«EMR-based P-HEV simulation using Simcenter Amesim»

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SIEMENS   Université de Lille   **Valeo**

Panda
Powerful Advanced N-Level Digital Architecture

1 **Simcenter Amesim**

2 **P-HEV model**

3 **Simulation results**

« Simcenter Amesim»

- Simcenter Amesim-

Model-based
system testing

Pre-design

Systems sizing &
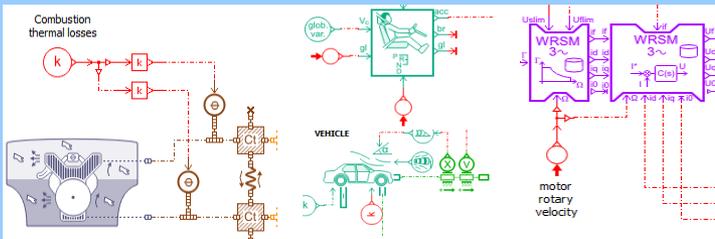integration

Performance balancing

Controls validation

Advanced industrial
Multiphysics simulation
package

based on
**structural libraries
for models**
and
a functional library
for control

**48 libraries
(6500 models)**
- Hydraulics
- Pneumatics
- Thermal
- Electrical
- Mechanical
- Signals, etc.

new **EMR-based
functional library**
for models
& control
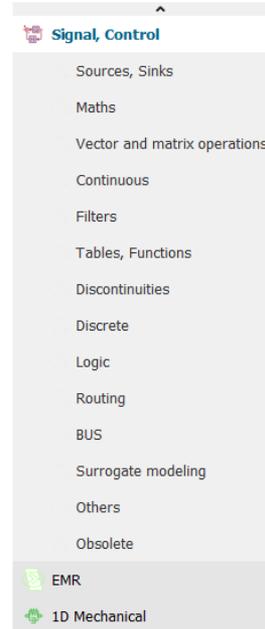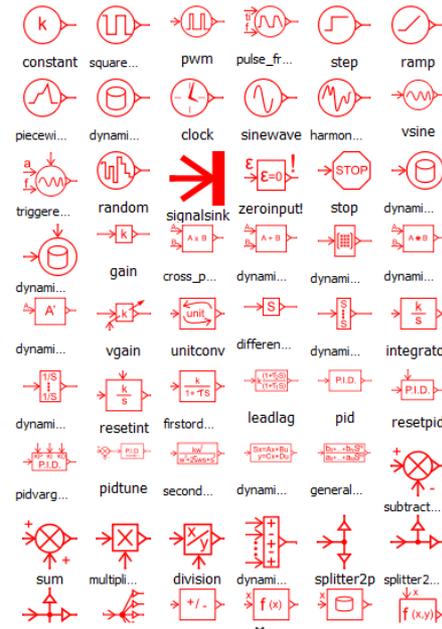
- EMR Library in Simcenter Amesim-
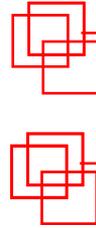
EMR'22, Sion, June 2022

New EMR library

Signal & Control library
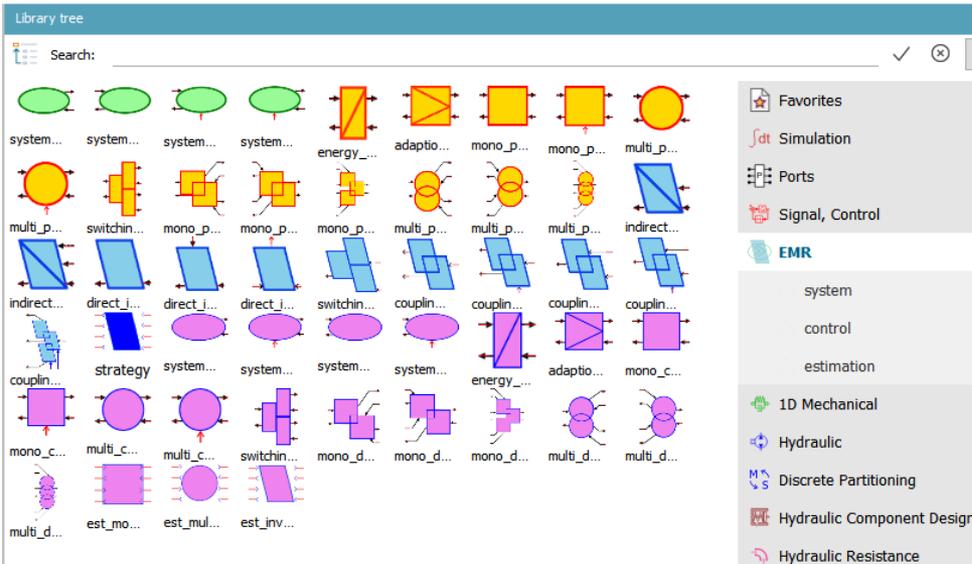
EMR simulations in Simcenter Amesim

