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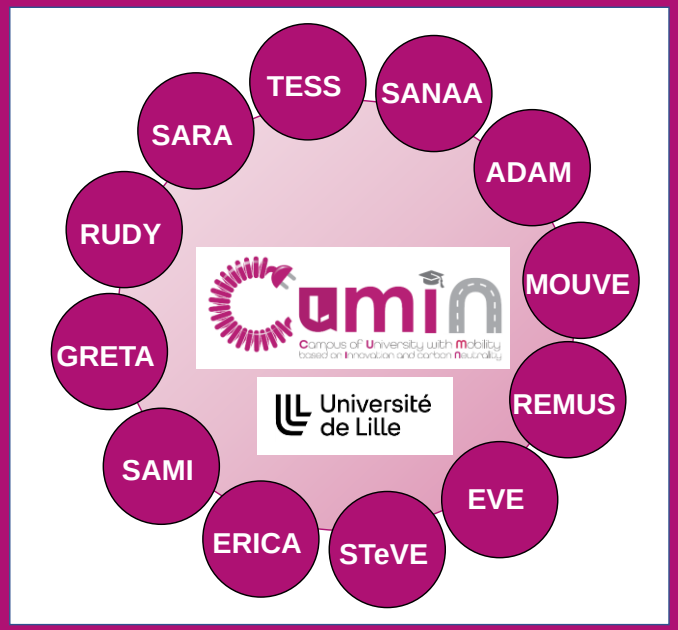

CUMIN - DILAN

Driver-In-the-Loop Application for New e-vehicles

Tournez Florian
Lemaire-Semail Betty
Bouscayrol Alain
Lhomme Walter
Castex Elodie

Supported by

within CEPR EE4.0 programme

Outline

1. Context & Objective
2. Power Hardware-In-the-Loop (HIL) testing
3. Drive-In-the-Loop and Power HIL testing

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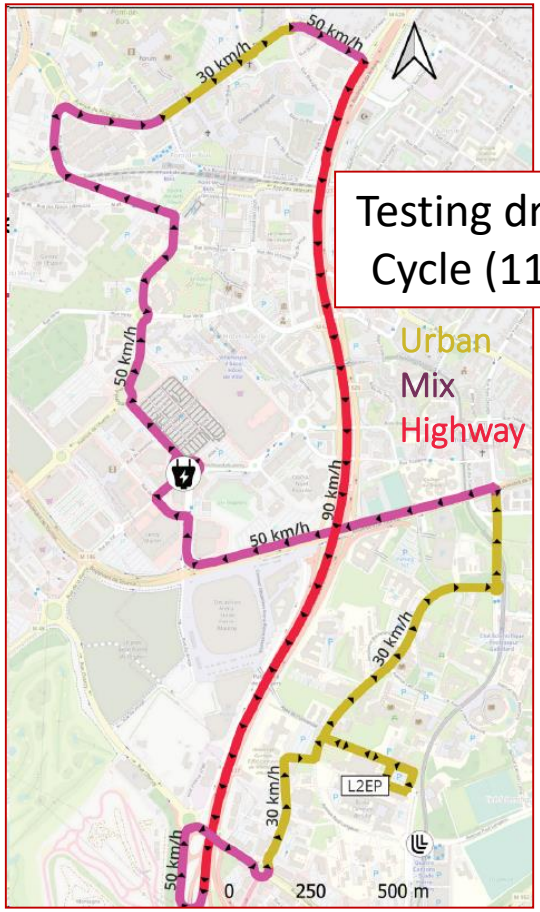
Context & Objective

CUMIN-SARA – Driving tests of an EV

(Cf. presentation of L. Junker)

1. Survey on EV perception
2. Driving test
3. Survey on EV perception and commuting habits

(1 SHS Eng. + 1 ST Eng.)



Testing driving Cycle (11 km)

Urban
Mix
Highway

72 drivers
same vehicle
same trip
same period
(2 months)

Long testing time!

