying or compliant) trees built.

The second, is the introduction of an update of the method of creating the "SAVEIT" assignments, the post-convergence assignment. This reduces the number of iterations that have to be saved in the cost path files (UFC) to reproduce the converged assignment. Though they have small differences from the previous UFC files, and are internally identified as UFC++ files, as the process is intended to replace the existing method, they are still given the .UFC extension.

The third form is the consideration that computing systems can now handle large files effectively (improved input/output etc), and instead of rebuilding the trees every time to do path analysis (using UFCs) we can now explore methods of directly storing the trees. We have implemented a method of storing the trees efficiently (but still large files) and these files are called UFF files. They are now provided as a replacement to the old UFO process (which had their difficulties in use, and the approximations used in generating them, and the difficulty in interpreting them when trying to do more complex path following, meant we were often surprised where the process could fail to give appropriate answers). Note, as with all brand-new methods, we are learning about the use of these new files. For select link analysis, UFF appear to be very fast in use and give similar answers to the UFC-based ones. However, currently, for skimming the analysis is slower that a multi-cored UFC equivalent. We're learning and refining, so please keep an eye on UFF results.

Most analyses requiring routeing information can now take advantage of the new UFF files where feasible. Some, such as "X-SLA" which requires rebuilding of paths, cannot use UFFs.

As you can imagine, the update has been a massive piece of work, affecting many areas of the software. With the previous SATURN 11.5.05N release undertaken in November 2021, there have been too many changes to the software (with various bug fixes as well) to be meaningfully detailed here. Full lists of the changes are provided in Appendix D-Future whilst Appendix E-Latest details the bug fixes. Some of the more important changes are described below:

Latest notable updates

These are of general interest, but especially for SATURNnext users that may have interim versions where the status of these items was unknown.

- Generally - UFF files DO NOT handle COMpliancy factors - BUT will work when compliancy is handled in separate user-classes. This will not be addressed before 11.7.
- SATLOOK skimming analyses with UFF files

  these have not been fully validated yet - there are some differences between the results from UFF and UFC/UFC++ files that are thought to be associated with the UFF being strictly an approximation to the UFC++ results.

  also, they are taking a long time to run - multi-cored UFC++ are running significantly faster, so at the moment it is not recommended to use UFF files in skimming,
- P1X SLA analyses are now multi-cored for UFC/UFC++ files.

- Cordoning.

    SATCH preferred for more options / fewer size limitations than P1X

    P1X creation of cordon definitions for use in SATCH improved

    P1X believed to handle both UFF path files and TAC networks now, not just SATCH, but not fully tested - if problems, let us know and revert to SATCH.

- P1X handling of network building ERL files has been further enhanced.

- DCF data

    SATALL - the limited DCF data created as the assignment proceeds may have a problem in the 2-TAC situation. "DVRT" data, those that divert appear to be only those that divert around TAC1 and NOT TAC2. This may not be fixed for 11.6, as it is intended to withdraw this feature to speed up convergence, and is replaced by the more extensive SATRAP process introduced as below.

    SATRAP - the new preferred method offering full detailed analysis is available through SATDB (and SATDB options in P1X). Please not that there is a new batch file SATDB_DCF which helps to create DCF output in a manner to pass to SatView.

- SATDB_ADDIN batch file (and SATURN2/SATNET2)

    A new batch file has been added so an updated UFN can be created without changing its name so that it can sensibly continue to be used in later assignments - see also new assignment batch files below in

- MSHELL is now available in this release - see Appendix U of the manual for more information.

    Note - MSHELL may not run on machines with only 8 Gb of RAM. In our tests, it does run on machines with 16 Gb of RAM or greater.

- SATPIJA analyses now can work with UFF files.

    but we recommend using the SATPIJA batch file when doing so (and not the SATPIJA_MC batch file) as the "IPART/NPART" was not envisaged as necessary with UFFs.

    Similarly, the ALLIJ option does not work with UFFs.

