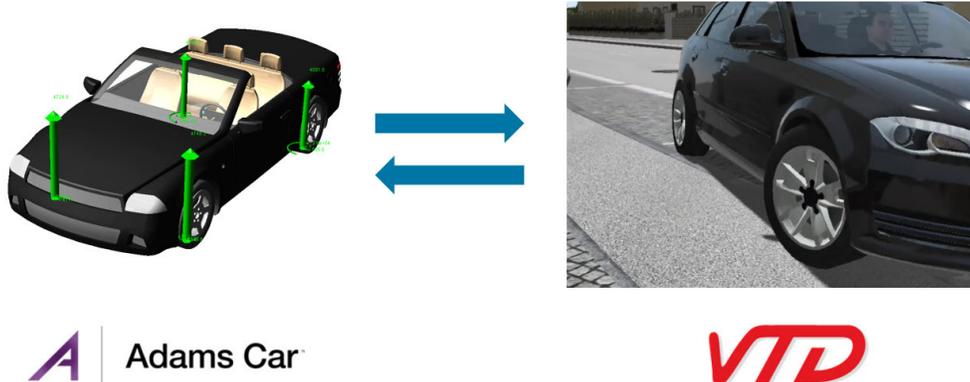


Adams Real Time

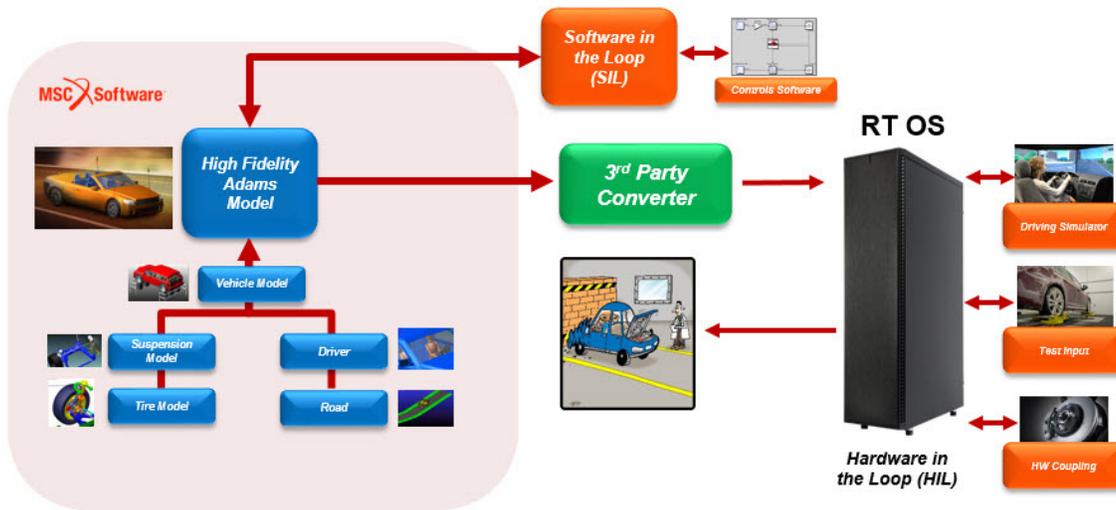
Hardware-in-the-loop Solution



Real Time computational speed is a pre-requisite when combining software models with hardware components, such as a chassis stability controller, vision / range sensors or a driving simulator (e.g. DiM Driving Simulator by VI-grade). MSC Adams has long been the automotive industry's tool of choice for vehicle dynamics predictions.

Now, with Adams Real Time, analysts can reuse the same base model for high fidelity off-line simulations, through SIL (Software-in-the-loop) to HIL (Hardware-in-the-loop) and ADAS (Advanced Driver Assistance Systems) applications. This one tool / one model approach has the potential to remove weeks from the typical vehicle development program and save tens of thousands of dollars by eliminating the error-prone model translations between different tools.

