Final Event
24-25th of May 2022

Validations

Fuel Cell vehicle virtual model

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Powerful Advanced N-Level Digital Architecture
for models of electrified vehicles and their components

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Fuel Cell Vehicle (FCV) description

FCV Mobypost powertrain structure
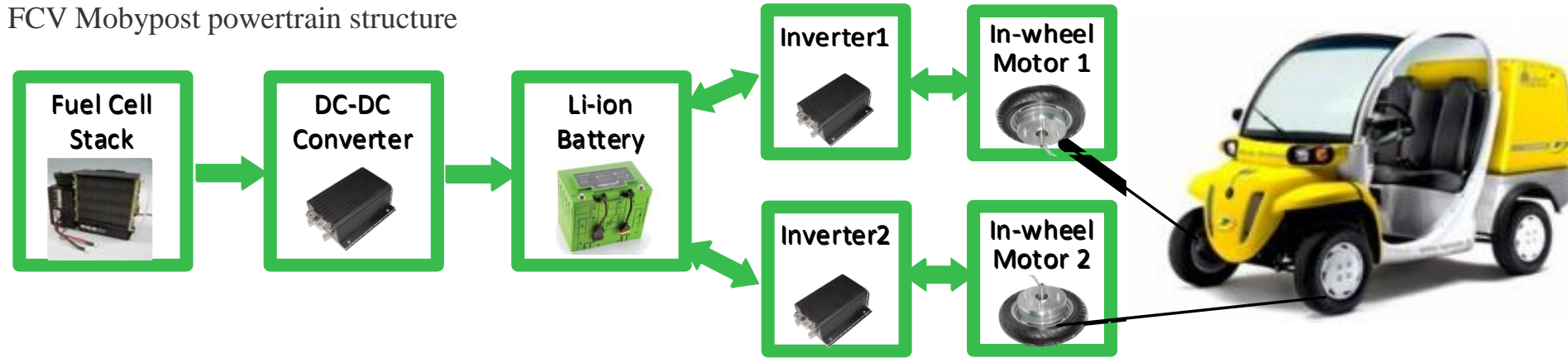
- Mobypost: fuel cell vehicle developed by UBFC for the postal delivery application;
- Hydrogen: the electric energy generated by photovoltaic to realize electrolysis of water;
- Primary/secondary sources: fuel cell/ Li-ion battery.

