

TruckSim 7.01 New Features and Bug Fixes

Additional Vehicle Configurations	1
More Examples	1
Improvements in the Browser (TruckSim.exe).....	2
Multiple Levels of Undo and Redo.....	2
Road Segment Builder	2
Improvements in the Math Models	3
TNO Delft-Tyre Model.....	3
Parametric Trailer Hitch.....	3
Optional Steering Geometry Calculations.....	3
New Import Variables	3
More VS Commands and Symbolic Functions.....	3
More VS API Functions.....	4
Improvements in the Animator	4
Converting Files: Importing and Exporting	5
Help and On-line Documentation	5
Bug Fixes and Errata.....	5
Browser	5
Math Models	5

TruckSim 7.01 is a minor update that provides improvements in the existing browser and GUI, vehicle models, simulation numerical methods, animator, and file import/export capabilities. There are also many minor bug fixes and miscellaneous improvements. This technical memo highlights the improvements.

Additional Vehicle Configurations

New solver programs have been added for four new vehicle configurations involving independent suspensions: i_i , i_ii , ii_ii , and $i_i + i$.

More Examples

Nearly all of the major new features are demonstrated in examples in the installed database to help you learn to use them. The sidebars for most examples also contain notes describing interesting details of each simulation.

In the installed example database in the category “* TS7.01 Animator Features” a run illustrates the display of tire paths to visualize off-tracking. Another run makes use of the new tracking camera.

In the category “* TS7.01 Extended Models” under the **Datasets** menu, a simple steering controller has been implemented five different ways, using VehicleSim (VS) commands, Visual Basic, MATLAB, and external C code. Two examples are provided using C: with and without Simulink. In the same category, another example illustrates a sensor detecting a moving object shown by the animator as a truck.

The category “* TS7.01 Independent Suspensions” has four runs, each using one of the new vehicle configurations.

The category “* TS7.01 Measured Test Data” contains an example using SurfAnim, the TruckSim animator, to produce animations of data from a set of physical measurements that were imported using one of two new file converter utilities.

The category “* TS7.01 New Import Variables” has a run demonstrating the import variable for modifying camber, and another simulating the use of in-wheel motors, as in a hybrid powertrain.

The category “* TS7.01 Parametric Hitch” illustrates the use of a new browser screen to specify hitch properties using parameters instead of tables. The new hitch also supports damping and hysteresis (friction).

The category “* TS7.01 Sensors (Radar)” illustrates the use of VS Commands and Simulink to simulate two vehicles interacting through an adaptive cruise control system, and visually represents the field of view of a sensor indicating a “detect” condition by turning red and a “no detect” condition by turning green.

The category “* TS7.01 Simple ESC” implements a simple Electronic Stability Control (ESC) system in Simulink, and illustrates several tests involving this system.

The category “* TS7.01 Traffic Example” has two runs that show how traffic is added using VS commands to define moving objects for the animator that are automatically positioned to stay within visual range (as done in driving simulators and video games).

Improvements in the Browser (TruckSim.exe)

Most TruckSim users spend more time interacting with the TruckSim GUI (the database browser) than any other part of the software. This update includes some subtle but significant improvements.

Multiple Levels of Undo and Redo

The functions of the **Save** and **Undo** buttons have been improved, and a **Redo** button has been added to the browser toolbar. You can still force the current dataset to be saved at any time by clicking the **Save** button. In addition, the new **Undo** button provides step-by-step undo of changes until the dataset returns to the state it was in when the screen was entered. If you undo to a point where you forced a save by clicking the **Save** button, you are prompted before the action is completed. If you undo by mistake, or just to remember what a parameter was before you changed it, you can use the **Redo** button to restore your change.

Road Segment Builder

A new browser library **Road: Segment Builder** was added to assist in creating road geometry from scratch. Link to a **Road: Segment Builder** dataset from the **Roads: 3D Surface** screen to gain access to this tool. Using it, you can specify straight and curved segments by length, number of degrees, number of data points, and so on. You can specify cross-slope banking and transitions from banked to flat, and generate tables of Z coordinates. The Segment Builder tool generates the tables used by the math models.

Two examples can be found in the installed example database in the category “*TS7.01 Road Segment Builder” under the **Datasets** menu, and the on-line help for 3D Roads has been extended.

Improvements in the Math Models

TNO Delft-Tyre Model

The TNO Delft-Tyre 6.1 software is integrated with TruckSim 7.01. The basic MF-Tyre runs with TruckSim with no additional license. The more detailed SWIFT Tyre with multiple contact points, rigid-ring dynamics, and turn-slip is also supported for users who have purchased licenses from TNO.

User controls have been added to the Tire library screen for selecting among the Delft-Tyre options. Several examples can be found in the categories “* TS7.01 Advanced Tires” and “* TS7.01 Tire Tester (Delft-Tyre)” in the installed example database under the Datasets menu item. A chapter was added to the on-line help file for Tires.

Parametric Trailer Hitch

An alternative method for specifying the properties of a trailer hitch has been added. Instead of defining tables of each component moment, linear coefficients can be entered for stiffness, total travel, and bump stop stiffness. The model also includes damping and hysteresis for the hitch moments. A new library was added to the browser for this feature, and the documentation for hitches was extended.

