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VS Solver Wrapper

VS Solvers are libraries that support the building and running of VS Math Models for CarSim, TruckSim, BikeSim, and SuspensionSim. The Windows versions of these products include both 32- and 64-bit solvers, e.g., `carsim_32.dll` and `carsim_64.dll` for CarSim. On Windows, the 32-bit VS Solver DLL files are normally used from the main application program in the products, e.g., `CarSim.exe` for CarSim. These applications, called *VS Browsers*, provide a GUI for interacting with the models and managing a database of files that are mostly read as input by the VS Math Model, or written as output by the model. Alternatively, a VS Solver may be loaded and controlled by other Windows programs.

Programs that are used mainly to load a DLL and use its functions are sometimes called *wrappers*.

In support of automation work in which a VS Browser is not needed, the Windows versions of the products include the wrappers `VS_SolverWrapper_CLI_32.exe` and `VS_SolverWrapper_CLI_64.exe`, which provide a command line interface (CLI), and are described in this document.

> **Note** The same wrapper is available on various Linux operating systems, with the name `carsim-cli`. Refer to the technical memo *Running CarSim on Linux* for more information about the Linux version.

VS Solver Wrapper Startup

Windows installations of VehicleSim products include the 32-bit and 64-bit versions of the wrapper in the `Programs` folder of the installation `_Prog` folder. For example, the location for CarSim 2021.0 might be `C:\Program Files (x86)\CarSim2021.0_Prog\Programs`.

The 32- and 64-bit VS Solvers for the product are located in the `Programs¥solvers` folder, and are typically named <*product*>_<*bitness*>`.dll`, e.g., `carsim_64.dll`.

You can run the wrapper from the original location, or, you can copy the `exe` file to another folder if it is more convenient for specifying pathnames. It will use the location of the Prog folder along with the product name and the bitness of the wrapper to locate the appropriate solver DLL.

To use a VS Solver Wrapper, open a Command Prompt and navigate to the directory containing the VS Solver Wrapper file. To get a list of available parameters, launch the wrapper exe with the `-help` command (Figure 1).

```
VS_SolverWrapper_CLI_32.exe -help
```