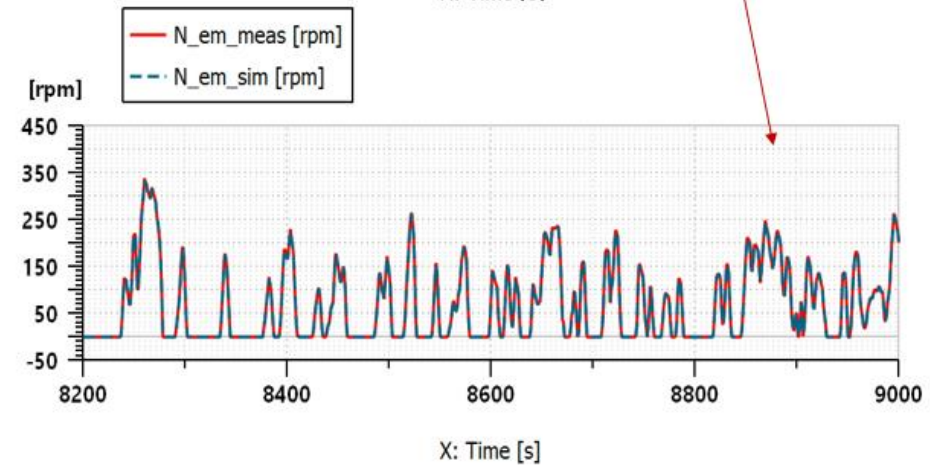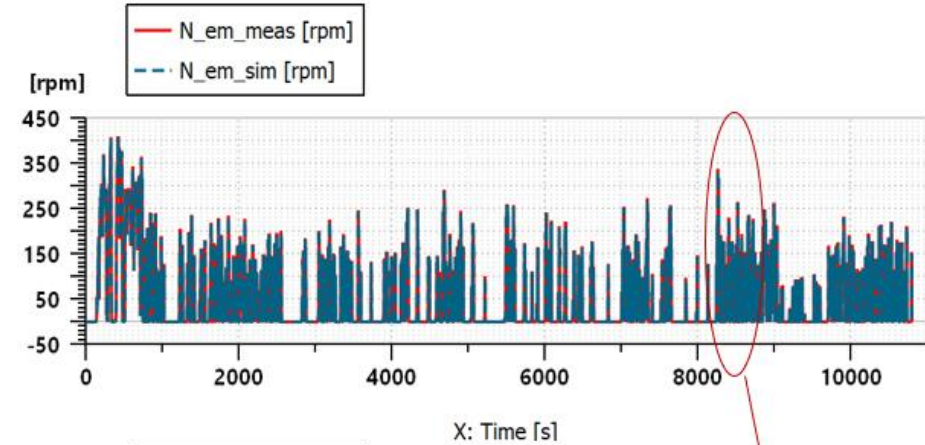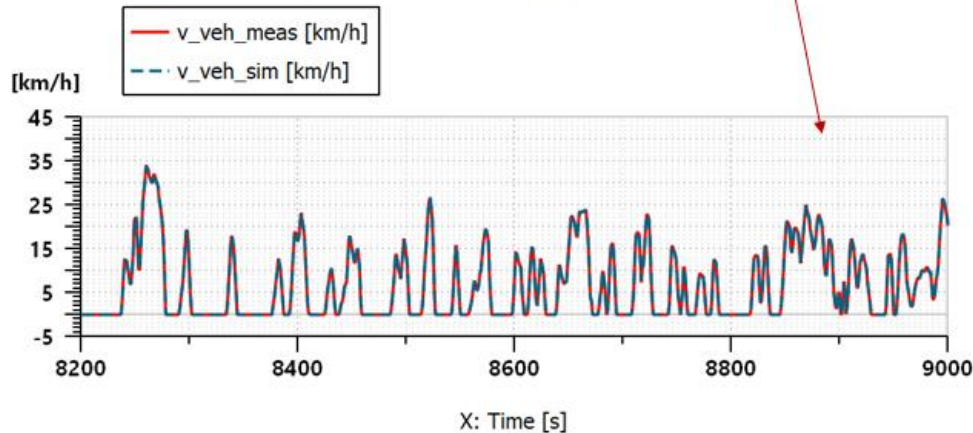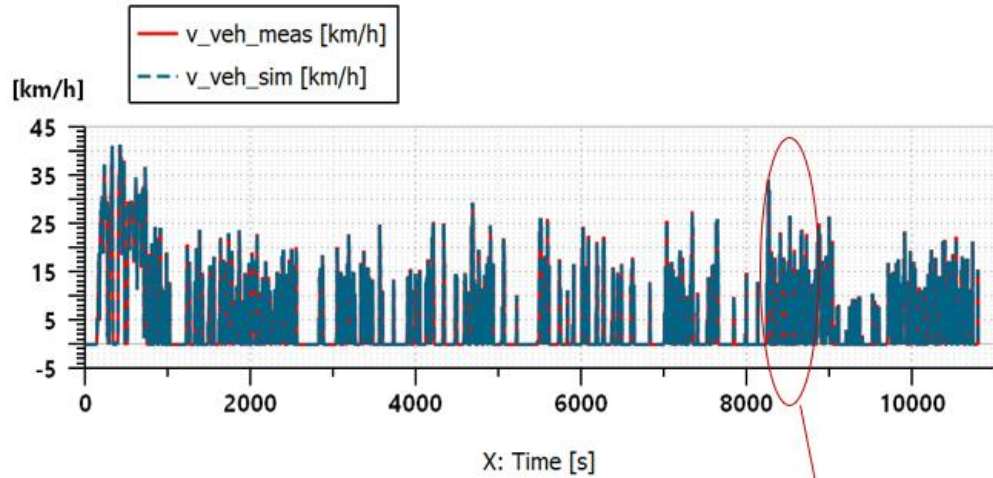| Number of seats	1	Electric motor technology	In-wheel PMSM
Weight (kg)	579	Electric motor nominal power (kW)	2
Fuel cell type	PEMFC	Electric motor peak torque (Nm) / maximum rpm	160 / 520
Fuel cell power (kW)	1.0	Battery Technology	Lithium-ion
Top speed (km/h)	60	Numbers of battery module	4
Wheelbase (mm)	270	Nominal module voltage (V)	12.8
Weight (kg)	579	Nominal capacity (Ah)	110