« P-HEV Simulation »
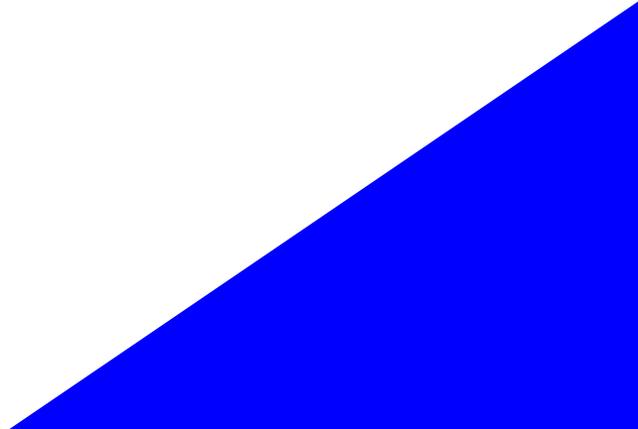
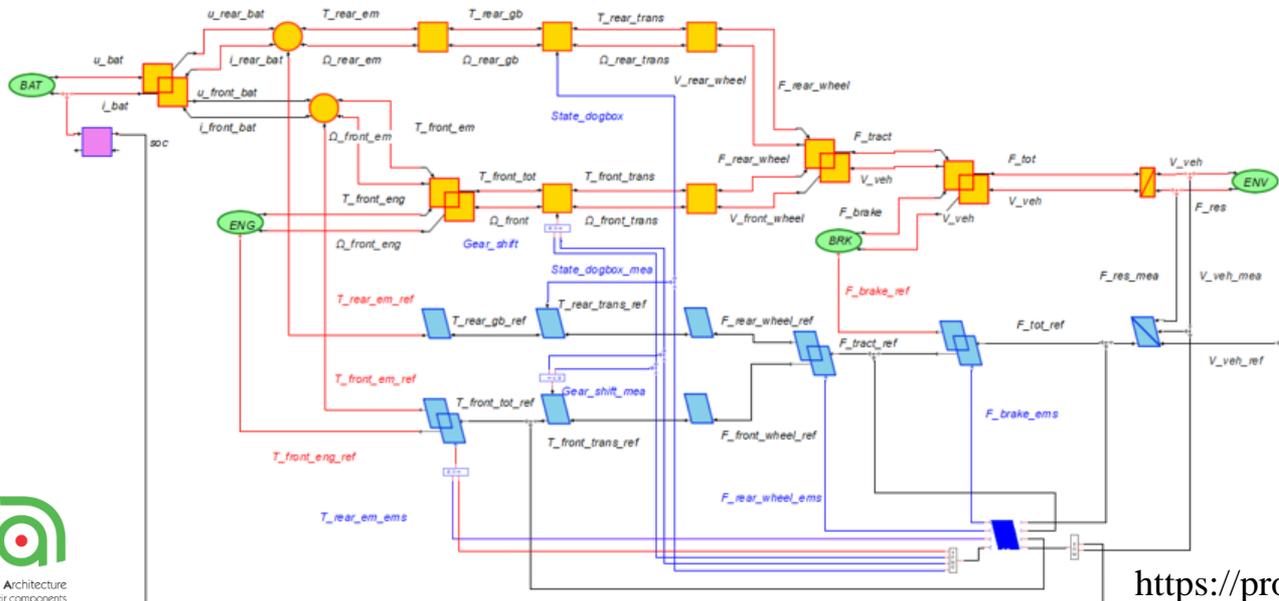- PANDA Simcenter Amesim EMR n-level vehicle models based on:

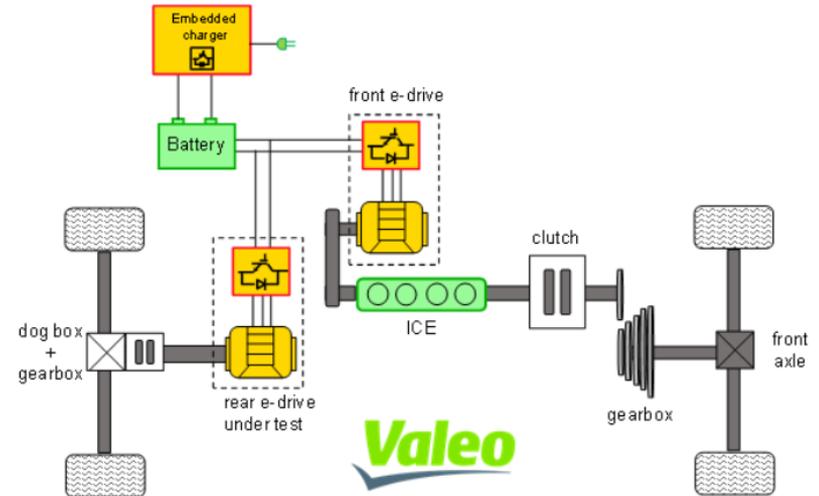 - Renault Zoe (BEV) Mobypost (FCV) Valeo Demo Car (P-HEV)

https://project-panda.eu/virtual-testing/

🐼 **Base vehicle:** Peugeot 308 130ch

🐼 **PHEV architecture:**

e-drive = Permanent Magnets Synchronous Machine (PMSM) + Inverter

🐼 **Valeo Physical rear e-drive:**

- 25kW peak power
- Low voltage 48V
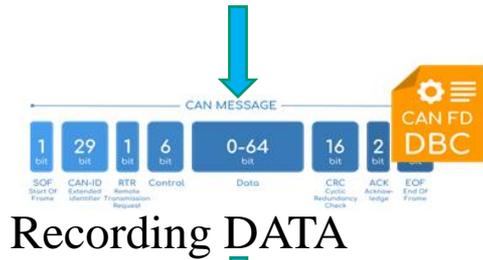- Watercooled

P-HEV validation process
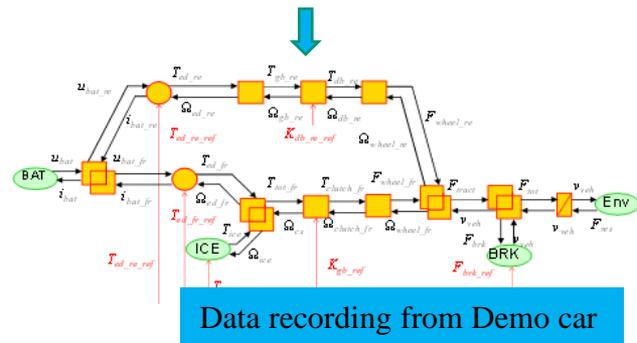
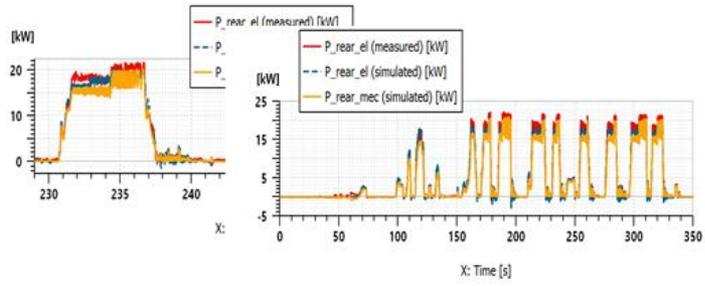*EMR'22, Sion, June 2022*

