

# DAIMLERCHRYSLER

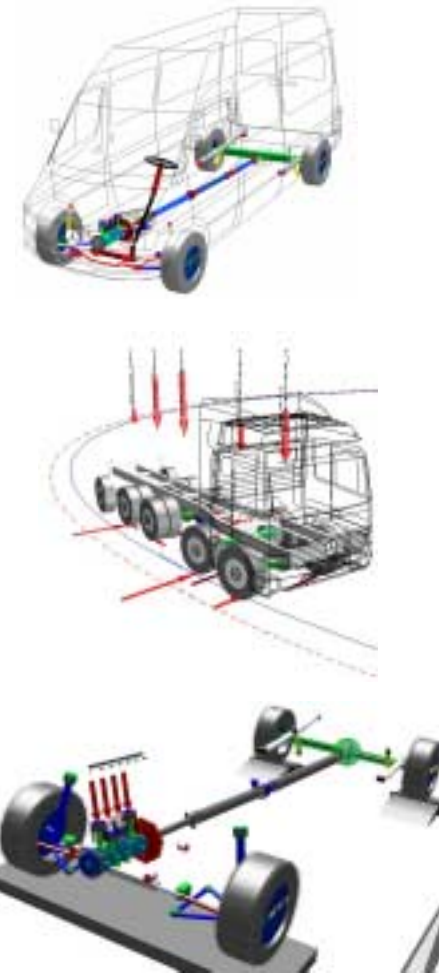
## **Simpack Realtime Models for HiL Testing at DC Trucks**

Klaus Wüst, CAE Commercial Vehicles, TPE/PCF  
Simpack User Meeting, Bonn, November 2007

## **Simpack Applications at DaimlerChrysler / CAE Commercial Vehicles**



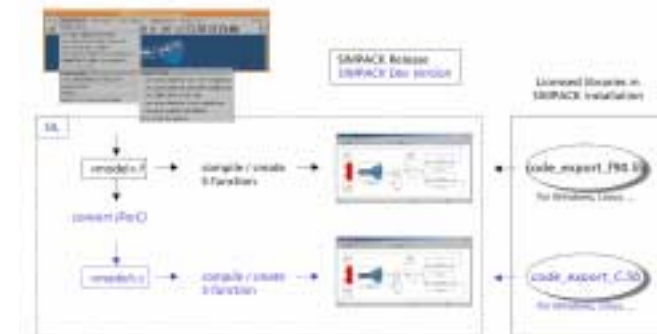
- **Simpack is the standard multibody software of the DaimlerChrysler commercial vehicles CAE division and is used for simulations of :  
Vehicle dynamics, ride comfort, brake system layout,  
drivetrain vibrations, durability  
(for details see the corresponding presentation during the Simpack User Meeting 2006)**
- **Via a MBS model database the various models of vans, trucks and buses and their subsystems (e.g. steering systems, suspensions) can be exchanged.**