EMR model of Mobypost
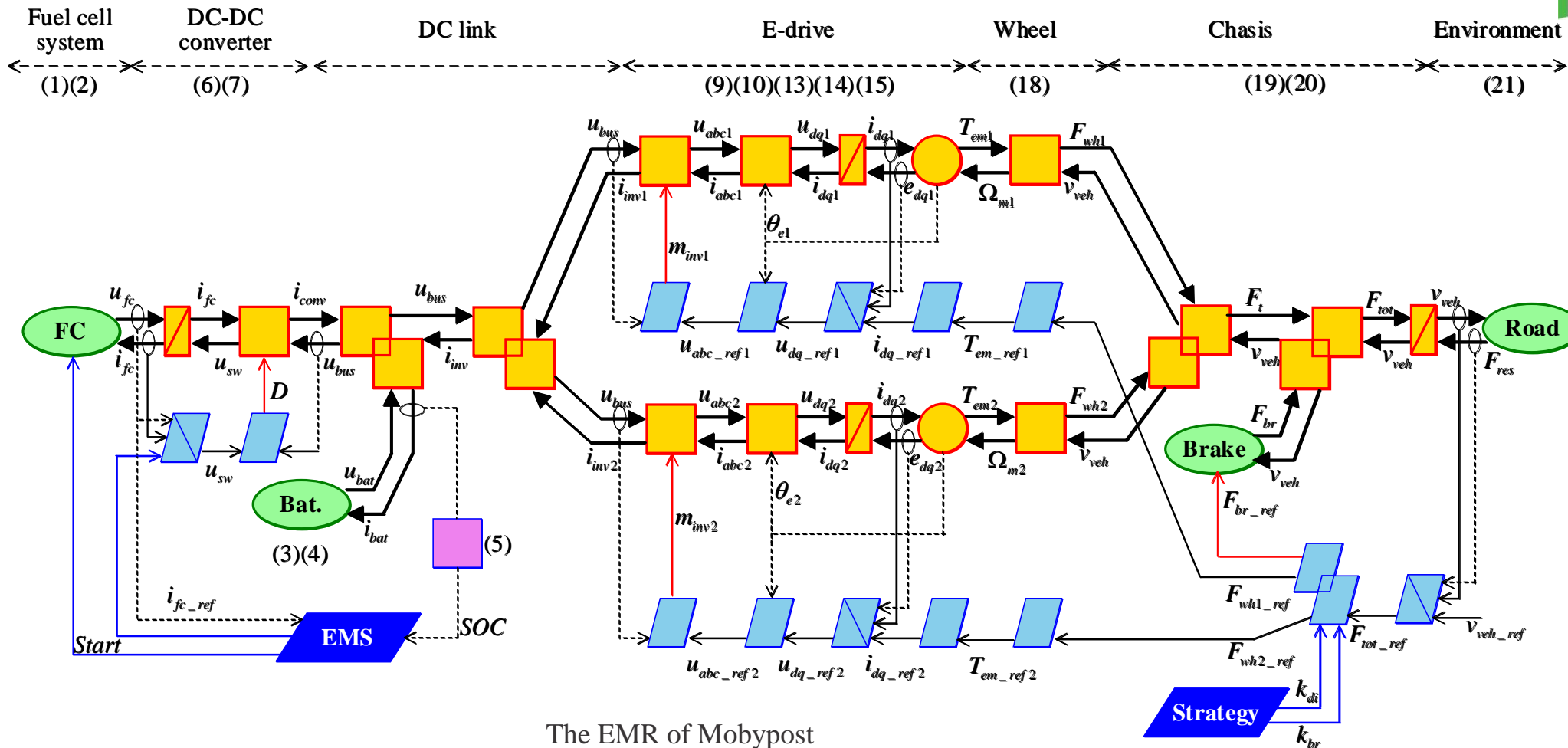
The EMR of Mobypost

Simulation and validation using Amesim
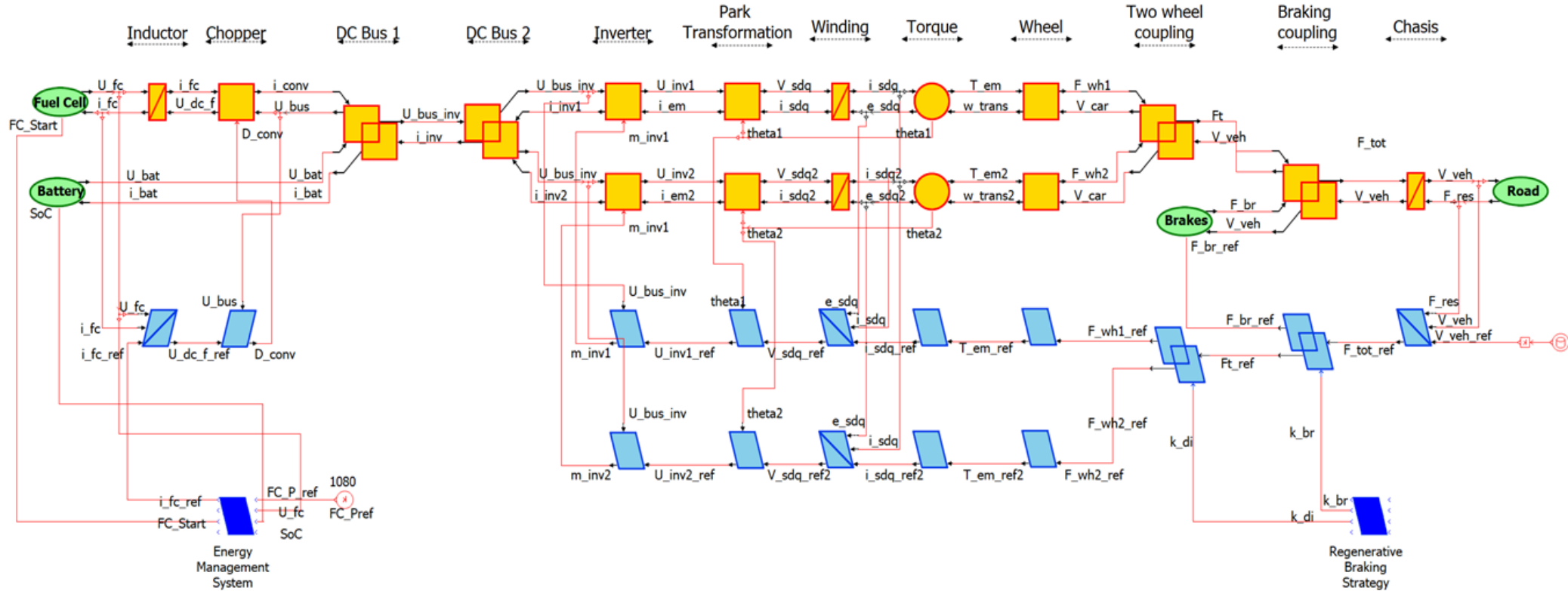
Simcenter Amesim © implementation of Mobypost EMR model

- Driving cycle is collected based on the daily postal delivery track from La Poste;
- 1ms fixed time-step solver for the driving cycle from 0 to 10800s (3 hours).