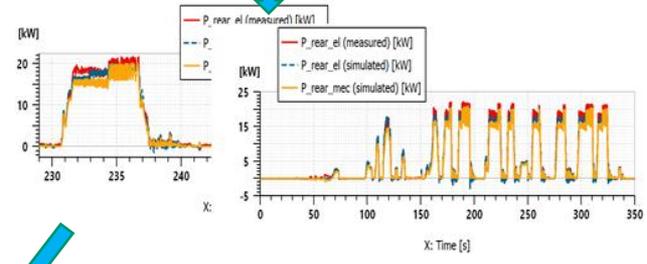P-HEV demo car

Simcenter Amesim

Recording DATA

Data recording from Demo car
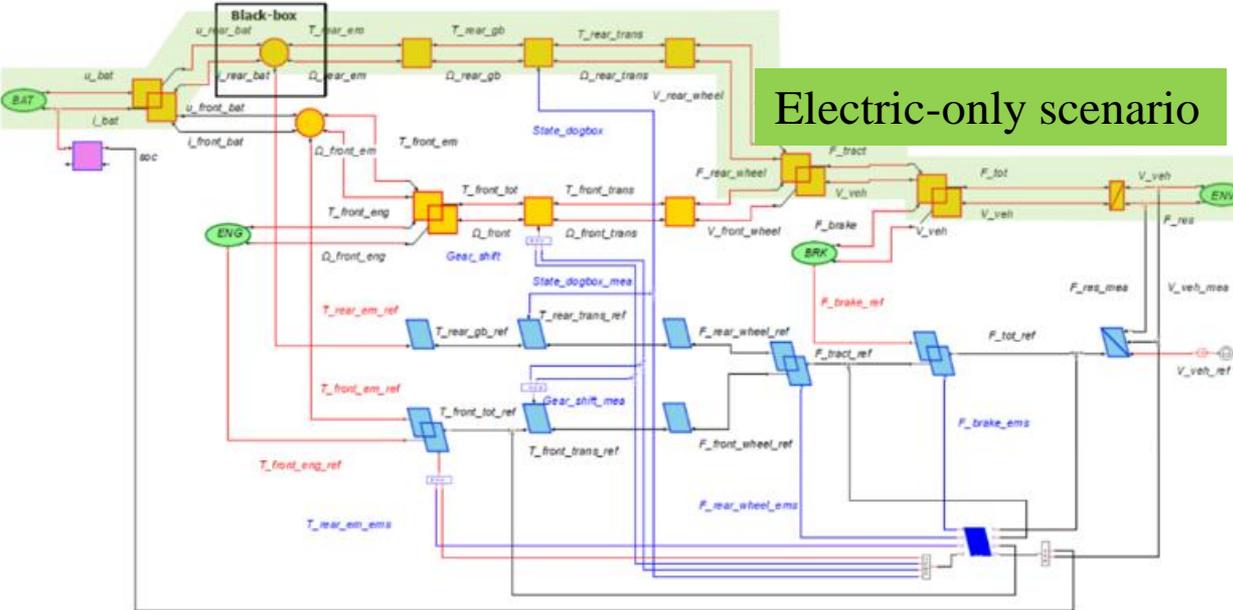

Demo car results

Simulation results

Comparaison and
Superposition of results
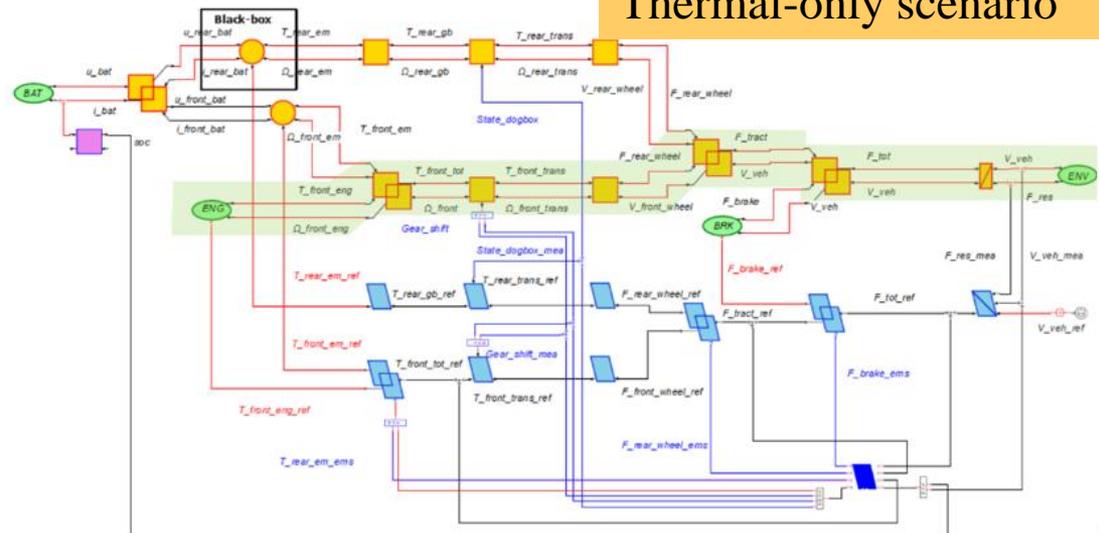
Testing scenario - active energetic path