Please see App D (Future) in the accompanying manual for all details.

Also: a reminder that analyses using UFC (from SAVUFC) / UFC++ (UFC from SAVUFE) / UFF(from SATUFF), though should be very similar, may not be identical, so you should not "mix" but "match" methods in final reports.

Running with the new tree build options

There are three new programs.

- SATUFE which will generate a new UFC++ path file from a "converged" assignment (effectively replacing the "SAVEIT").

- SATUFF to create the UFF path files from the SATUFE output (similar to previous use of SATUFO).

- SATPATH to dump the UFF file to text format (but beware, VERY big files).

These each have their individual batch files, though new batch files have been introduced to facilitate the ease of running a complete assignment previously provided by the **SATURN**.bat file.

These new files are collectively known as 'SATURN2' procedures, and more detail in "14.3.2 'SATURN2' procedures" of the latest manual. The "help" for each batch file, as normal, can be read either by selecting the appropriate module in the new SatWin provided, or by calling the batch file without any parameters from a command line (with, of course, this latest version of SATURN being available through the PATH).

These are summarised here.

Before using these batch files, you should review your network.DAT files. SATALL in 11.6 now defaults to having SAVEIT=F, and this is now the expected situation. If your network.DAT files have SAVEIT=T hard-coded, you should remove the reference to SAVEIT completely. This means if you run in 11.5 it will correctly run the SAVEIT, but for 11.6 it will skip it as required. If you really want to match the old-style, you can run SATUFC as a separate step, or indeed, use the options in the batch files below to do this. This is because SATUFE is effectively the new replacement for SATUFC.

SATNET2

This is effectively the 11.6 replacement for the SATNET batch file, but can run the SATDB_ADDIN step to include additional extra user information, eg DfT Road Classification, in the network .UFN - available for use in all subsequent UFS files.

The next two batch files operate dependant on the setting of the environmental variable SATURNcfcf, and is useful when you are setting up testing of the new algorithms - ie you can have one procedure set up, but switch the method used by a single variable, and of course was the initial methodology set up.

SATALL2

Runs the 11.6 assignment steps as follows:

If SATURNcfcf=C

runs the equivalent to the "old" method, running SATALL and SATUFC to give an old-style UFC file (equivalent to running SATALL with SAVEIT=T)

If SATURNcfcf=E

runs the "new" method, running SATALL and SATUFE to give a new UFC++ file

If SATURNcfcf=X (or if SATURNcfcf not defined)

runs the "new" method, running SATALL and SATUFE to give a new UFC++ file, but additionally goes on to run SATUFF to also give a UFF path file.

If SATURNcfcf=X

Just runs SATLL with no additional path information creating steps (for example if you want to run an assignment to create a file to pass queues only.

SATURN2

This is effectively SATNET2 followed by SATALL2 - the equivalent to the old SATURN running SATNET and SATNET but giving access to the new features.

However, while this facility for externally selecting the approach is useful for testing purposes, it can be dangerous in model production mode, when a completely different run is generated if the SATURNcfcf is not set correctly. For this reason, the preferred batch file to use are of the form:

SATALL2E / SATURN2E

Equivalent to running SATALL2 (or SATURN2) with SATURNcfcf set to E but hard coded

SATALL2F / SATURN2F

Equivalent to running SATALL2 (or SATURN2) with SATURNcfcf set to F but hard coded

SATALL2C / SATURN2C

Equivalent to running SATALL2 (or SATURN2) with SATURNcfcf set to C but hard coded

SATALL2X / SATURN2X

Equivalent to running SATALL2 (or SATURN2) with SATURNcfcf set to X but hard coded

VERY IMPORTANT - For 11.6, please use these new batch files. Though the batch file SATURN at the moment acts as SATURN2, it is intended to revert it back to the old SATURN at some stage. If, for some reason, you want to run SATURN in its old manner, please ensure SATURNcfcf is unset

SATURN EXES

Multi-core should be working for TAC and non-TAC networks, and the new SATUFE program. SATDB and P1X are also multi-cored for SATRAP for UFCs, and P1X multi-coring of SLAs for UFC files is now reintroduced. However, the use of UFFs should reduce the need for multi-coring the analysis programs.