Simulation and validation using Amesim

- Results show accurate predictability power of the developed models, though having small differences

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Conclusion

- Mobypost FCV modelled and organized using the EMR formalism

- Mobypost FCV tested in a 3-hour driving cycle to cover the most use cases

- 5% error for the battery energy and 2% error for the DC bus energy

- FCV model validated and credible in the virtual testing

- FCV virtual model as efficient tool for the system/component design and testing

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Thanks for your attention!

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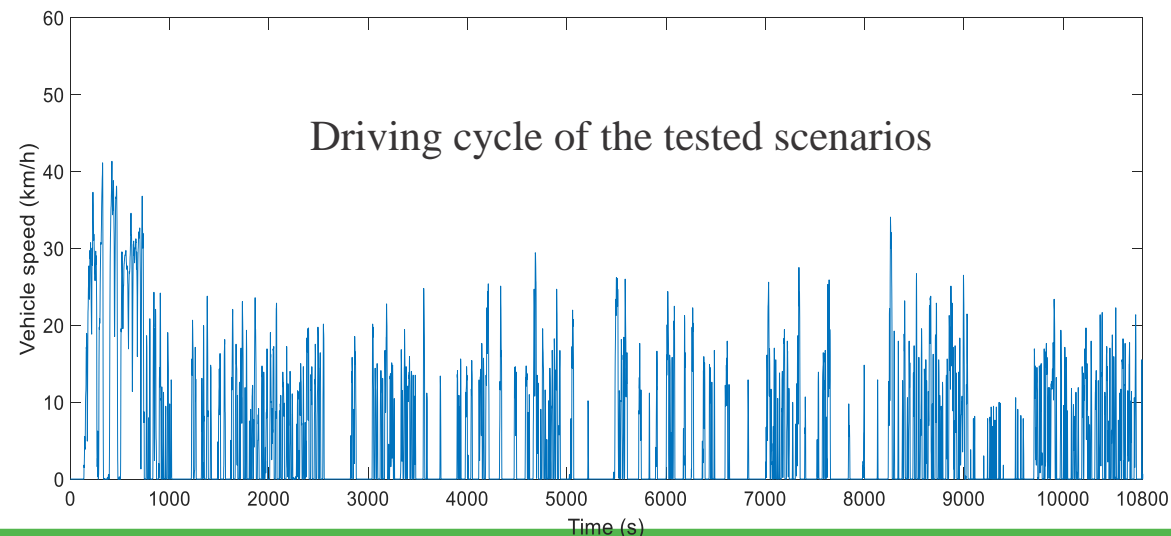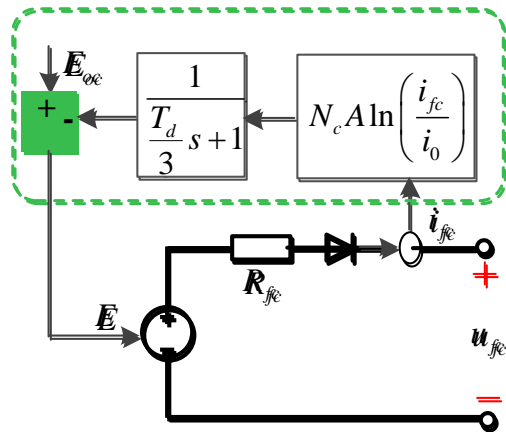# Approach of the FCV model development

- For model

    Develop a N-level model organization; Different models are developed for the same subsystem;

    Dynamical models (for transient states), static models (only for steady states) and quasi-static.

- For representation

    Functional description is imposed to avoid the need of co-simulation; Using pure causality that leads to the reduction of the computation time; EMR formalism is selected.

- For simulation

    Functional approach is used by adaptation of actual simulation packages; Forward approach for dynamic models; Backward approach for generally static or quasi-static models.
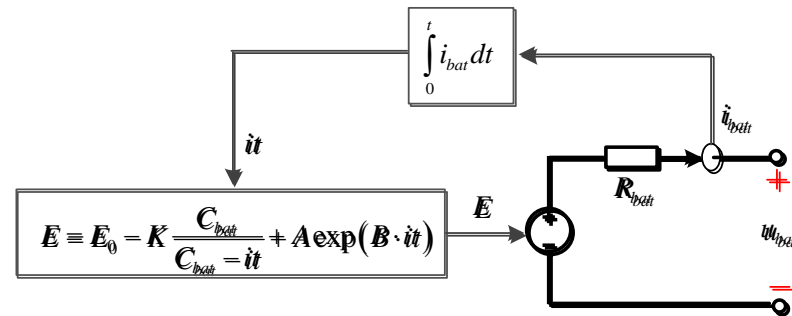
Driving cycle of the tested scenarios