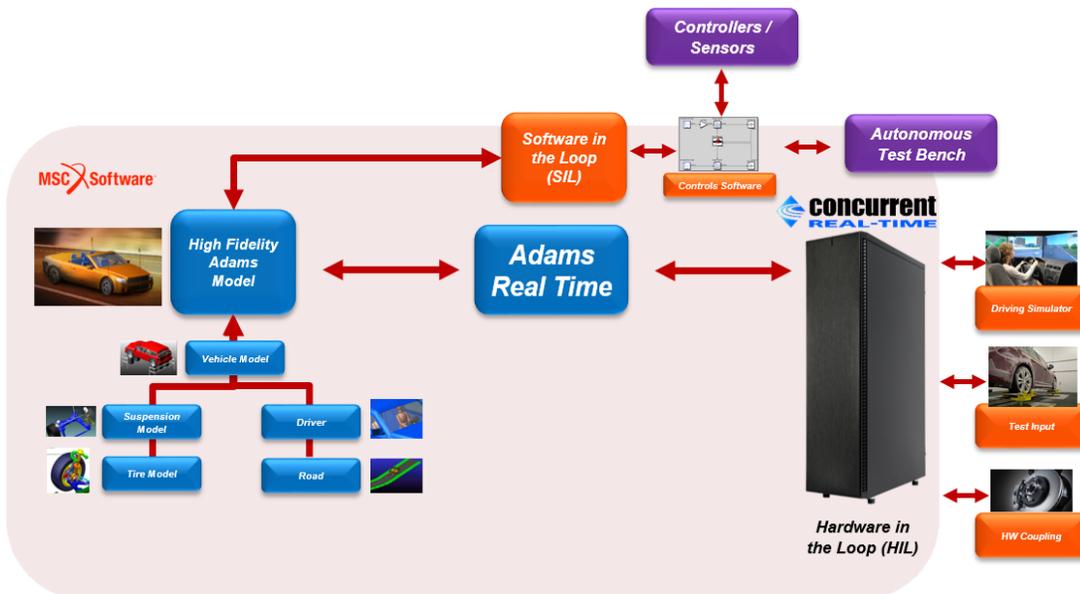
Before Adams Real Time...



Before Adams Real Time, Adams Car users need to convert the Adams model into a 3rd Party model before he can run hardware-in-the-loop (HIL) simulation. This workflow has 3 drawbacks:

1. 2 different sets of full vehicle models using 2 different tools had to be created
2. Reduced order 3rd party models could not be converted back into the original Adams models
3. Components/topology changes were not possible in some of the 3rd party models

With Adams Real Time !



With Adams Real Time, engineers can use one Adams model for both high-fidelity simulation and real time analysis. Combining 2 sets of models into one will drastically reduce the amount of work required to convert one model into another, thus improving consistency and increasing workflow efficiency between different departments.

With Adams the following innovations enable Real Time capability and can be leveraged in ADAS simulations:

1. Platform Integration

- **Adams Car VTD Integration**- Ability to provide Adams Car plant models for consumption within VTD

Virtual Test Drive (VTD), from MSC Software's VIRES Simulationstechnologie GmbH, is used for the development and testing of advanced driver assistance and active safety systems, leading to solutions for automated driving. Adams Car allows its users to generate a full vehicle model that can be used as a plant in the VTD simulation environment. The inputs to the Adams model in terms of steering, throttle and brake will be provided by VTD, via either VTD scripted driver controls or HIL/DIL simulations. The Adams model will return the states of the vehicle body and wheels to VTD. The capability assumes an install of Adams 2018.1 or later and VTD 2.1.

- **Real Time Analysis on Concurrent Platform** – Connecting Adams with a hardware controller or a driving simulator

Engineers need Real Time Simulation to connect with a hardware controller or driving simulator. Adams Real Time users to stay inside of Adams for both high-fidelity (complex model with high accuracy) simulation and real time analysis for hardware-in-the-loop. Adams Solver supports Concurrent's SIMulation Workbench® (SimWB) real time modeling environment on the RedHawk™ Linux® operating system.

Adams Solver can participate in co-simulations performed in the SimWB real time environment. This is achieved via extensions to Adams' support for the Functional Mockup Interface (FMI). A functional mockup (FMU) unit exported from Adams Controls or Adams Mechatronics within Adams View or Adams Car can be imported into SimWB.

Standalone Adams Solver analyses can now be run on the RedHawk Linux operating system.

MSC Software has certified Adams Solver in the following environments:

- iHawk® running RedHawk Linux 6.5 with SIMulation Workbench Control Center 7.5
- RedHawk Linux 7.0 with SIMulation Workbench Control Center 7.4

2. Enabling Real Time Compliance

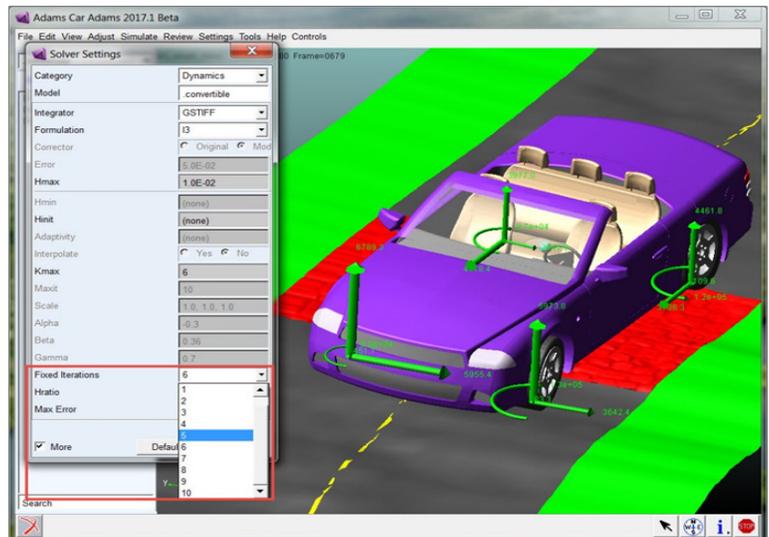
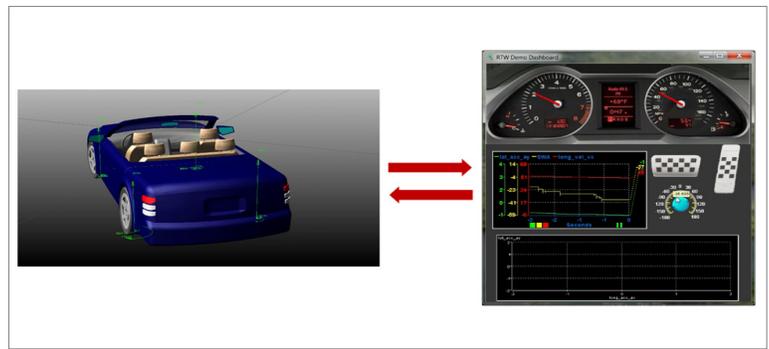
- **Adams Real Time Integrator** – New fixed-step integrator for faster simulation