Socio-behavioural aspects

- 49% unaware of campus charging stations
- 82% in favor of adopting an P-HEV
  but 47% cannot buy P-HEV
- 51% with cost as their first issue

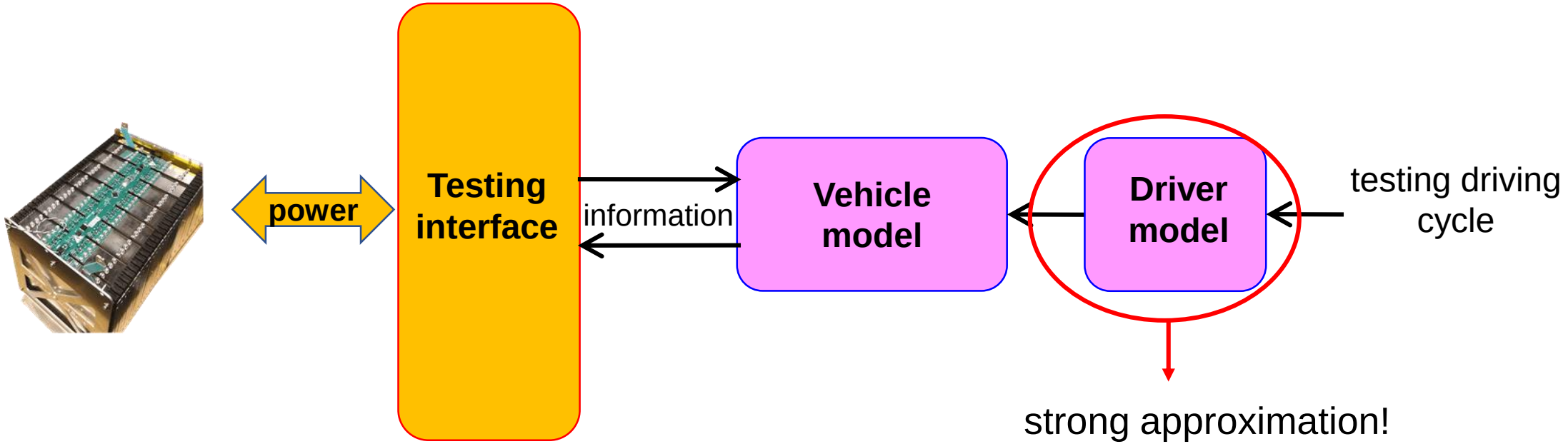
Technical aspects

Variation in terms of energy consumption of 21%

⇨ Impact of the traffic? Impact of drivers? → difficult to identify

CUMIN-EVE – Testing of new batteries

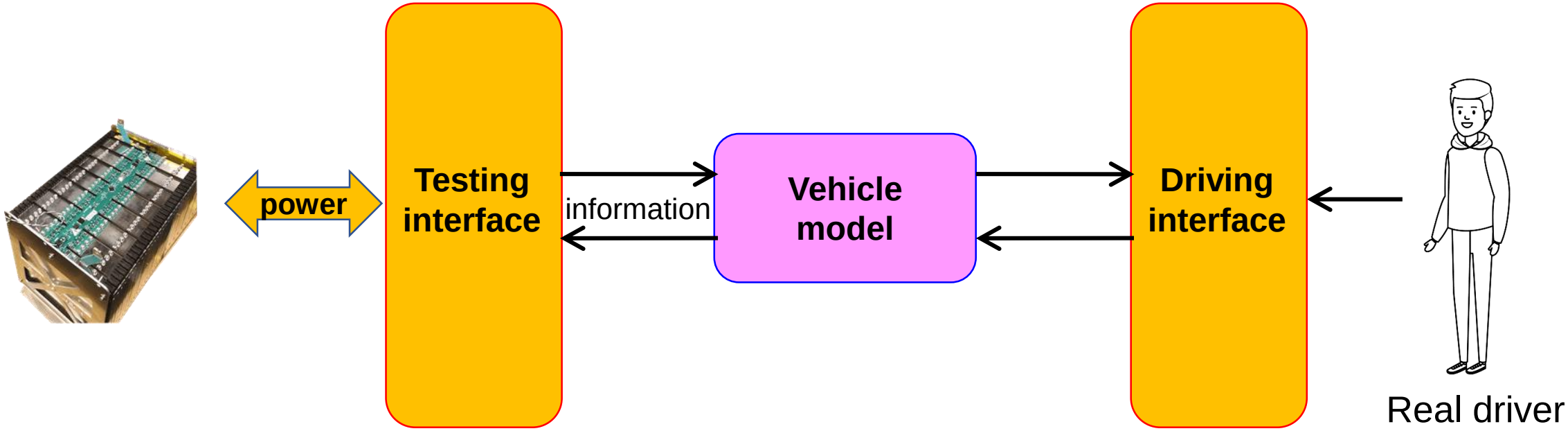
Experimental tests using HIL (Hardware-In-the-Loop) method fir study of a new battery
(cf. presentation of S. Fadili)



CUMIN-DILAN – Objective

Include the Driver in the testing Loop?

