BikeSim® 2: New Features

BikeSim 2 is an extensive upgrade that involves substantial improvements in the simulation environment. The software has hundreds of revisions and new features that add new capabilities and increase efficiency for all users.

Math Models

VehicleSim Command Language

The math model solvers use a new simulation technology called VehicleSim® (VS) that includes a command language for extending the model at run time.

1. All model parameters can be specified with symbolic equations based on other parameters. (Of course, they can still be specified with numbers.)
2. Most import variables are tied to internal native variables (for example, steering torque). These imports can function in any of four modes: (1) ignore, (2) replace native variable, (3) add to native variable, or (4) multiply with native variable.
3. New variables can be defined at run time for import, output, export, or extending the model.
4. New variables can be calculated with equations that you provide at run time. Both algebraic equations and differential equations are supported.
5. Units associated with variables can be changed at run time, existing units can be redefined, and new units can be defined.
6. Events conditions can be defined with algebraic equations, allowing almost unlimited control options.
7. The capabilities of the VS command language are shown with examples that include path follower, traffic, a K&C test rig, etc.

The VehicleSim API

8. The solver programs are Windows DLL modules with the VehicleSim application program interface (VS API). The same solver DLL is used in all Windows simulation environments (built-in, Simulink, LabView, ETAS ASCET, command-line EXE, etc.).
9. Example source code (ANSI C) is provided showing how to use the VS API to run the BikeSim solvers from programs written in any language that can load a DLL (C/C++, Visual Basic, Excel, etc.)
10. The same design has been applied to the real-time (RT) versions of BikeSim to provide consistent support of all BikeSim features on many RT platforms.
11. Run options include “run forever” to allow lengthy runs terminated by user-defined conditions.
12. Memory management has been improved to allow almost unlimited batch runs with various RT systems.
13. The VS API provides access to the 3D geometry of the BikeSim roads for use with external models such as user-defined vehicle models and traffic vehicles that use road geometry.

Nonlinear Tables

14. Most nonlinear tables in a math model can be set at run time to one of 11 possible calculation methods, ranging from a constant, to a linear coefficient, to linear interpolation, to a spline, to 2D carpet plots.
15. Most tables include a scale factor and offset that can be used to transform a given nonlinear shape. These have keywords to help work with other software (DOE, sensitivity, optimization, etc.).

Multibody Model Features

16. The interaction between the steering system and the suspension has been redone with more detail for accurate 3D kinematics over the full range of steering.
17. The steering system involves caster angle geometry, which is either fixed relative to the main frame or variable with suspension stroke.
18. The suspension models have full nonlinear kinematical behavior that can support various types of suspension kinematics.
19. Longitudinal compliance of front fork (bend) is added.
20. The powertrain components have been organized to more easily replace parts of the powertrain with external models.
21. A dynamical time lag (degree of freedom) was added to the engine model.
22. Driveshaft torsional stiffness and damping were added.
23. TNO Delft-Tyre model and non-linear table lookup tire model are added.

BikeSim Browser and Database

The familiar BikeSim database browser is even easier for new users to learn, while supporting many more options for advanced users.

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Database and GUI Features

24. A sidebar shows an active tree-based view of the database, with quick access to any of the 150+ datasets that might be used in the current run.
25. The sidebar also shows notes for datasets, providing a visible and convenient place for user documentation.
26. The BikeSim browser can be controlled by the Windows COM interface. Users can control BikeSim from other programs such as Excel, Visual Basic, MATLAB, C/C++, Python, etc.
27. The software follows the organization standard for Windows (with programs and data in different areas), for better management by corporate IT departments.
28. Users can work with multiple BikeSim databases from a single installation on the same computer.
29. The interfaces to other graphic modeling tools such as Simulink, LabView, ASCET, and various RT HIL systems have been standardized and simplified.
30. Access to live animation has been improved, with support for multiple-screen animation (for driving simulators) and several levels of automation in running live animation.
31. More on-line information is available by right-clicking on screen controls.

Nonlinear Tables

Many vehicle properties, controls, and road properties are described in BikeSim with nonlinear tables. New table capabilities in the BikeSim math models are fully supported by the GUI.

32. Nonlinear tables can be shown in both spreadsheet views and classic plain text.
33. Graphs of tabular data show the interpolation and extrapolation of the data. When spline interpolation is used, the original data points are shown along with the interpolation line.
34. Most nonlinear tables include a drop-down control to specify the type of relationship, ranging from constants, to linear coefficients, to linear interpolation, to spline, to 2D carpet plots. (There are 11 calculation options.)
35. Most tables include a symbolic calculator, to rapidly generate data from algebraic equations, or transform existing series of numbers.
36. A new Symbolic Calculator screen provides a library for using and storing table equations.
37. Most tables include a button to transfer the contents to Microsoft Excel for editing and transformations.

New and Improved Screens

38. The layout of the main Run Control screen has been simplified for new users, while offering more options for advanced users.
39. A new Events and Procedures screen organizes data for standard tests, and provides a clean interface for defining events.
40. The Model setup screens include more simulation settings for advanced users.
41. The import and output control screens have been extended to support the new VS options.
42. The powertrain screens have been revised to simplify the replacement of components with external models.
43. Many screens have been added to support new model options.

Animator

44. The animator can generate AVI and other Windows-standard multimedia files for use in Microsoft PowerPoint and other presentation software.
45. Audio options have been added for engine noise, wind noise, and tire noise.
46. Overall efficiency has been improved to allow high-frequency update rates with much less CPU demand.
47. Communication for live animation has been improved to provide high-frequency full-screen displays on multiple monitors as needed for driving simulators.
48. Improvements have been made for fog, certain lighting conditions, and field of view.
49. Features have been added to support traces of images with dynamic control of size and transparency, allowing visualization of tire marks on the ground.

Documentation

50. The main reference manual has been converted to a modular form with more information. At the same time, redundant material has been condensed.
51. Reference documents that list available import and output variables are available in text (as before) and in Excel, where they can be sorted by name or category.
52. A new reference manual describes the VehicleSim solver program design, including the VS calculator and command language.
53. A programmers reference manual is provided that describes the VehicleSim API.
54. Numerous technical memos covering model details and examples are provided in the Help menu.