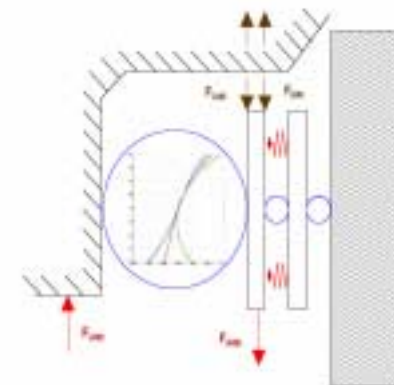
## Application of Feature „Codeexport“



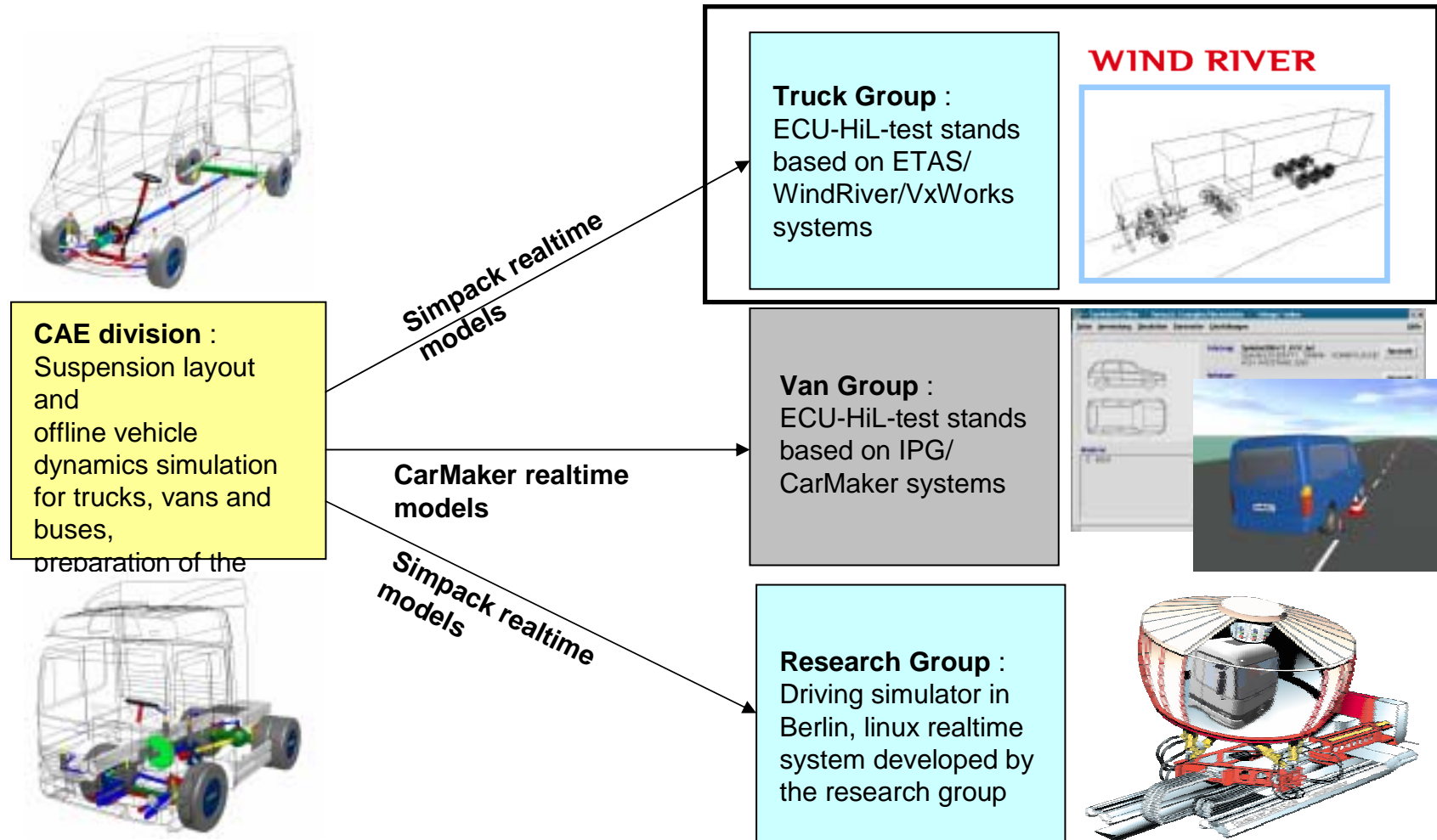
- To generate realtime Simpack models the functionality „Codeexport“ is used (see also former Simpack User Meetings).
- With reduced complexity and a constant stepsize solver (Euler), the exported models have realtime capability. The stability of the model with the Euler solver has to be checked.
- Thus, the Simpack realtime capability is not restricted to distinct models, but any exportable Simpack model has realtime capability if the level of complexity is adequate.
- To achieve an adequate level of complexity, the feature „virtual suspension“ may be used, but is not substantially necessary (e.g., rigid axles can be modeled in detail even for realtime purpose).



Look up table based kinematics and elastokinematics:

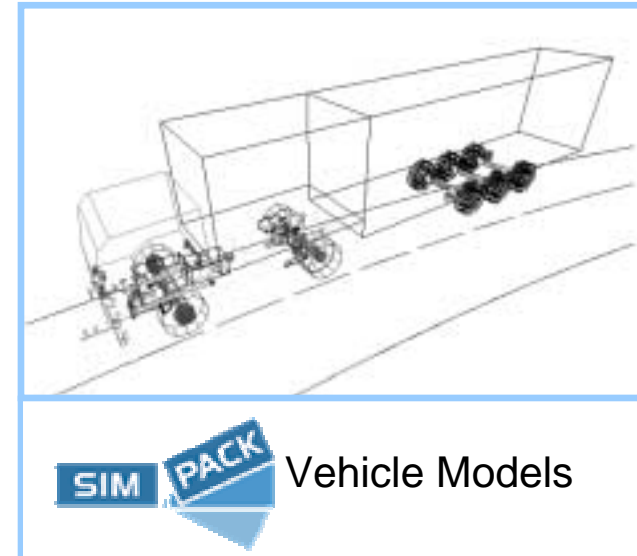


# Realtime Vehicle Dynamics Models of the DC Commercial Vehicles CAE division



## Transfer of **Simpack Vehicle Dynamics Models** to the HiL ECU Test Stands

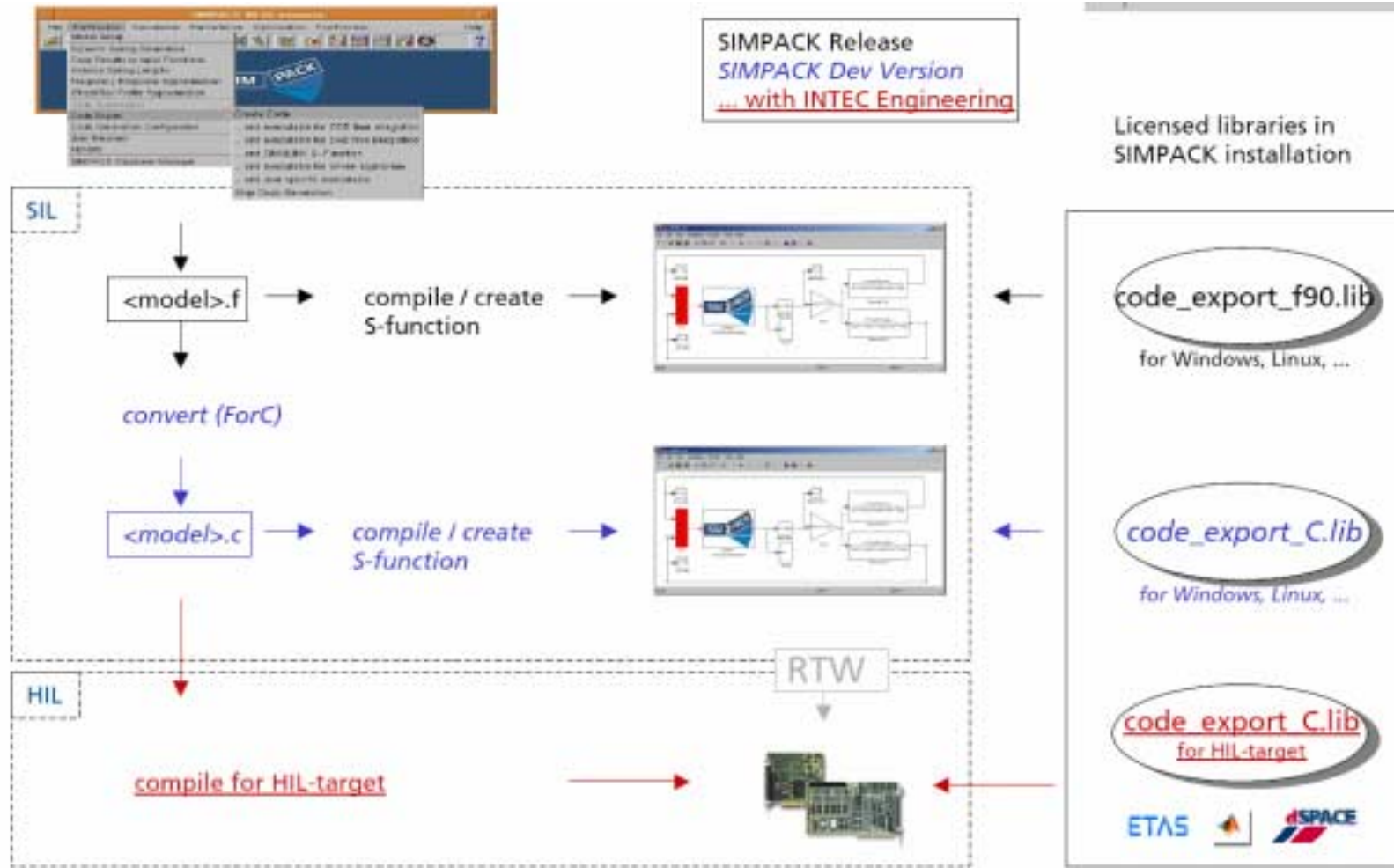
- Originally, the vehicle models used on the hardware-in-the-loop test stands were self-generated models in a MATLAB/SIMULINK environment.
- These models are now replaced by Simpact realtime models using the same environment with identical I/O parameters.
- For this purpose, INTEC implemented a Fortran/C converter into the codeexport feature and developed specific options for the VxWorks operating system.
- In August 2006, a first test of a simpact model on the target system could be completed successfully.
- Currently, several realtime models are prepared, which will cover the basic model variety which is needed for truck vehicle dynamics simulation (2-, 3-, and 4-axle straight trucks, tractor/trailer and tractor/semitrailer combinations)