- Interest for multiply the driving tests?
- Interest for separate impacts of traffic and driver?
- Interest for testing components with the drivers' variations?



How to develop such a complex multi-objective testing facility?

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Power-HIL testing

UNION EUROPEENNE

Power HiL simulation methodology

Two main types of HiL simulation:

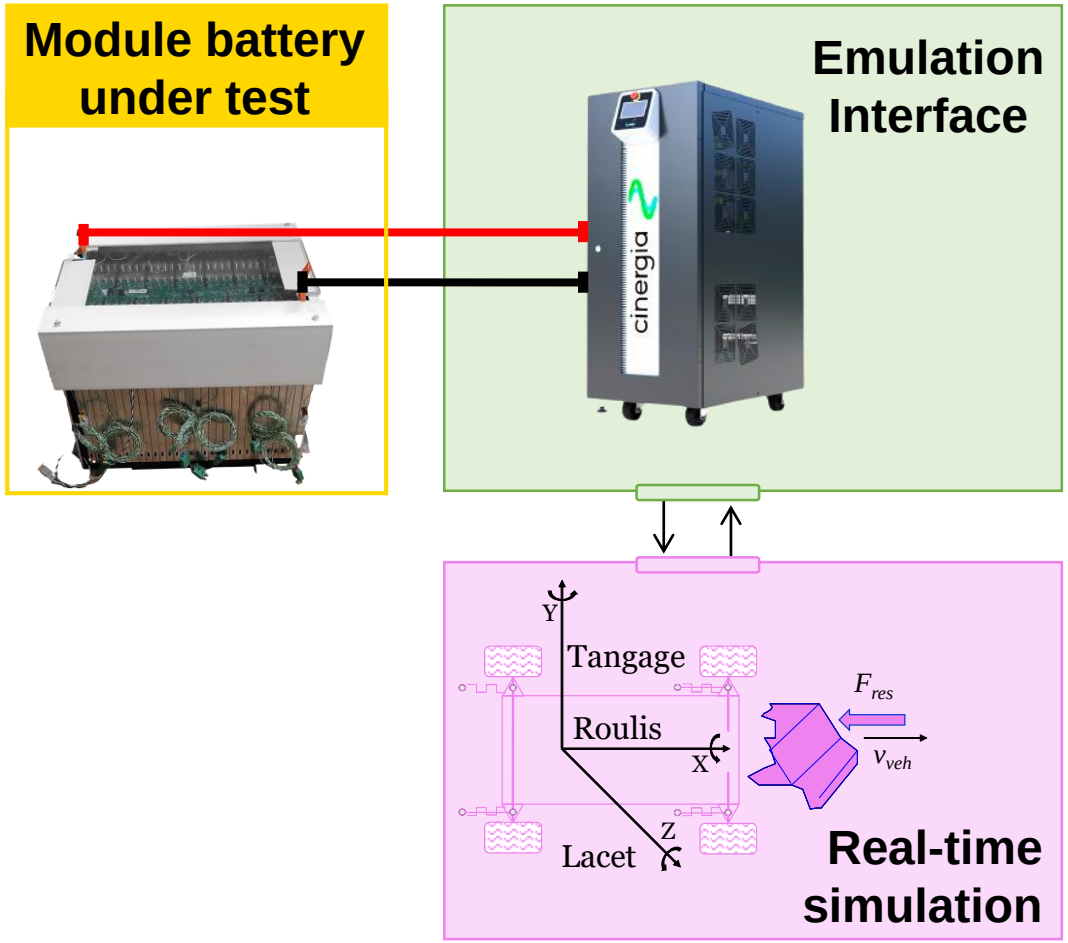
- Signal HiL simulation
- Power (+ reduced scale power) HiL simulation

Advantages:

- Real conditions as close as possible to reality
- Less expensive than prototype
- Highly flexible for problem-solving