The Real Time Integrator in an Adams solver setting that will allow the user to meet the real time operating system requirements. This Integrator ensures that both the Adams simulation speed and the communication interval meet the real time platform/hardware requirements (e.g. driving simulator, or abs controller).

A fixed step option is introduced for the GSTIFF integrator supporting both the I3 and SI2 formulations and for the HHT integrator. The purpose of the fixed step option is to ensure that a fixed amount of work is completed in a given time to satisfy the requirements for a Linux real time operating system (RTOS).

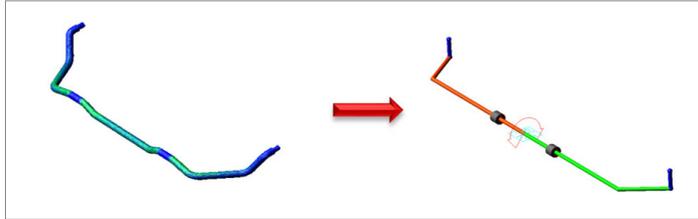
- **Model Fidelity Tuning** - Automated utilities for generating more efficient vehicle models

Higher-fidelity component models can represent a significant performance cost in the solve time of a vehicle dynamics model and in many instances sufficiently accurate results can be achieved with a more efficient modeling approach, which is preferable in real time analysis.

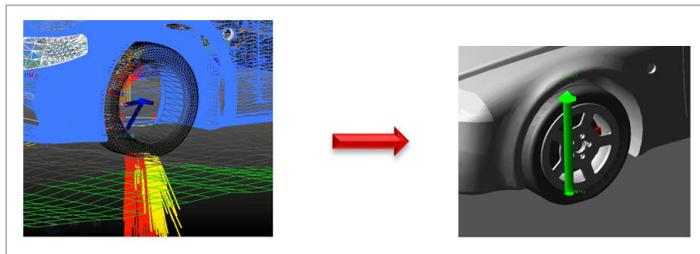


Adams includes an automated utility for reducing the modeling fidelity of Adams Car anti-roll bar objects. Users with anti-roll bars modeled via the FE Part or Beam methods are guided in reducing them down to a comparable anti-roll bar modeled via the Simple method (two parts and torsion spring).

This involves automated derivation of an appropriate torsion spring stiffness through a series of simulations exercising the anti-roll bar and providing a comparison of the original and simplified models. Users can opt for the auto-derived spring stiffness or re-run the comparison with their own value. Once satisfied with the spring stiffness, one can proceed and the utility will automatically replace the anti-roll bar with the simplified version.



Also in Adams an automated utility for reducing the modeling fidelity of tires is available. Users with tires modeled via FTire, detailed 3rd-party models or the more sophisticated Adams Tire PAC2002 options (for example, transient model, belt dynamics, 3D enveloping contact) are guided in reducing them down to a simpler PAC2002 model. This involves a semi-automated process with a wizard guiding one through the use of the appropriate tools: tire testrig and tire data and fitting tool (TDFT). Finally, vehicle models can be updated automatically with the new tire models.



3. Visualization/Post Processing Capabilities

- **Real Time Animation for Adams Car Models-** Animate Adams Car Models during Real Time Simulations either on the same machine as the solver or a different one.

When running an Adams Real Time simulation via an FMU, it may be hard to gauge if the simulation results conform to expectations. With the Real Time Animation feature, an Adams Car model is animated online during the simulation. Within the SimWB real time environment this is achieved by including geometry of the vehicle model in the Functional Mockup Unit (FMU) during Adams Controls plant export. The animation can be effected on the same machine as Adams Solver is running, or on a different machine. Currently the animation component can run on supported Red Hat Linux platforms only (no SUSE Linux support or Windows support) and only Adams Car models can be animated in real time.