EMR'22, Sion, June 2022

Electric-only scenario

Thermal-only scenario

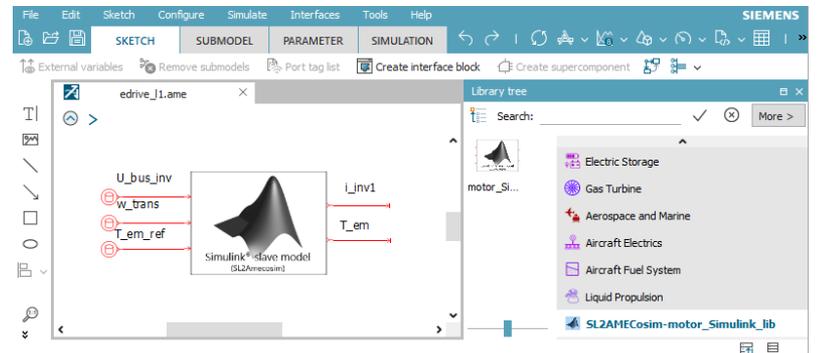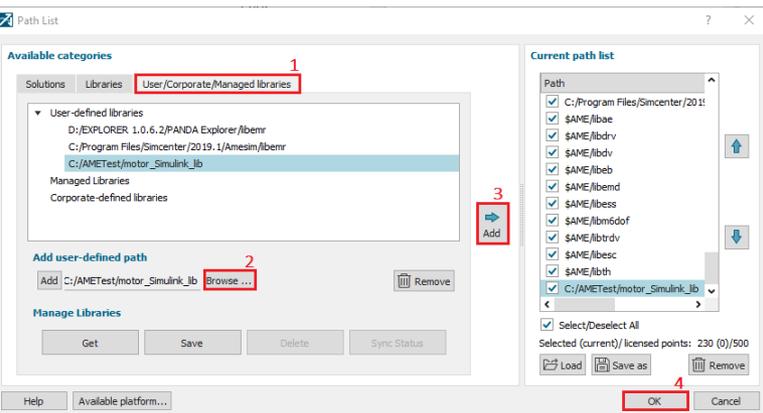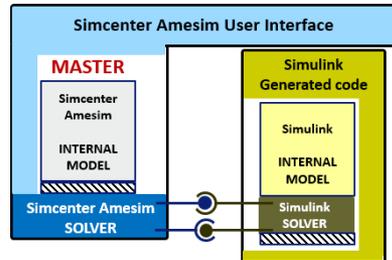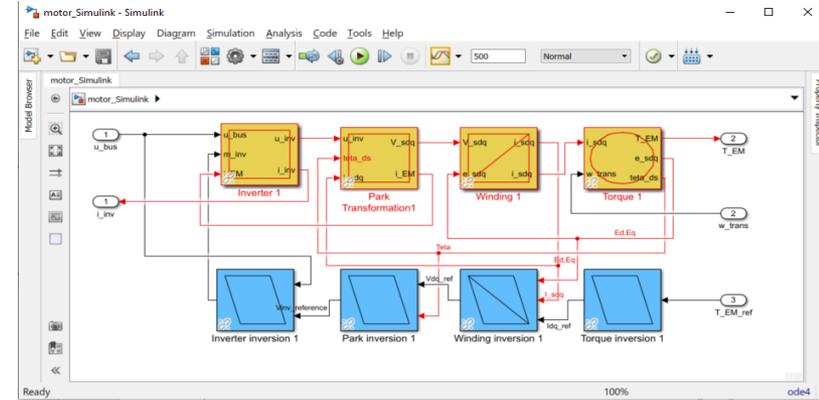## Black-box Simulink EMR model into Simcenter Amesim

Requirements

- MATLAB-Simulink

- Simulink Coder (or Real-time workshop)

- For Linux: an ANSI C compiler that is supported by Simulink

- For Windows: Microsoft Visual C++ (standard edition or higher)

Simulink interface for Simcenter Amesim

Co-simulation (sl2amecosim):

«Simulation results»