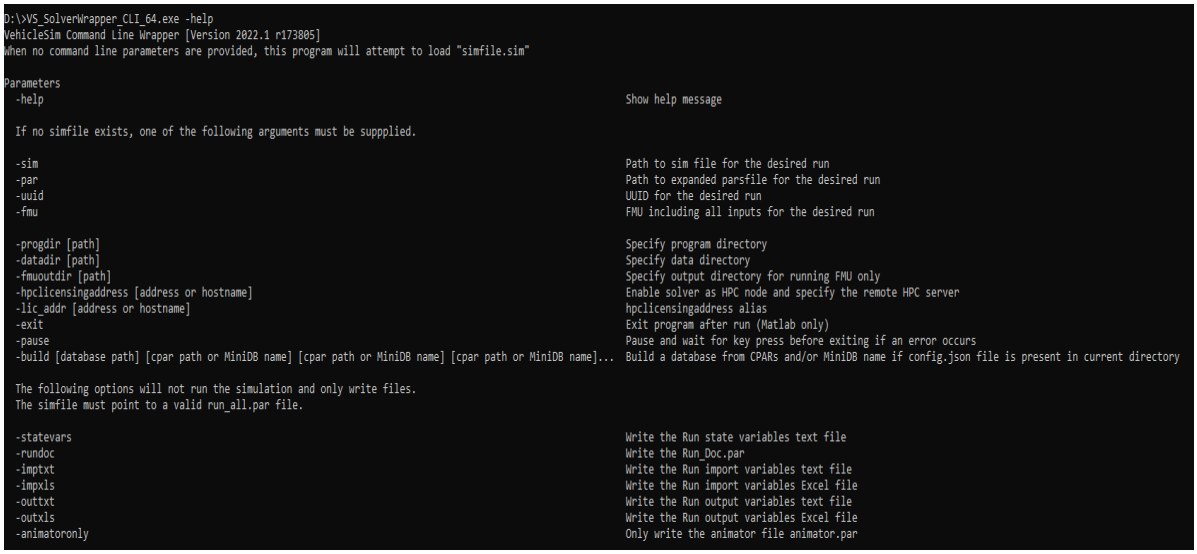


Figure 1: Executing -help parameter with VS_SolverWrapper_CLI_32.exe

Making a Run

The VS Solver Wrapper can run with either a simfile or a Run_all parsfile. You can specify a simfile using the `-sim` filename command; otherwise, it will search for an existing simfile located in the data directory. If the current database does not yet have a simfile, launch the VS Browser and run the Baseline run. Now that a simfile is generated, open the Command Prompt, and navigate to the Programs folder as mentioned above. Run the following command and edit the database directory as necessary.

```
VS_SolverWrapper_CLI_32.exe -datadir C:\Users\Public\Documents\CarSim2020.0_Data
```

```
C:\Program Files (x86)\CarSim2019.1_Prog\Programs>VS_SolverWrapper_CLI_32.exe -datadir C:\Users\Public\Documents\CarSim2019.1_Data
Loaded C:\Program Files (x86)\CarSim2019.1_Prog\Programs\solvers\carsim_32.dll
CarSim 2019.1
Vehicle Configuration: I_I
Revision 101010, June 19, 2019

Baseline <* * Quick Start Guide Example>

==================================================
Termination at simulation time = 6.313 s.
Computational time ratio: 0.0988437 (real time)/(simulation time)
```

Figure 2: Results after running first command using VS Solver Wrapper

Running Simulations

There are two ways to run the solver wrapper from any directory. The first method is to copy the 32-bit or 64-bit exe file to whichever directory you plan on running the solver wrapper from. Run the same command with the appropriate `-datadir` path to get the same results.

To avoid copying files everywhere you need to run the solver wrapper, add the product `Programs` path to the Windows `PATH`; e.g., the following command in the Command Prompt to add the programs path for CarSim 2021.0:

```
set PATH=%PATH%C:\Program Files (x86)\CarSim2021.0_Prog\Programs\;
```

Navigate to any directory and run the same command from the section above. Once again, the solver should run the simulation. If the Command Prompt does not recognize `VS_SolverWrapper_CLI_32.exe` as an internal or external command, the computer may need to be restarted.

If the `Programs` path is added to the windows `PATH`, then we can simplify the command by navigating to the database directory in the Command Prompt. Once the Command Prompts current working directory is the same as the database directory, we can execute the solver wrapper without defining the `-datadir` parameter. The following figure shows running the solver wrapper without any additional parameters.

```
C:\Users\Public\Documents\CarSim2019.1_Data>VS_SolverWrapper_CLI_32.exe
Loaded C:\Program Files (x86)\CarSim2019.1_Prog\Programs\solvers\carsim_32.dll
CarSim 2019.1
Vehicle Configuration: I_I
Revision 101010, June 19, 2019

Baseline <* * Quick Start Guide Example>

================================================
Termination at simulation time = 6.313 s.
Computational time ratio: 0.106447 (real time)/(simulation time)
```

If you are running more than one VehicleSim product on your machine be careful when adding the program drectory to your path. Make sure the example you are running matches the Solver Wrapper version within your path directory.

VS Solver Wrapper Usage Examples

Below are usage examples of the VS Solver Wrapper command line parameters for VehicleSim products. These commands are executed from within the root of the database directory.

```
VS_SolverWrapper_CLI_32.exe

VS_SolverWrapper_CLI_32.exe simfile.sim

VS_SolverWrapper_CLI_32.exe -sim simfile.sim
```

The above examples run the wrapper using `simfile.sim` as input.