Limitation on use:

- Develop a power test bench
- Have real-time simulation model

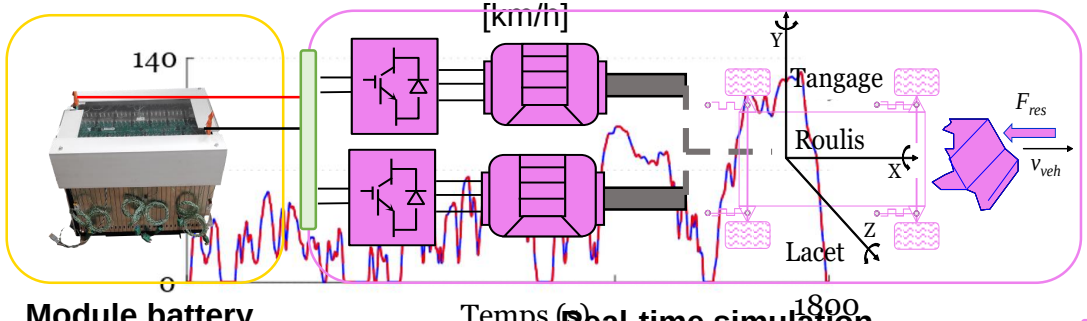


ECU: Electronic control unit

HiL: Hardware-in-the-Loop simulation

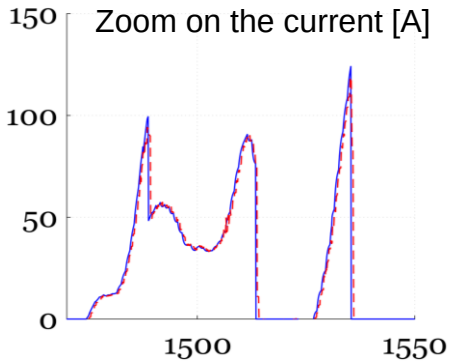
Module battery testing (Power-HIL)

Reference and simulated vehicle speed [km/h]