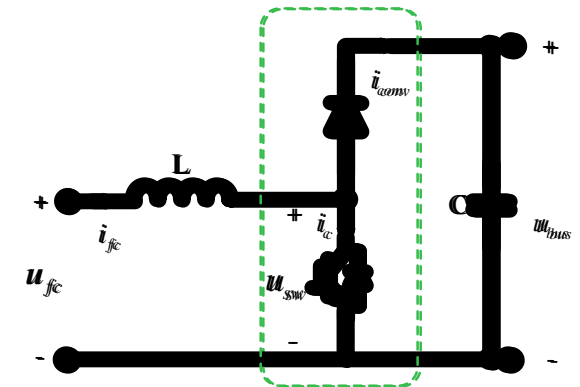# Structure of Mobypost Powertrain

FCV Mobypost modeling structure
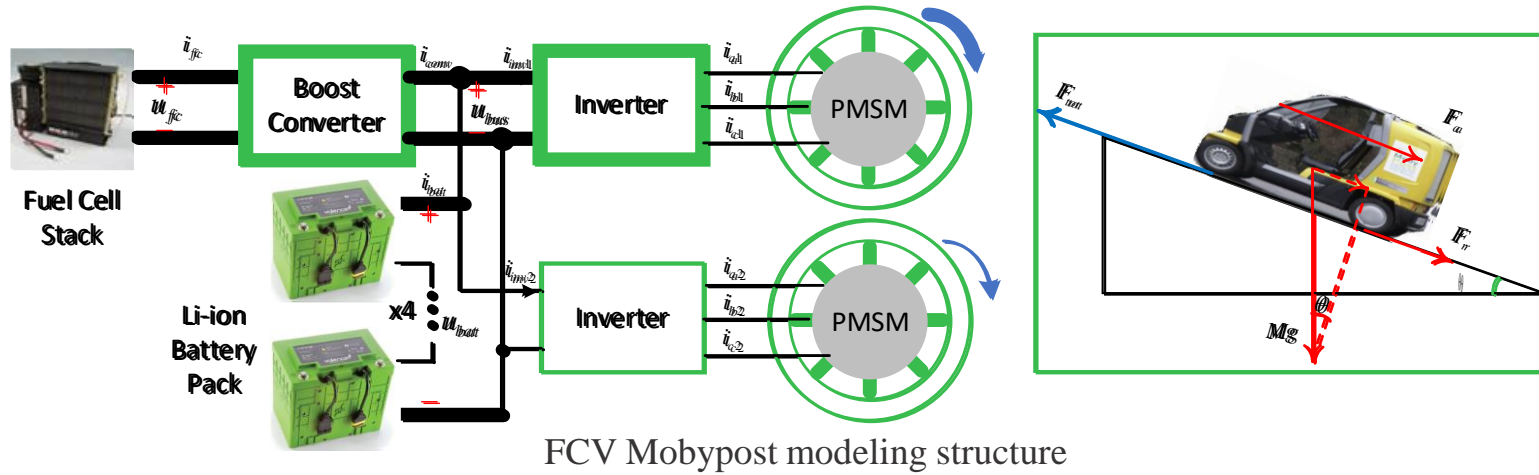
Generic fuel cell model