Simulation results – electric scenario

EMR'22, Sion, June 2022

Vehicle velocity *function* of the time for the Electric-only scenario

Angular velocity at the rear motor

Simulated and measured electrical and mechanical power

Battery voltage

Battery current

Battery energy consumption
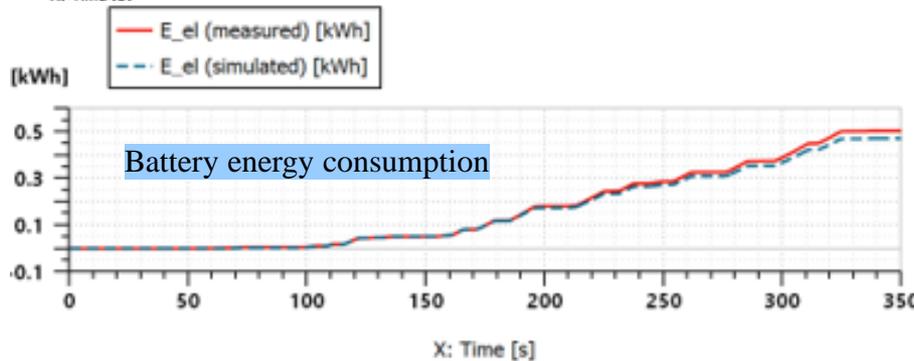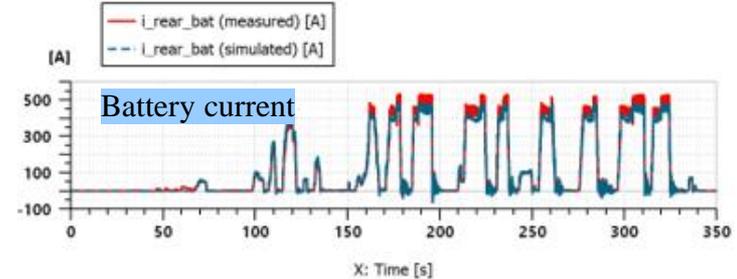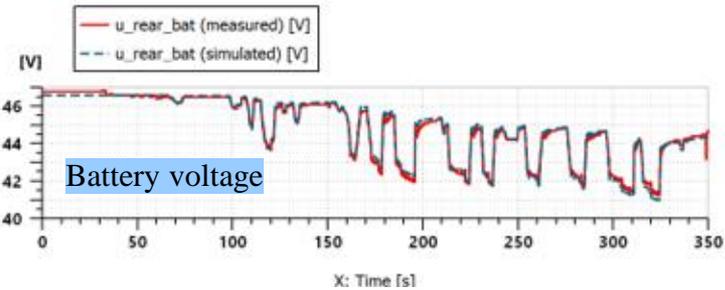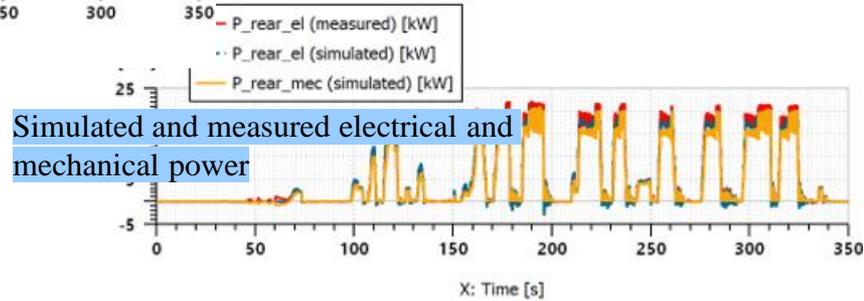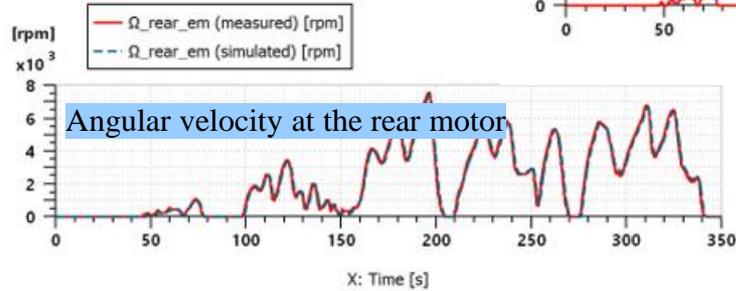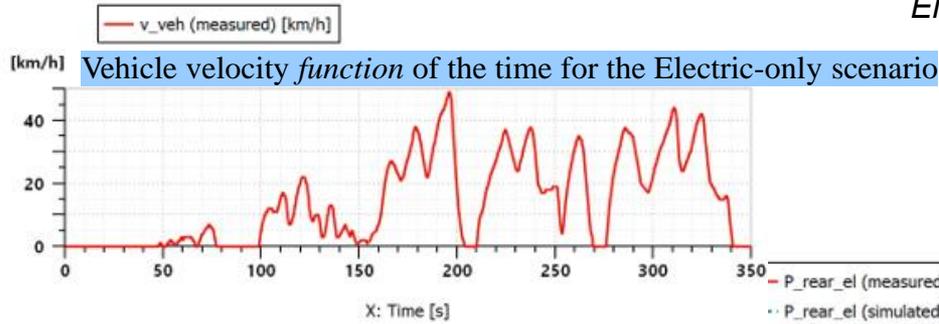
$$Error(E_{el}) = \frac{|E_{el,meas} - E_{el,sim}|}{E_{el,meas}}$$