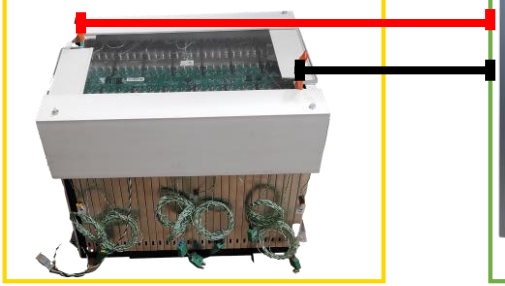


Module battery under test

Real-time simulation

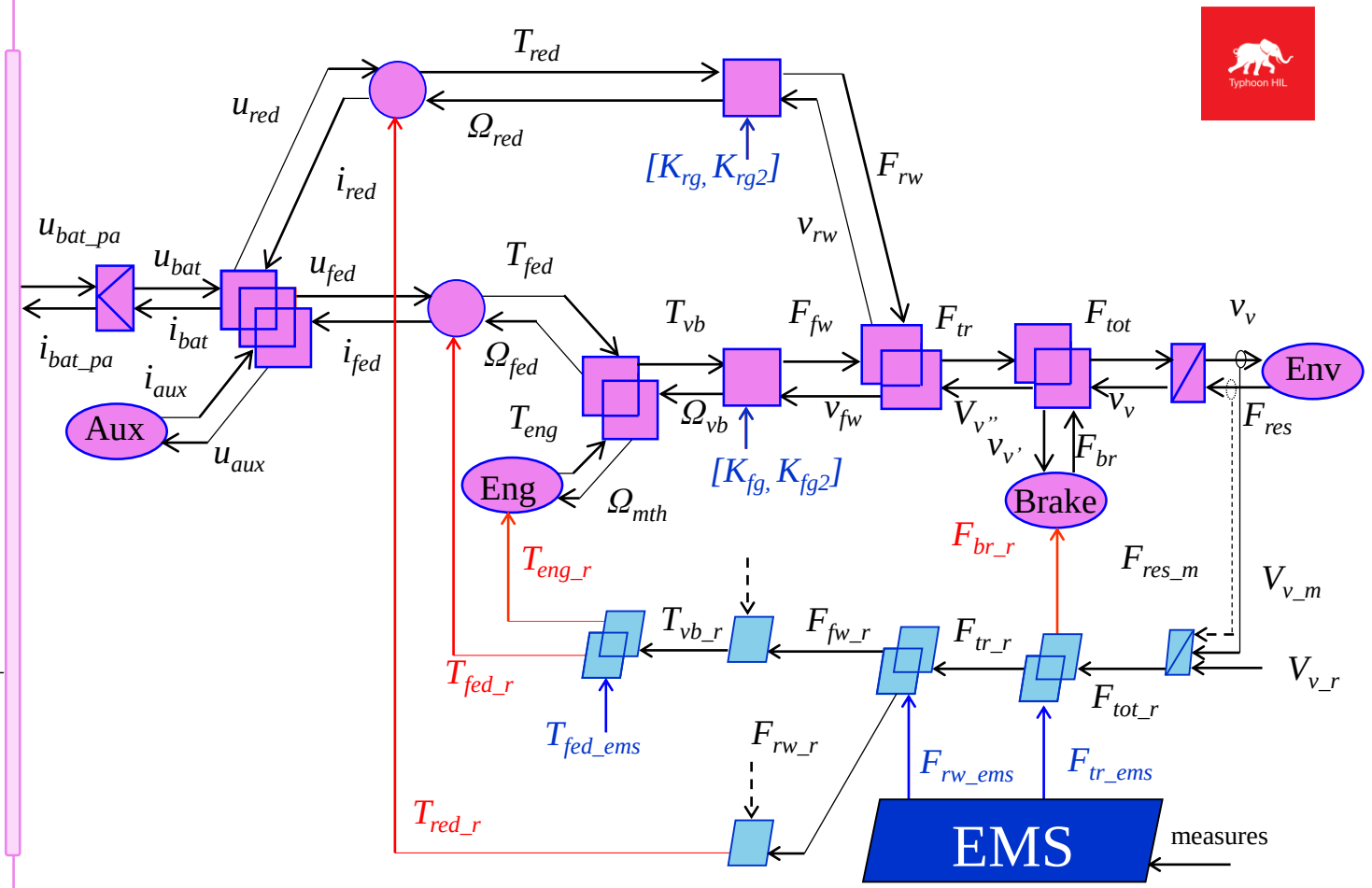


Module battery under test



Emulation interface

Real-time vehicle simulation (Typhoon HIL)



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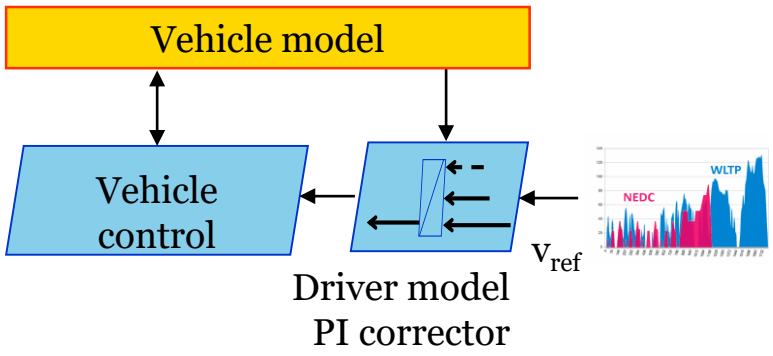
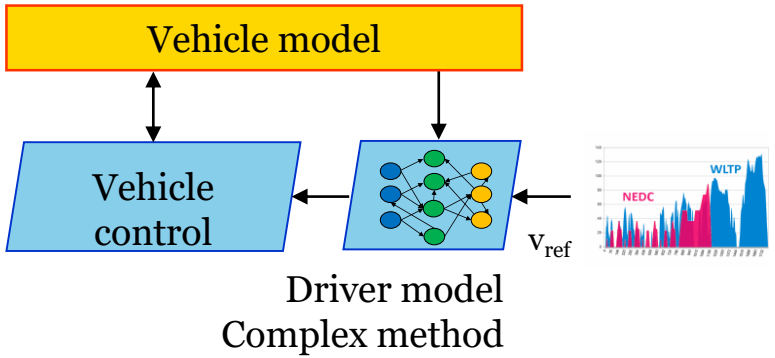
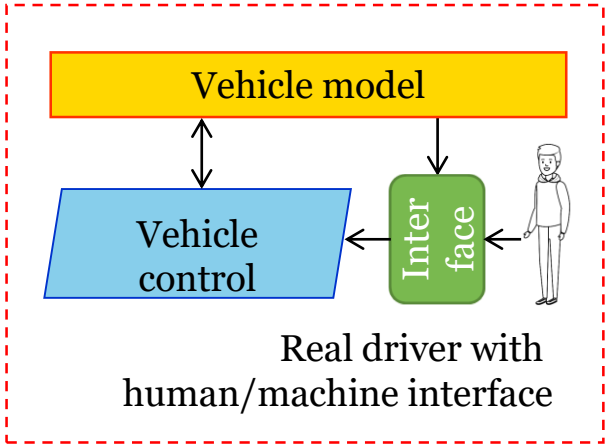
Driver-In-the-Loop & power HIL testing