Battery model

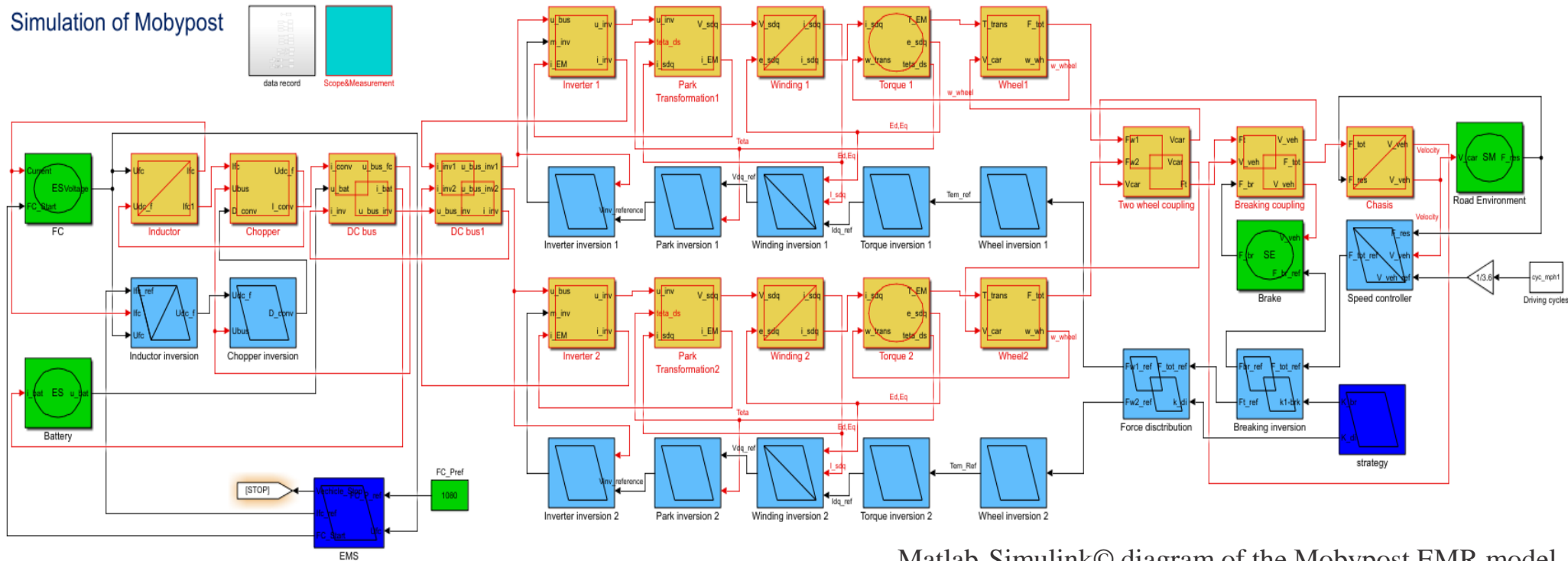

Boost converter model
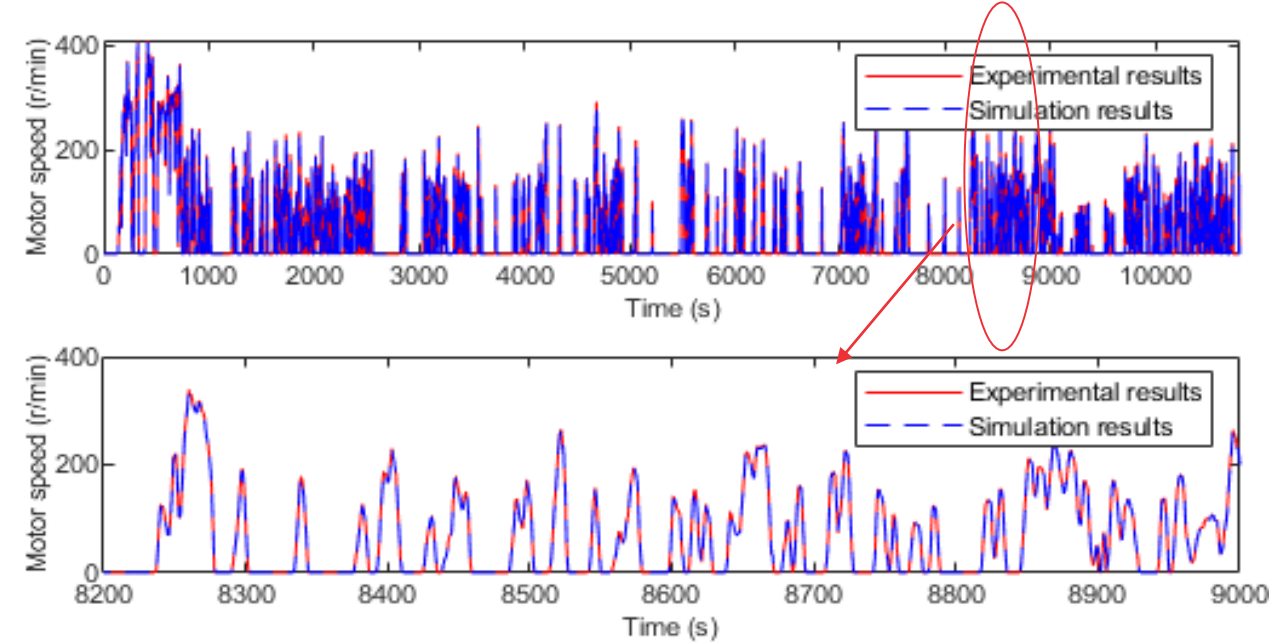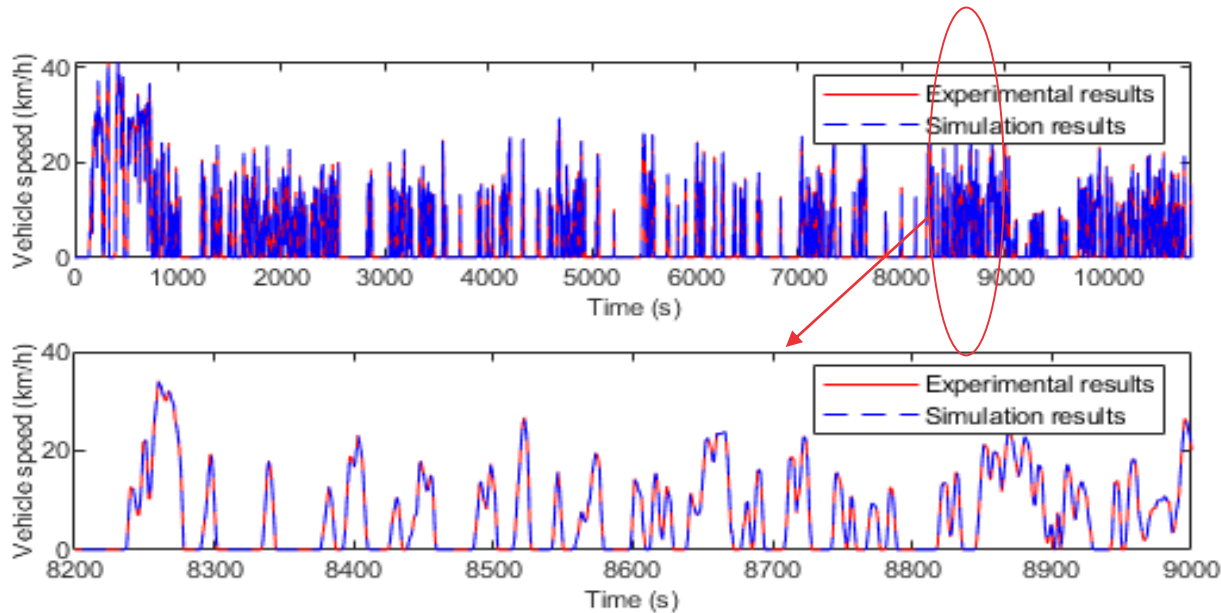
Simulation and validation using Matlab-Simulink