$$= \frac{|0.50482\ kWh - 0.47237\ kWh|}{0.50482\ kWh} = 6.4\%$$

Simulation results – thermal scenario

Vehicle velocity for the Thermal-only scenario

Gear shift profile

Engine angular velocity

Measured and simulated mechanical power for thermal only validation

Engine angular velocity, selected interval

Stand alone vs. Cloud computing simulation

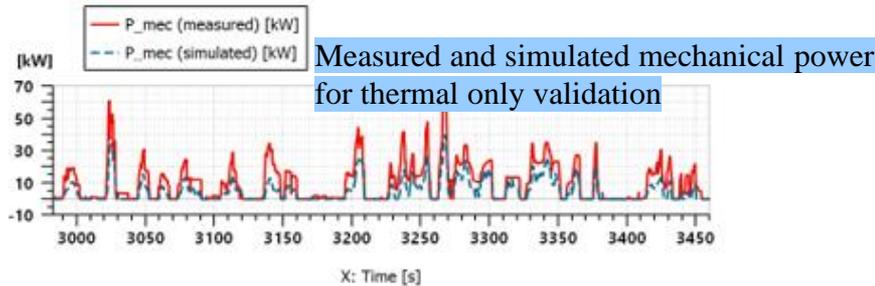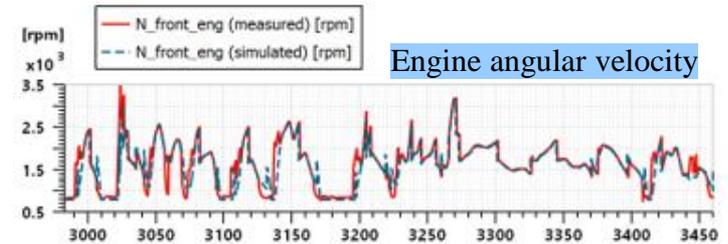| Stand-alone computer specifications	Cloud computing specifications
Processor: Intel Core I7-9850H @ 2.60GHz	Processor: Intel Xeon E5-2666 v3 @ 2.90GHz
Installed memory (RAM): 32.0 GB	Installed memory (RAM): 15.0 GB
Operating system: Windows 10 Enterprise	Operating system: Windows Server 2012 R2
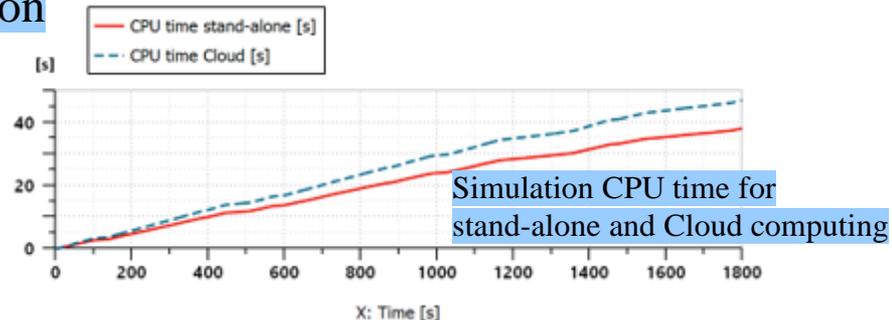
Simulation CPU time for stand-alone and Cloud computing

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[PANDA D4.5] R. Vincent, F. Tournez, report "PANDA D4.5 Virtual testing of the P-HEV", March 2022

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