Driver-in-the-Loop (DiL)

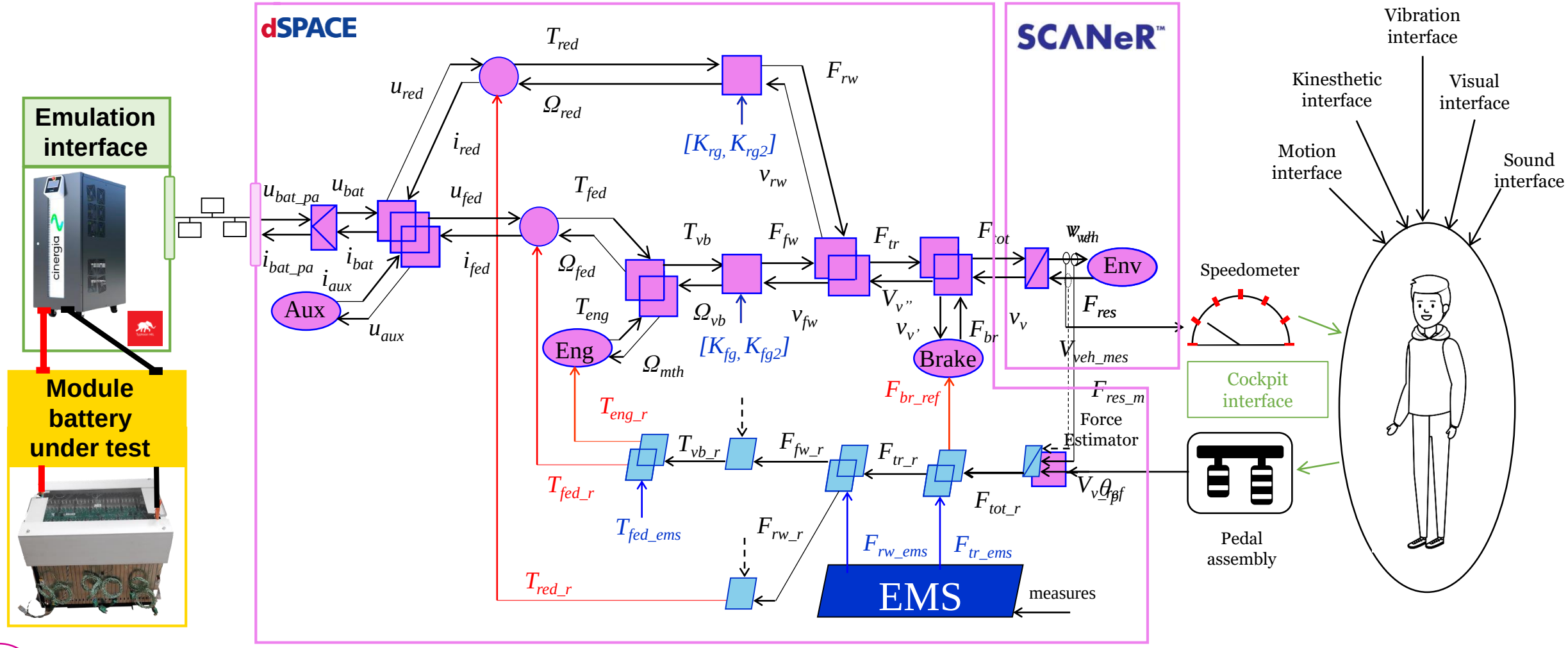




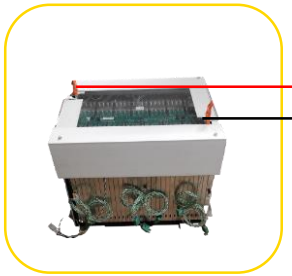


Introduction of the Driver-in-the-Loop for battery testing

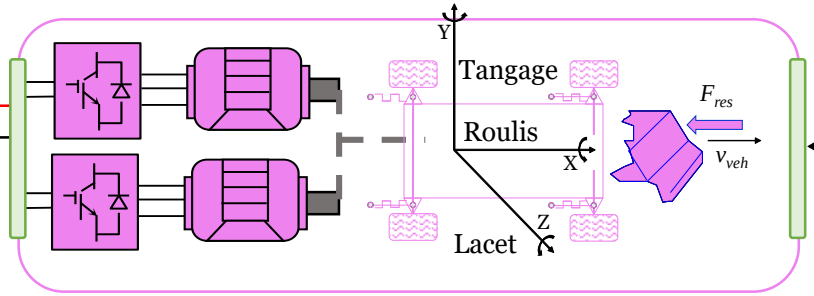
How introduce the driver through the cockpit interface?



Driver-in-the-Loop for subsystem testing

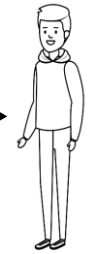