Matlab-Simulink© diagram of the Mobypost EMR model

- Driving cycle of Mobypost is the input of the simulation;
- The fuel cell and battery are operating under the control of EMS;
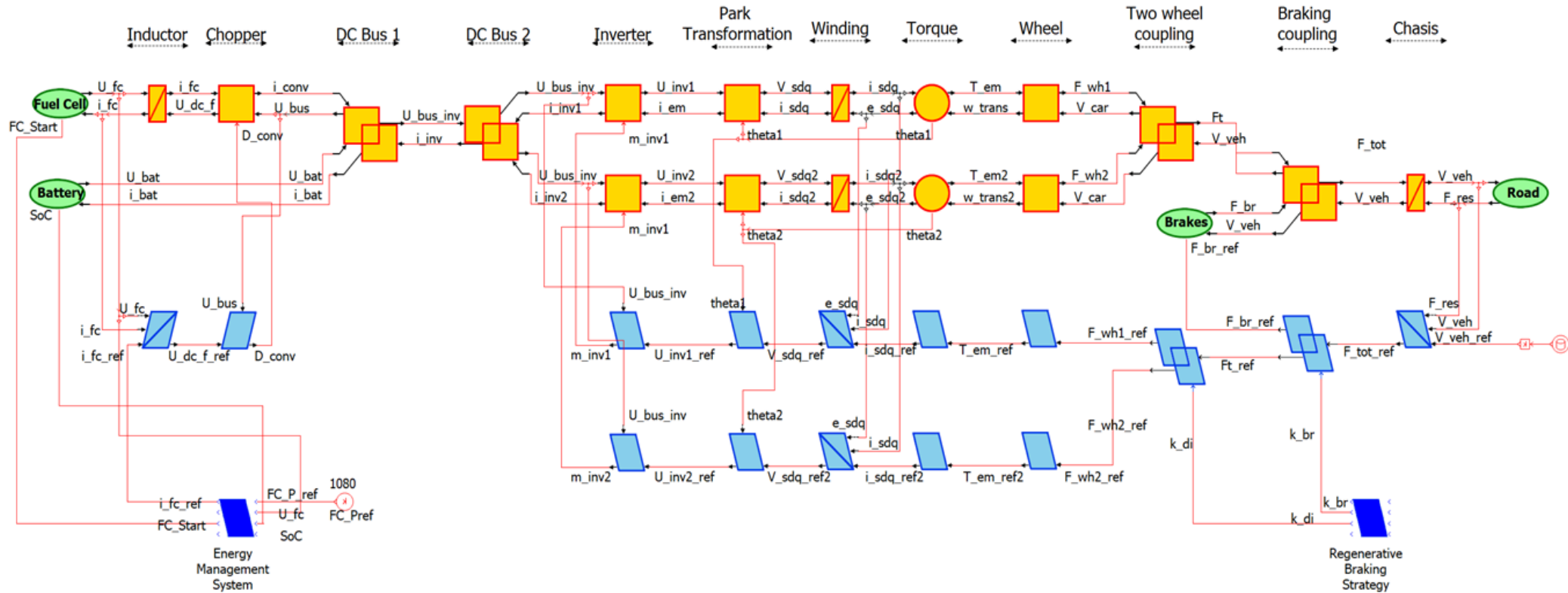- EMR of Mobypost is implemented in Simulink© environment (1ms time-step).