### **WIND RIVER** Realtime Models

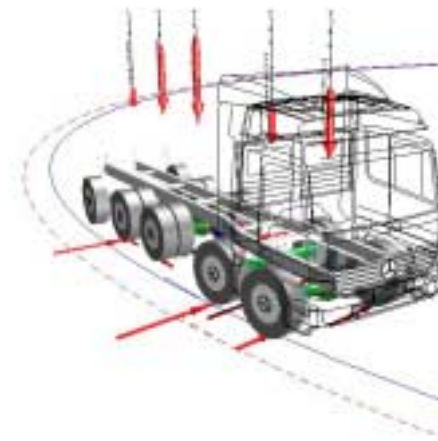
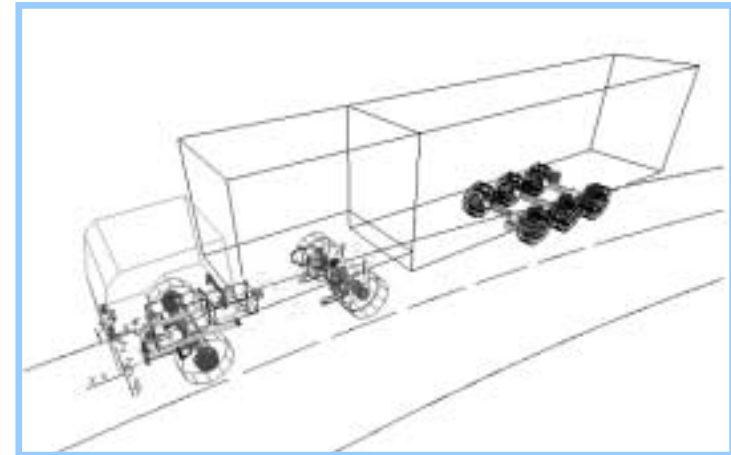
Based on the models used for offline vehicle dynamics simulation;  
reduced complexity;  
I/O adapted to the test stand requirements;  
used also for the driving simulator purpose.

# Schematic of Model Transfer (from 2006 User Meeting)



## Variety and Complexity of the Realtime Models

- Prepared realtime models :
  - 2-axle straight truck
  - 3-axle straight truck, steered rear axle
  - 4-axle straight truck, 2 steered front axles
  - 2-axle tractor / 3-axle semitrailer combination
  - 3-axle tractor / 2-axle trailer combination
- The models include :
  - detailed steering model
  - detailed rigid axle models
  - cab suspension
  - torsional frame stiffness
- Model reductions :
  - Twin tyres reduced to one tyre
  - Trailer axles reduced to one axle
  - No FE leaf spring modeling
  - No FE frame modeling



## **Simpack Realtime Models in the SIMULINK HiL Environment – I/O and Parameters**

- The model I/O was harmonized according to the originally used SIMULINK models
- Inputs :  
Manoeuvre definition (accelerating, braking, steering), road surface input, optional input of external SIMULINK air spring model
- Outputs :  
Characteristic values of vehicle dynamics (e.g., accelerations, yaw velocity, roll and sideslip angle, ...), wheel motions (for ABS/ESP ECU input) and forces,  
steering motions and forces (for simulator interface)
- Parameters :  
Basically, all the parameters of the model database can be modified after the codeexport (open issue : parameters of the MFTYRE tyre model).  
Explicitly, parameters of the basic model such as the loading condition are accessible via the model „subvar“ file.

## **What is the benefit ?**

### **Using Simpact MBS models in realtime environments offers :**

- Reduction of the effort for generation, parametrization and validation of the vehicle dynamics models used on the HiL test stands.
- Improvement of the quality and quantity of the models used on the HiL test stands,  
based on a database of validated MBS models.
- Usage of the same realtime model for HiL ECU testing and for subjective vehicle evaluation on the driving simulator.
- Improvement of the collaboration between CAE and field testing divisions.

## **Plans for the future**

- Increase of model variety  
(e.g., actively steered rear axle of 3-axle truck)
- Frequent updates of the models used for HiL testing
- Standardized testing of the generated models inside  
SIMULINK  
(„release checks“)
- Interface between Abaqus FE suspension models  
and Simpact Virtual Suspension