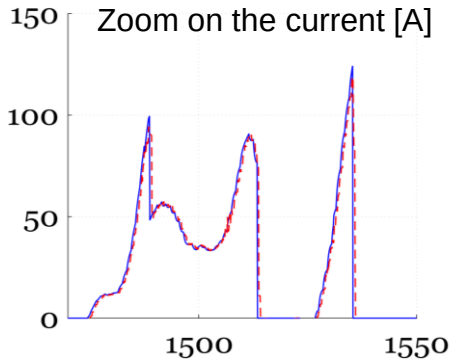
Module battery under test



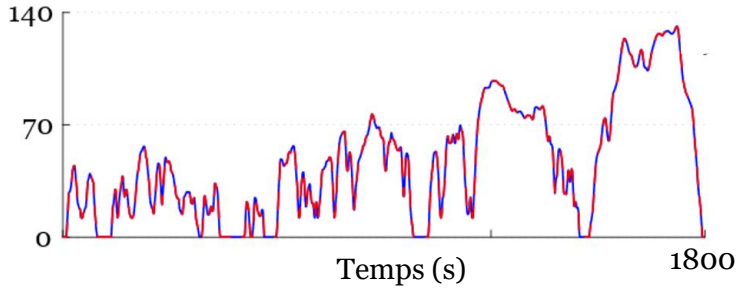
Real-time simulation

Driver





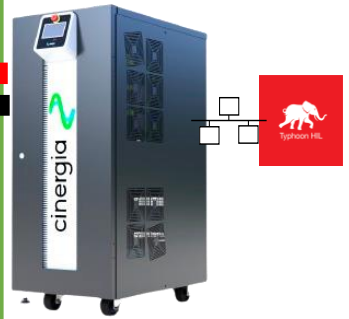
Reference and simulated vehicle speed [km/h]



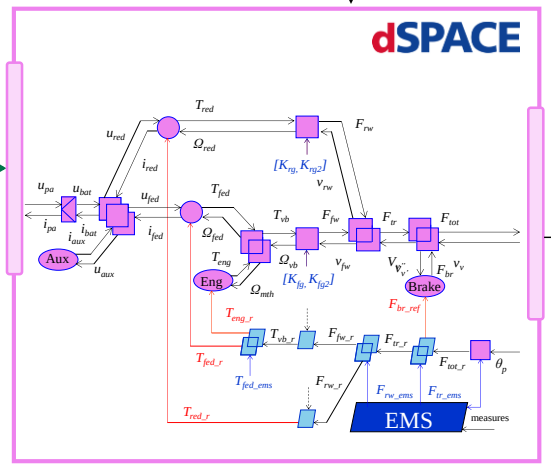
Supervisor PC
+ Vehicle Settings
+ C++ Plugin
+ Python Script
+ MICE Script