Note though, with increased demands for memory in the programs and the machines having more available threads, we now are sometimes seeing the following error message.
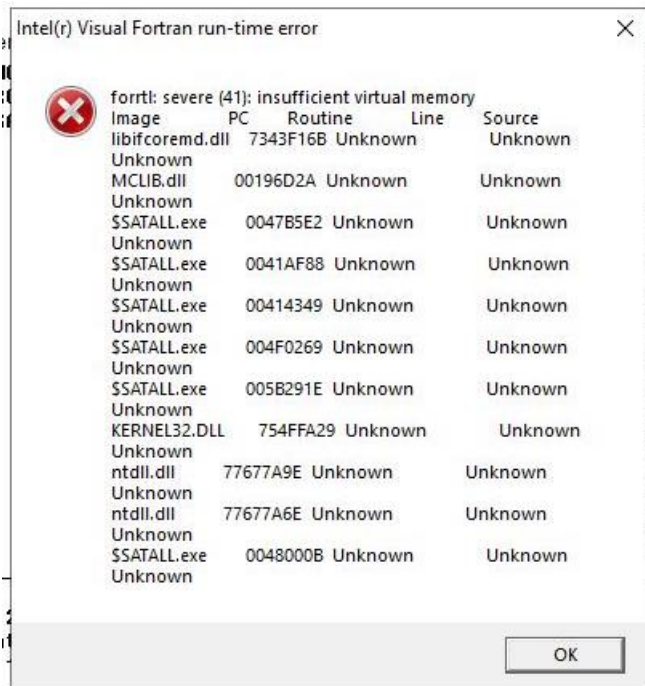
Looking at the "Intel(r) Visual Fortran run-time error" window above, the detail message is "insufficient virtual memory".

This arises because the program is not acquiring sufficient virtual memory to run the MC version of the software, and doesn't mean that there is necessarily anything fundamentally wrong with the program, just that the machine isn't meeting the requirements to run.

When running in multi-core mode, the program has to replicate memory for each thread it is using. Our programs default to running with as many threads as possible (to a limit of 32). What exactly controls the virtual memory it can find is not easily quantifiable but is dependant on what physical memory the machine has, what also is running, how any paging is set up, etc etc.

Typically, you may get this message when running on a machine capable of running more threads. It may work on a machine handling 20 threads with no problem, but moving to one running 24 threads will require it finding 20% more virtual memory and potentially fail.

However, we can control the number of threads that are used by the environmental variable OMP_NUM_THREADS. All other things being equal (which they probably won't be), the solution on the 24-core machine may be to limit it to 20 threads as follows:

```
set OMP_NUM_THREADS=20

call SATURN net mat

set OMP_NUM_THREADS=
```

You may need to experiment to discover what the appropriate setting for a machine / program is.

SATURN manual

The installer will overwrite any manual on the machine with the latest draft of the 11.6 manual / help files.

SatWin

This has now been updated for the additional 11.6 programs, with access to the new batch files mentioned above. It, of course, continues to function with older versions of SATURN.

SatView / UFS2UFV

SatView has been updated to permit the display of Z2Z connectors.   A new release, SatView v1.34 is expected to be provided shortly.

UFS2UFV has now been updated to take on board the new features, and a version of the corresponding SATURNelements.dll and be found in the XEXES directory. This file will need to replace the identically named file in the SatView installation to make the 11.6 data accessible (but will also preclude the use of old UFVs generated by 11.5 UFS2UFVs. The normal state of affairs is that UFVs must be regenerated with a version of UFS2UFV in the latest version of SATURN to be strictly compatible with the latest released version of SatView. However, we hopefully have removed the limitation that caused this difficulty, so from 11.6 onward this requirement should no longer exists - but of course does exist for pre 11.6 versions.

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