Run the wrapper using a specified expanded Parsfile:

```
VS_SolverWrapper_CLI_32.exe -par /Results/Runs_e8824e5d-
     2cc4-40a3-975e-3bb3d0a7615f/LastRun_all.par
```

Run the wrapper using a matching expanded Parsfile from the `/Results/folder`, e.g.,

```
VS_SolverWrapper_CLI_32.exe -uuid e8824e5d-2cc4-40a3-975e-
     3bb3d0a7615f
```

If multiple Parsfiles are available, the wrapper will use the most recently modified file.

```
VS_SolverWrapper_CLI_32.exe -help
```

> **Note** For the `-uuid` and `-par` command line arguments, the wrapper will generate a temporary Simfile named `simfile.sim` in the current working directory

There are options available to generate documents without running the simulation. The following command with `-statevars` will generate the `Run_svs.txt` file. Generate one or more documents using a single command. Including any of the document commands will prevent the run from executing.

```
VS_SolverWrapper_CLI_32.exe simfile.sim -statevars
```

```
VS_SolverWrapper_CLI_32.exe simfile.sim -rundoc -imptxt
    -outtxt
```

Running Simulink

To use Simulink models, run the wrapper using any run configured to use the Simulink model. All Simulink runs contain the `SIMULINK_MODEL_FILE` keyword in the `all.pars` file.

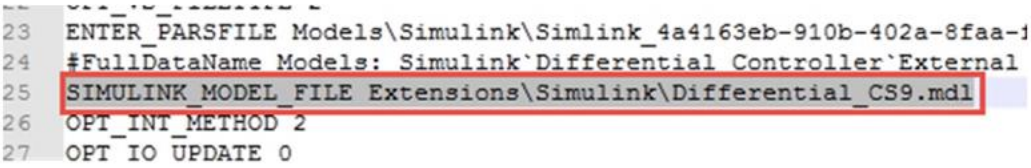


Figure 3: An example `run_all.par` file using Simulink.

For example, the following run uses the Simulink model, via the `SIMULINK_MODEL_FILE` keyword.

```
VS_SolverWrapper_CLI_64.exe -uuid Run_333d07a8-912b-417b-
    8761-07870e16c3c1
```

The wrapper will start the Simulink graphical interface, load the model, and start the simulation in Simulink. Henceforth, the model may be manipulated in the Simulink interface.

To immediately exit the Simulink interface and return to the command line after the run, as for a batch process, use the `-exit` parameter.

```
VS_SolverWrapper_CLI_32.exe -exit -uuid Run_333d07a8-912b-
    417b-8761-07870e16c3c1
```

Table 1 describes the installed locations of the files used for CarSim in Simulink. (Similar locations are used for TruckSim and BikeSim.) Advanced users may wish to edit or move these files to an alternate location. Any new location should be added to MATLAB using the `addpath` command within MATLAB, or by appending the path to the `MATLABPATH` environment variable.

Table 1. Simulink file locations

Item	Type	Purpose
/CarSim_Prog/Programs/solvers/vs_sf2v.mexw64	S-Function	Interface and host to the CarSim Solver
/CarSim_Prog/Programs/solvers/Solver_SF.mdl	Model Library	Describes the CarSim function block
/CarSim_Prog/Programs/solvers/vs_sf2.png	Model Thumbnail	The display image for the CarSim function block
/CarSim_Prog/Programs/solvers/slblocks.m	M-File	MATLAB script file, supports `Solver_SF.mdl`

Running FMU

VS Solver Wrapper can run the FMU with:

a. The FMU was generated by CarSim/TruckSim/BikeSim
b. FMI version 2.0
c. Self-contained FMU
d. Windows 32/64 bit and Linux 64 bit (not FMU for RT)
e. Accept only single FMU each run

The FMU includes all input files and binary solvers: vehicle solver 32/64 bit for Windows and Linux 64 if running on Linux 64, simfile.sim, Run_all.par, events parsfiles, vs_terrain file, external tire files if needed:

An example of running the FMU with arguments is:

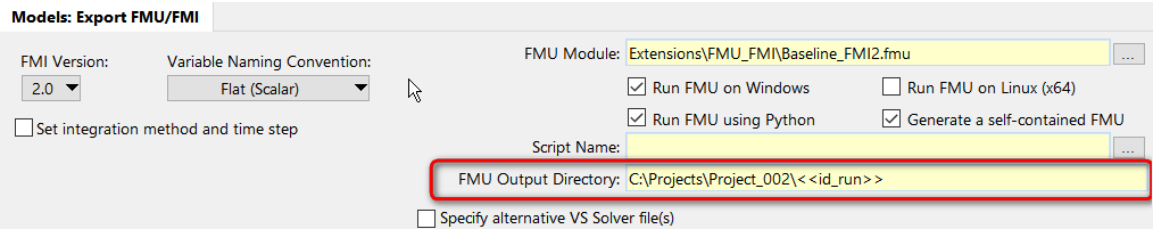
```
VS_SolverWrapper_CLI_64.exe -fmu project_001.fmu
    -fmuoutdir c:\my_local_dir\Project_001
    -hpclicensingaddress hps_lic_server
```

VS Solver Wrapper can only accept these input arguments when running FMU :

```
-fmu, -fmuoutdir, -hpclicensingaddress, -pause, -statevars,
-rundoc, -imptxt, -impxls, -outtxt, -outxls
```

You can set results output directory follow this order:

(1) Command line argument -fmuoutdir [path]
(2) If no argument (1), try to use the path in the FMU. Use VS Browse to set output path:



(3) If (1) and (2) do not exist use current working directory.

In the path setting you can use the symbol "~", it represents user's "Home" folder. On Linux it is `/home/{user}/`, and on Windows it is `%USERPROFILE%\Documents\`.

VS Solver Wrapper Command Line Arguments

Table 2 lists the command line arguments for the VS Solver Wrapper.

Table 2. VS Solver Wrapper Command Line Arguments

Usage Format	**Description**
VS_SolverWrapper_CLI_32.exe (no arguments)	Runs a VS Math Model using `simfile.sim` from the current directory
VS_SolverWrapper_CLI_32.exe [simfile]	Runs a VS Math Model using the specified Simfile
VS_SolverWrapper_CLI_32.exe -sim [simfile]	Runs a VS Math Model using the specified Simfile
VS_SolverWrapper_CLI_32.exe -par [parsfile]	Runs a VS Math Model using the specified expanded Parsfile, or "all" Parsfile
VS_SolverWrapper_CLI_32.exe -uuid [UUID]	Runs a VS Math Model using the specified run UUID
VS_SolverWrapper_CLI_32.exe -fmu [fmu file]	Runs an FMU including all inputs for the desired run
VS_SolverWrapper_CLI_32.exe -progdir [directory]	Specify the Program directory.
VS_SolverWrapper_CLI_32.exe -datadir [directory]	Specify the Data directory.
VS_SolverWrapper_CLI_32.exe -fmuoutdir [directory]	Specify output directory for running FMU only.
VS_SolverWrapper_CLI_32.exe -hpclicensingaddress [address or hostname]	Enable solver as HPC node and specify the remote HPC server
VS_SolverWrapper_CLI_32.exe -lic_addr [address or hostname]	hpclicensingaddress alias
VS_SolverWrapper_CLI_32.exe -exit	Exit program after run (Matlab only)
VS_SolverWrapper_CLI_32.exe -pause	Pause and wait for key press before exiting if an error occurs. Mainly used by VS Browser when using VS_SolverWrapper_CLI by using "*Pause 1".
VS_SolverWrapper_CLI_32.exe -build [database path] [cpar path or MiniDB name] [cpar path or MiniDB name] …	Build a database from CPARs and/or MiniDB name if config.json file is present in current directory
VS_SolverWrapper_CLI_32.exe -statevars	Write the Run state variables text file. Does not execute a run.
VS_SolverWrapper_CLI_32.exe -rundoc	Write the Run_Doc.par. Does not execute a run.
VS_SolverWrapper_CLI_32.exe -imptxt	Write the Run import variables text file. Does not execute a run.
VS_SolverWrapper_CLI_32.exe -impxls	Write the Run import variables excel file. Does not execute a run.
VS_SolverWrapper_CLI_32.exe -outtxt	Write the Run output variables text file. Does not execute a run.
VS_SolverWrapper_CLI_32.exe -outxls	Write the Run output variables excel file. Does not execute a run.
VS_SolverWrapper_CLI_32.exe -animatoronly	Only write the animator file animator.par