

IEEE VPPC 2010

Vehicle Power and Propulsion Conference
September 1-3, 2010 – Lille, France

Clean Tech for Transportation

<http://www.vppc2010.org/>



Special session

“ **ENERGETIC MACROSCOPIC REPRESENTATION
AND OTHER GRAPHICAL DESCRIPTIONS** ”

organized by
MEGEVH

(French network on Hybrid Electric Vehicle's)

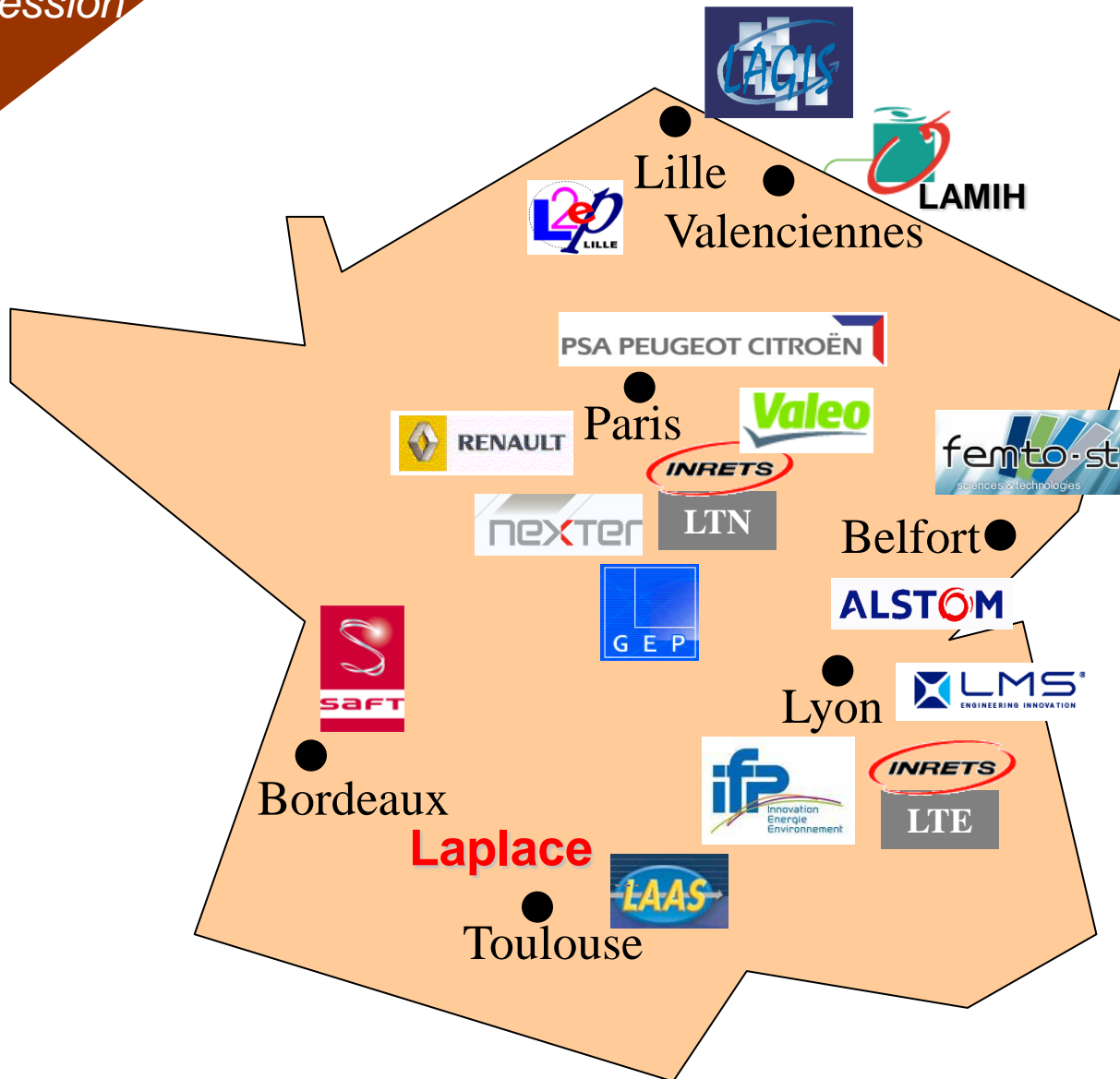
Session chairs:

Dr. Keyu CHEN (University of Lille, France)

Prof. Pierre SICARD, (Université du Québec à Trois-Rivières, Canada)



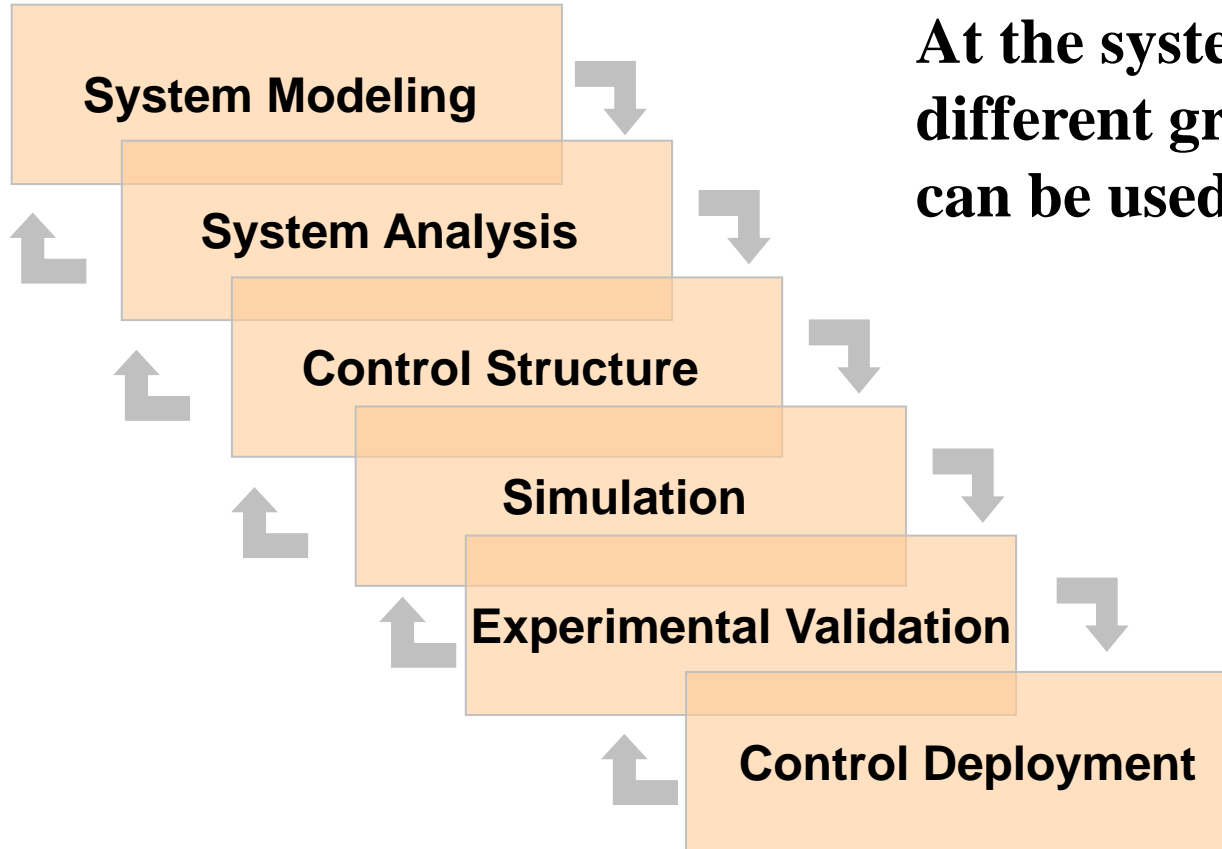
MEGEVH partners



**Objective:
to promote
collaborative works
on HEV in the
French community**

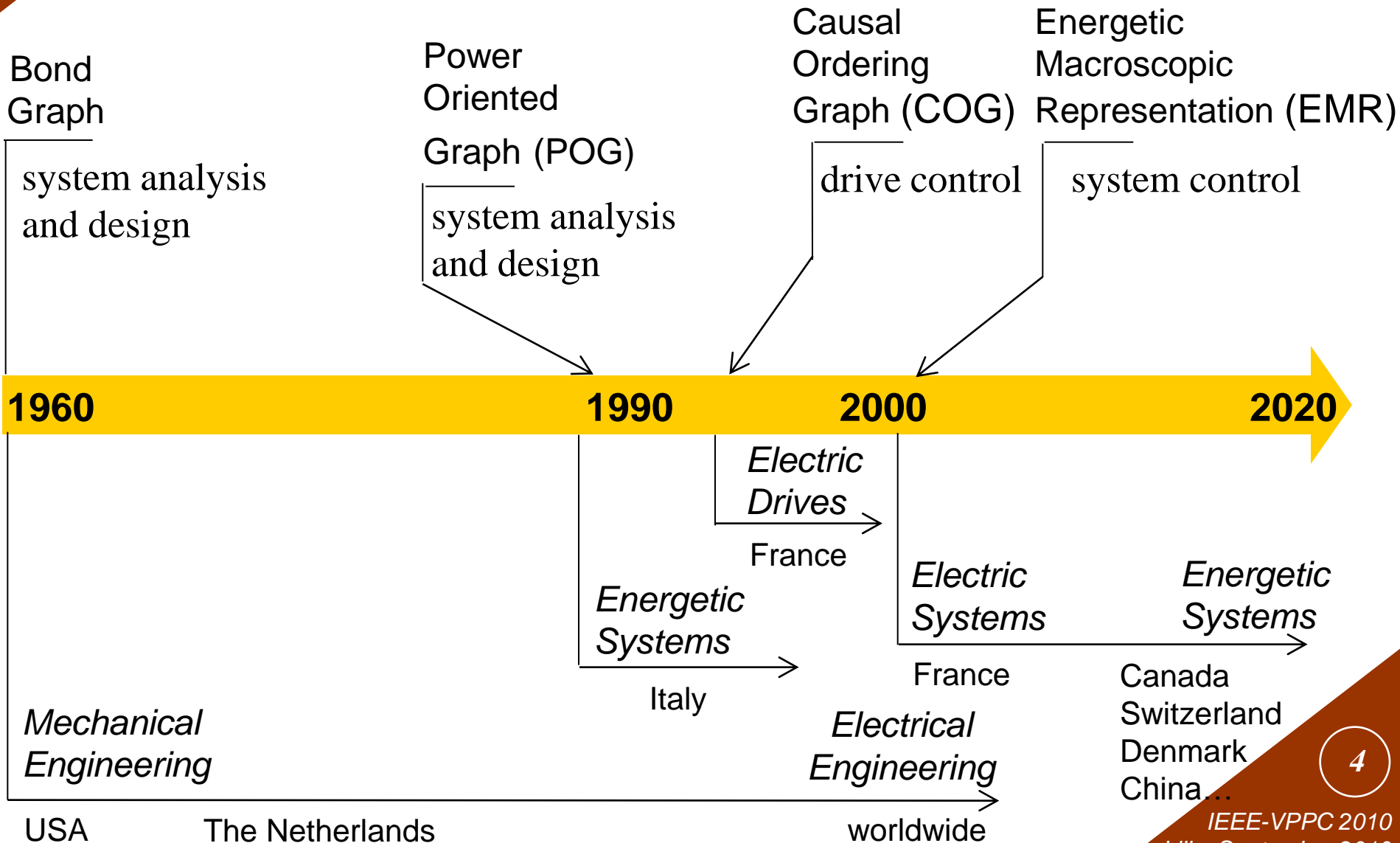
**Energetic Macroscopic
Representation (EMR)**

Model-based control design process



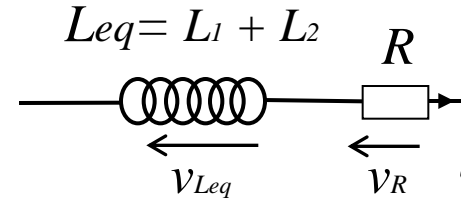
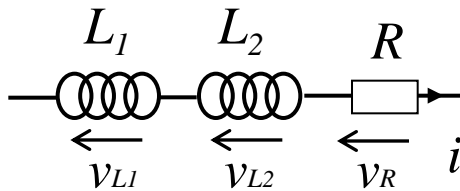
**At the system modeling step,
different graphical descriptions
can be used to organize models.**

