SIMPACK Realtime

With SIMPACK 9.3, the new solution for realtime simulations — SIMPACK Realtime — was introduced. SIMPACK Realtime enables the use of complex models for a wide range of performance-critical realtime applications such as Hardware-in-the-Loop (HiL) and Software-in-the-Loop (SiL) scenarios. Typical applications include handling and comfort simulations, and ECU testing and component test rigs, e.g., for gearboxes and engines. To achieve realtime for complex models, SIMPACK Realtime runs on INTEL x86 hardware and Linux operating systems with realtime kernel extensions. This brings realtime simulation to an unprecedented level of performance. For example, detailed vehicle models with more than 200 DOF and a stepsize of 0.2 ms have been successfully solved in realtime.
Unlike previous realtime solutions, SIMPACK Realtime works directly with fully parameterized SIMPACK models without a time-consuming code- or lookup table generation process. SIMPACK Realtime supports a wide variety of targets, including dSPACE and Concurrent. It includes the possibility of animating the simulation results in realtime and logging them to disk.

SIMPACK REALTIME

Following a long history of successful realtime implementations (e.g., see [1] and [2]), SIMPACK has developed the next step in realtime simulation products, SIMPACK Realtime. SIMPACK Realtime has many advantages over its predecessor (SIMPACK classic Code Export).
A SIMPACK model can run directly in realtime when the model has no constraints, is stable when using a fixed step-size solver, and the individual elements do not require internal iterations.
To execute the model in realtime mode, the user can remain in the SIMPACK environment and start the SIMPACK Realtime solver directly, without a time-consuming code generation and compilation process.
Whereas previously, the Code Export based SIMPACK realtime models were directly executed on proprietary realtime hardware and operating systems, SIMPACK Realtime runs on standard realtime-enabled Linux operating systems and communicates with realtime computers via a dedicated network connection, shared memory or a user-defined communication library.
To fully utilize latest multi core processor hardware, the SIMPACK Realtime solver contains an automatic parallel computation feature. Besides running the model in realtime mode, it is now possible to view the results directly using the included Realtime animation. It is also possible to capture the realtime simulation results using the realtime logger for offline post-processing or to replay the animation.

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SIMPACK REALTIME SETUP

SIMPACK Realtime is designed to run on Linux systems with realtime kernel extensions such as SUSE Enterprise, Debian, or Concurrent RedHawk. The communication between SIMPACK Realtime and proprietary realtime systems takes place either via a dedicated peer-to-peer UDP network communication (this is a dual computer setup, see Fig. 3) or via shared memory (a single computer setup, e.g., with Concurrent Simulation WorkBench, see Fig. 4). The SIMPACK model communicates via u-Inputs and y-Outputs with the outside world.

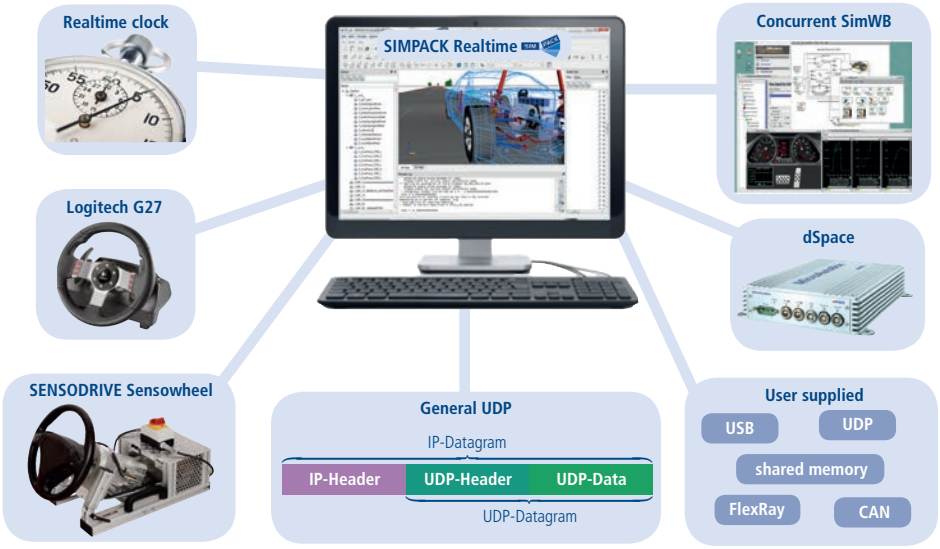

Fig. 1: Realtime targets supported by SIMPACK

SIMPACK REALTIME PACKAGE

The SIMPACK Realtime package contains the following products:

- SIMPACK Realtime solver
- SIMPACK Realtime animation
- SIMPACK Realtime logger

The specific SIMPACK Realtime solver enables direct realtime integration of the model. It uses a constant step-size to solve the equations of motion in realtime and guarantees a fixed frame rate with a very low margin. Frame rates of 0.2 ms in a

Fig. 2: SIMPACK Realtime desktop driving simulator using a high precision SENSODRIVE steering wheel

200 DOF vehicle model have already been achieved in realtime. The Realtime solver supports automatic parallelization in order to utilize multiple cores.