Module battery under test

Emulation interface + Typhoon

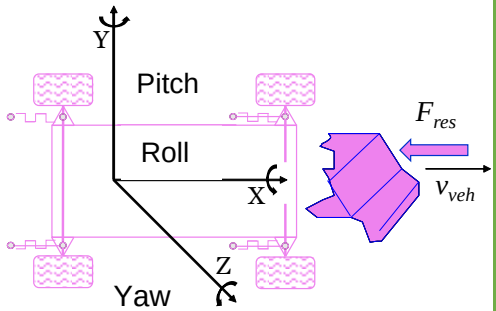


Vehicle model
Simulink version



SCANeR
AVSIMULATION

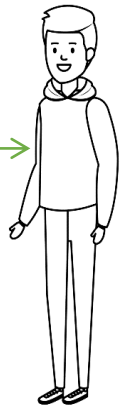
Modèle du châssis (partie 2)



Driving simulator

Emulation interface

Driver



Conclusion

- **Development of the Driver-in-the-Loop set-up**
  - coupling with a Power HIL testing
  - coupling different software and hardware parts (thanks to EMR formalism)
  - Standard field bus to excahnge dare (CAN/modbus)
  - Cockpit interface validation

- **Perspectives**
  - validation of the other interfaces of the driving simulator
  - Validation of the user perception compared to the real vehicle
  - Testing new components with various drivers
  - Recording more driving tests for CUMIN (CUMIN-SARA)
  - Testing new e-motors (see next presentation)

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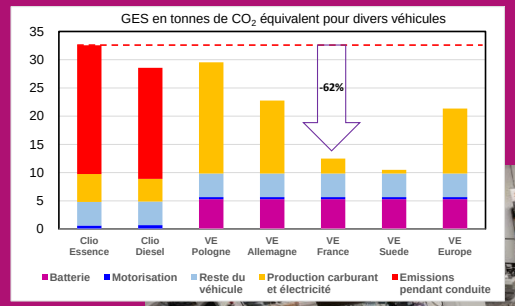

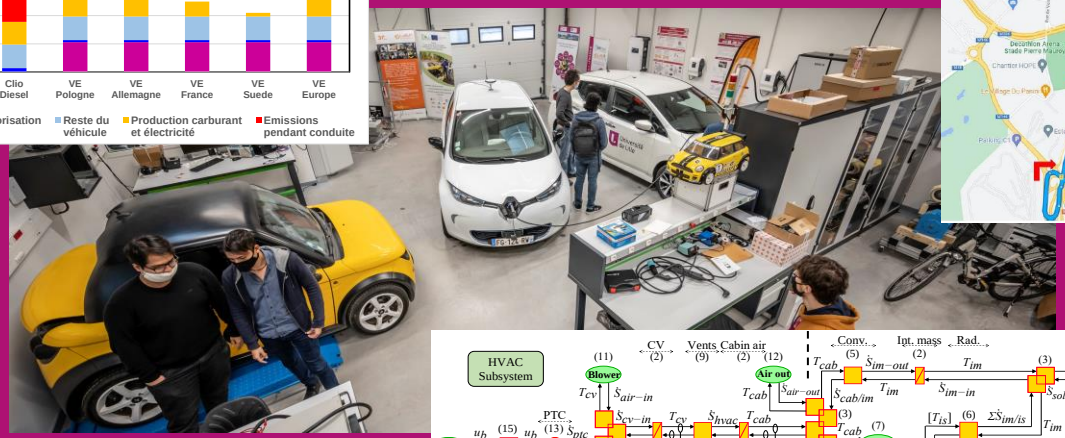

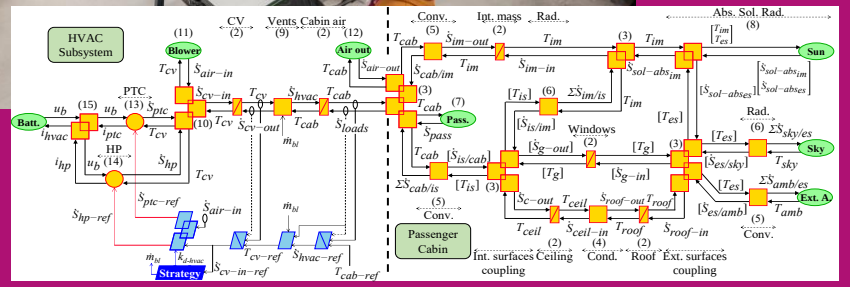

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