Optional Steering Geometry Calculations

An option is provided on the **Steering System** library screen to specify whether steer angles are defined at the ground, including the non-linear gain effects, or as rotation angles about the kingpin, ignoring them. The first option is appropriate when steering geometry is measured with a Kinematics & Compliance test rig with turntables at each wheel. The second option is useful if steer data is measured directly on a running vehicle as rotation at the steering axis.

The steering system on-line help file is updated to include a discussion of these effects.

New Import Variables

New import variables are now supported to assist advanced users in extending the TruckSim models. Camber (`IMP_CAM_CON_L1`, `L2`, etc.) and its time derivative (`IMP_DCAM_CON_L1`, `L2`, etc.) can be used to extend or replace the internal definition of camber change. Systems like in-wheel motors for hybrid or electric vehicles can be modeled using moments (`IMP_MYUSM_L1`, `L2`, etc.) applied to each wheel and reacted at the unsprung mass.

More VS Commands and Symbolic Functions

There are more options available for extending the TruckSim math models using VS commands and symbolic algebraic expressions. When introduced in 2007, the symbolic expressions supported standard math functions (`SIN`, `COS`, `MAX`, etc.) and recognized all parameters, import variables, and output variables from the math model. The VS functions also provided information about the 3D road geometry, with functions such as `ROAD_X`, `ROAD_Y`, `ROAD_YAW`, etc.

TruckSim 7.01 adds Boolean functions (`AND`, `OR`, `NOT`, etc.) to simplify equations involving multiple conditions. It also adds ten new road access functions, to simplify the tracking of externally defined objects that are common when developing scenarios for testing advanced warning and control systems. (The new functions support the efficient tracking of 50 separate objects on the road.)

TruckSim 7.01 also supports the use of table lookup functions in the symbolic expressions. For example, the table that has target speed as a function of location on the road can be used for equations added with

VS commands. Most tables have gains and offsets that can now be set via VS commands. This lets advanced users extend existing tables at runtime in order to provide extra sensitivity.

TruckSim 7.01 includes a generic table with 12 datasets that exist solely for use within equations defined at runtime. This allows you to take advantage of the TruckSim database to define nonlinear relationships that can be used in equations defined in VS commands, to define new controls within TruckSim, or to export information to external software such as Simulink. (An example is provided showing how the generic table is used to implement a crosswind test facility: see “* TS 7.01 Generic Tables.”)

13 new VS commands were added to help manage complicated scenarios, where equations and events are added dynamically during a run. The new commands delete some or all of the equations or events in various categories.

More VS API Functions

The VehicleSim application program interface (VS API) has been updated for convenient use in more languages, and to provide consistent usage that is easily updated as new features appear in products. Examples are now provided for MATLAB and Visual Basic (VB), along with documentation in the VS API manual and in a tech memo that implements a simple steering controller using VS commands, MATLAB, VB, and C.

All of the functions that can be used in equations added at runtime with VS commands have also been added to the API, including the new road functions that can track 50 moving objects.

Access to the internal variables in the VS solver program has been improved, to include access to the offsets and gains associated with the tables.

More internal functions have been added to the API in support of advanced users; a TruckSim 7.01 VS solver DLL has 75 API functions. For example, new functions are provided to support the combination of model extensions in C that also work when the DLL is used with Simulink.

Improvements in the Animator

The animator has been modified to improve performance and add features. Here are some of the major changes.

- The internal processes were revised to make better use of graphics card hardware and use almost no CPU time. This supports multiple instances of the animator running simultaneously.
- The number of “ghost” images was increased to 1000, to allow visualization of tire paths.
- The visibility of images was made continuous, allowing variable transparency. This has been used to visualize skid marks, where the visibility of the path is proportional to “skidding.”
- Camera settings have been added to automatically track a target (such as a vehicle) from a fixed camera position, and automatically zoom to hold the target in the frame. This simulates a human camera operator at a racetrack or proving ground.
- “Audio zoom” is supported, to automatically adjust the sound level based on distance from the camera.

Converting Files: Importing and Exporting

The TruckSim animator and plotter shows data that is contained in pairs of files with extensions ERD and BIN, often called ERD files. A utility program in TruckSim has automatically converted ERD files to other formats for export to other software, such as spreadsheets and MATLAB. The converter has been extended to also convert data from spreadsheets to ERD files, to simplify the process of importing data into TruckSim for viewing with the animator and plotter. In addition, a simple utility program is installed for drag-and-drop conversion of CSV (comma-separated variable) files from spreadsheets to ERD files for animation.

Help and On-line Documentation

New text and spreadsheet documentation files are installed for the new models in the TruckSim_Prog\Programs\Solvers\Readme folder.

Existing technical memos have been updated and in some cases extended. New technical memos have also been added to describe how to do specialized tasks in TruckSim. All of the documentation is now directly accessible from the **Help** menu of the TruckSim database browser.

Bug Fixes and Errata

Browser

- On the **Batch Runs** screen, the function of the Miscellaneous Yellow Field and Overriding Data Link were corrected. Previously, these settings were ignored during the batch run.
- A bug on the **Events and Procedures** screen, when linking to another **Events and Procedures** dataset from one of the miscellaneous data links could cause datasets to be written incorrectly. It has been corrected.
- All other known browser bugs have been corrected. Review the Users area on the TruckSim.com website for details.

Math Models

- A bug in the math models caused the reaction to brake moments on independent suspensions to be ignored. This has been corrected. Anti-dive geometry effects will now be completely captured.