The SIMPACK Realtime animation displays the simulation results in realtime as a 3D animation. It can run on the same computer as the Realtime solver, or a different machine, and utilizes one or more CPU cores. The Realtime animation communicates with the Realtime solver over UDP. For each simulation step, the Realtime solver sends its state vector to the Realtime animation. The Realtime animation also loads the model and performs online Measurements with the received state vector and displays the results in a 3D animation. The Realtime animation computes and displays the next animation frame once it has finished displaying the previous one. The target update frequency for the Realtime animation is 25 Hz, whereas typical Realtime solver step-sizes and communication step-sizes range from 0.2 to 2 ms.

The SIMPACK Realtime logger — same as the SIMPACK Realtime animation — receives the state vectors which can be used for post-processing, like data plotting or performing a replay of the animation.

CONCLUSION

SIMPACK Realtime introduces a new way to run SIMPACK models directly in realtime without a time-consuming code- or lookup table generation process. SIMPACK Realtime runs on standard realtime-enabled Linux operating systems and communicates with realtime computers via a dedicated network connection, shared memory, or a user defined communication library. Users don't need to leave the SIMPACK environment and have the benefit of using all model elements (with a constant calculation time) in realtime. SIMPACK Realtime solver supports automatic parallelization in order to utilize multiple cores and can be used with the latest off-the-shelf hardware; a fixed frame rate of 0.2 ms for a more than 200 DOF vehicle model has already been achieved in realtime in industrial applications.

KEY FEATURES

- Direct realtime simulation; no time consuming code- or lookup table generation required
- Most modeling elements supported
- Offline models can be used for realtime simulation
- Built-in multi-core support
- Use of latest off-the-shelf hardware, no expensive specialized realtime hardware needed
- Realtime animation and Realtime logging included
- Fully parameterized models
- Users do not have to leave the SIMPACK environment
- Zero turnaround time after model changes
- Parts-based suspension models supported
- Communication with realtime targets via UDP or shared memory
- Various realtime targets predefined, user target interface supported (Fig. 1)
- Can be applied to a wide range of industrial applications in addition to the automotive sector.

REFERENCES

[1] www.simpack.com/fileadmin/simpack/doc/newsletter/2009/SN_2_Nov2009_BMW-HighDyn_TestBench_using_SIMPACK.pdf

[2] www.simpack.com/fileadmin/simpack/doc/newsletter/2004/sn-2-04-vdym.pdf

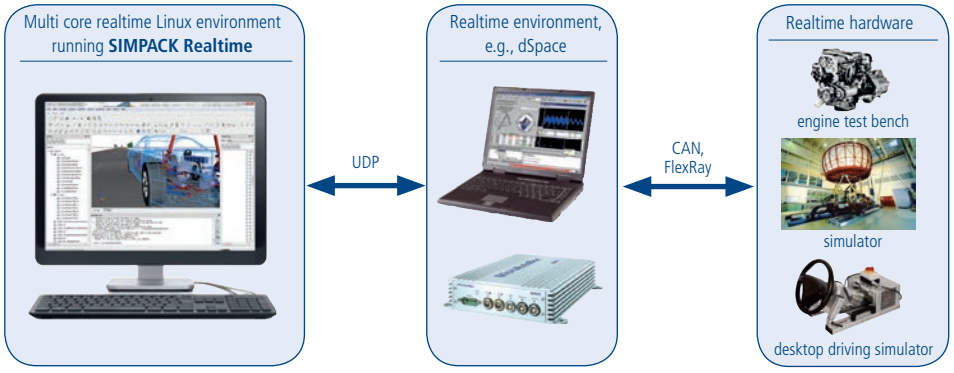

Fig. 3: Dual computer setup, SIMPACK Realtime communicates via UDP network with realtime environment

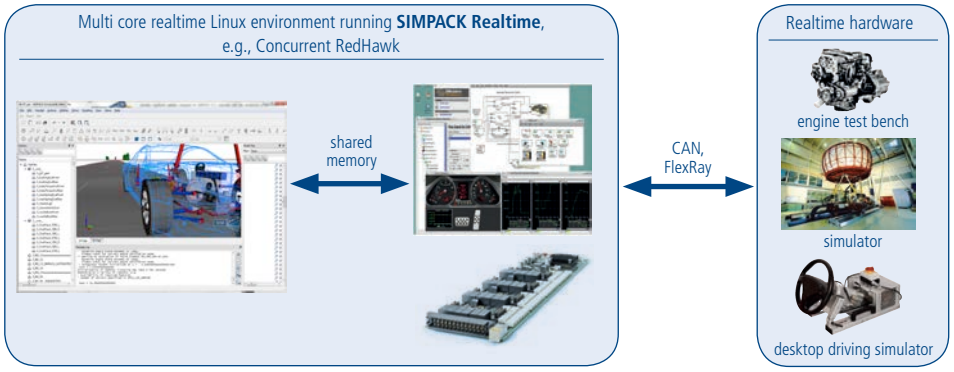

Fig. 4: Single computer setup, SIMPACK Realtime communicates via shared memory with realtime environment