Simulation and validation using Matlab-Simulink

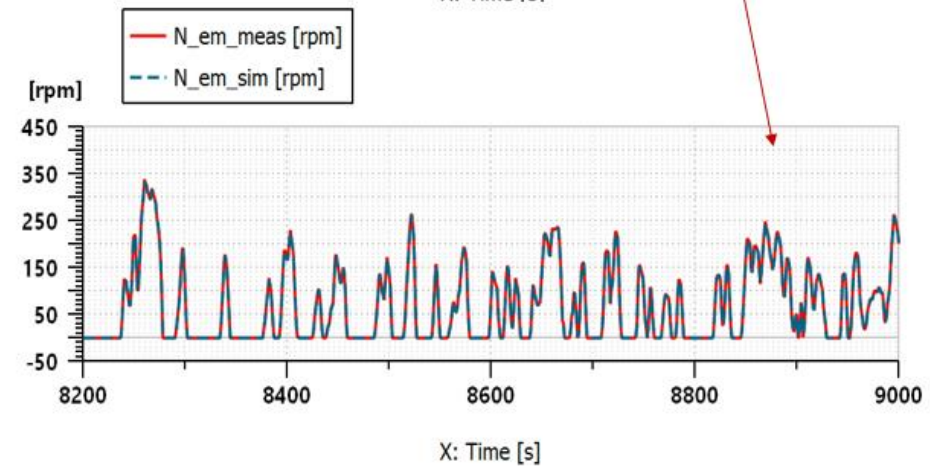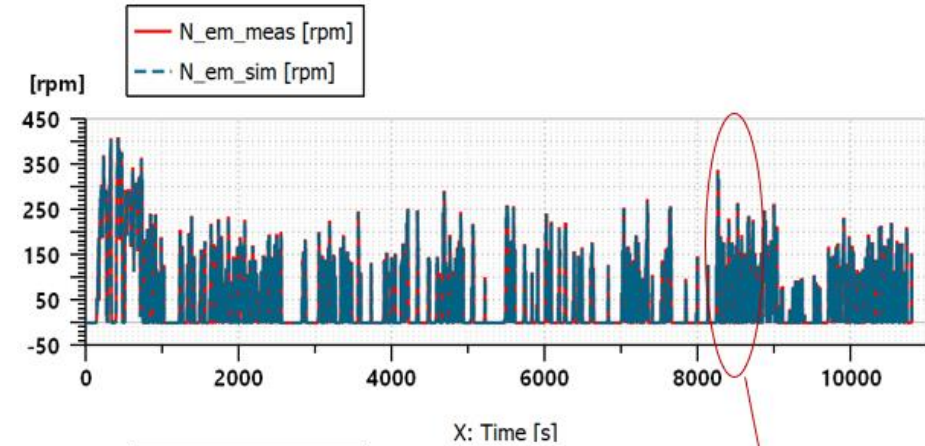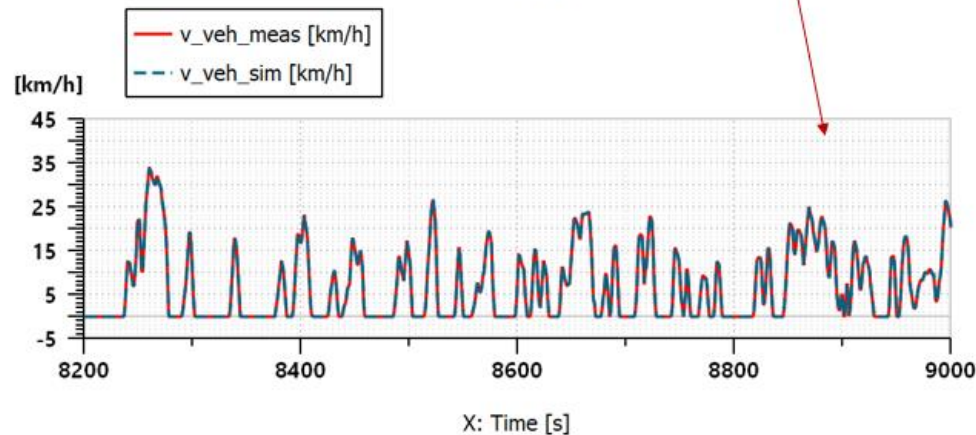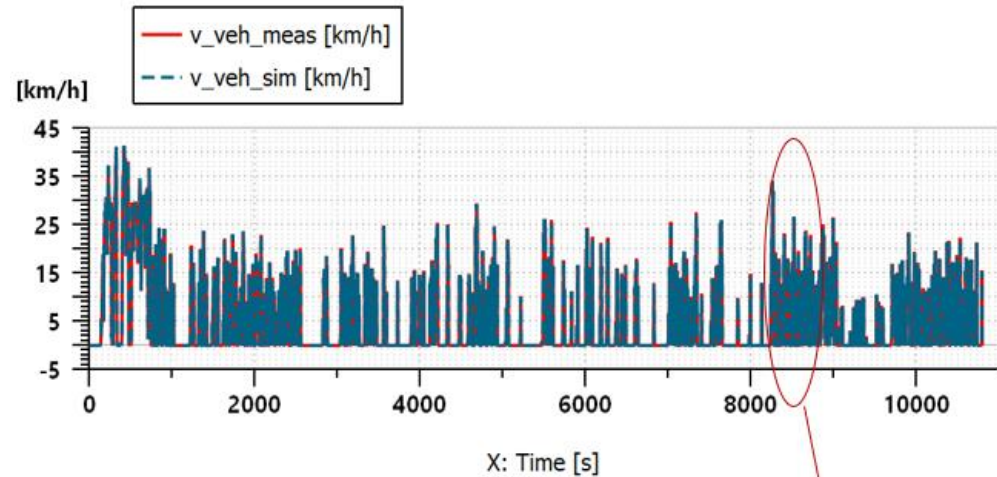🐼 Errors between experimental results and simulation results are very small

Simulation and validation using Amesim

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