Different graphical descriptions



Different graphical descriptions

- Structural or functional descriptions



Structural descriptions

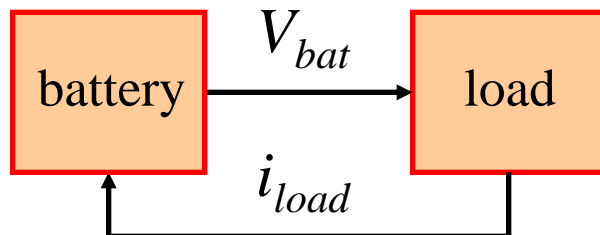
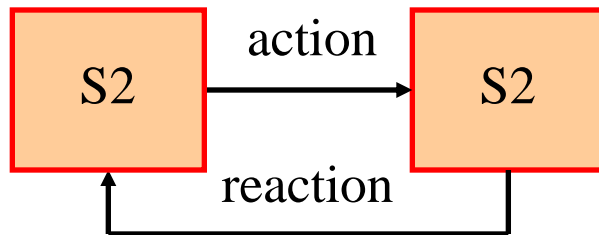
- Priority to the physical structure
- Physical links between subsystems
- Application to design

Functional descriptions

- Priority to the functionality
- Virtual links between subsystems
- Application to analysis, control

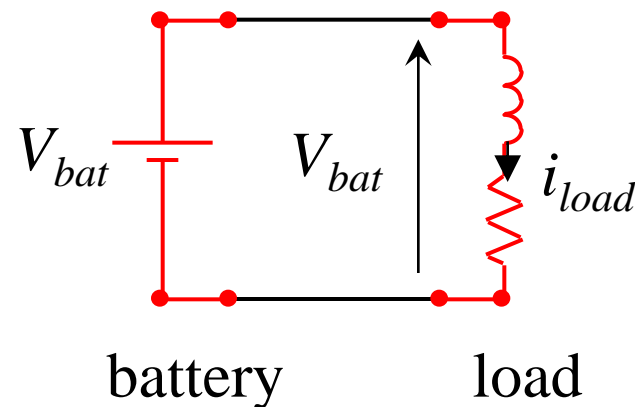
Different graphical descriptions

- Structure or functional descriptions
- Interaction principle for energy systems



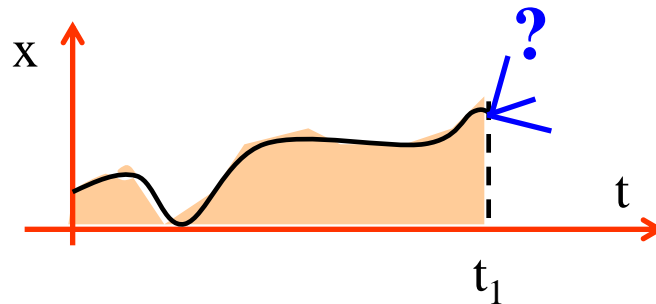
Power exchanged by S1 and S2 =
action x reaction

Example



Different graphical descriptions

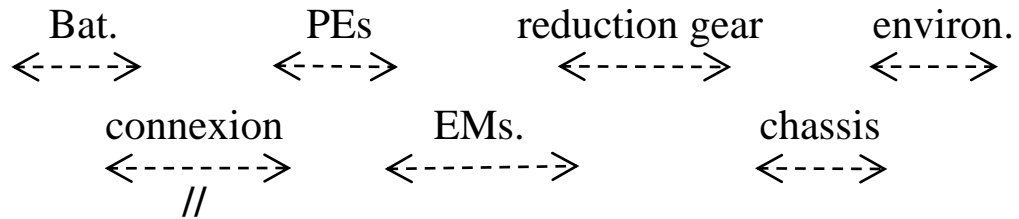
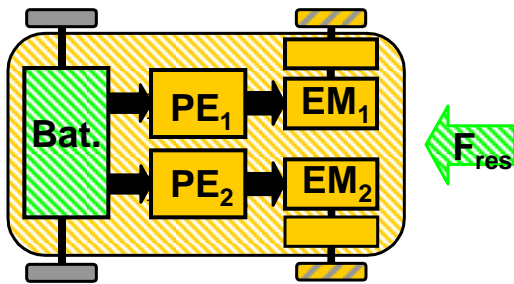
- Structure or functional descriptions
- Interaction principle for energy systems
- Causality



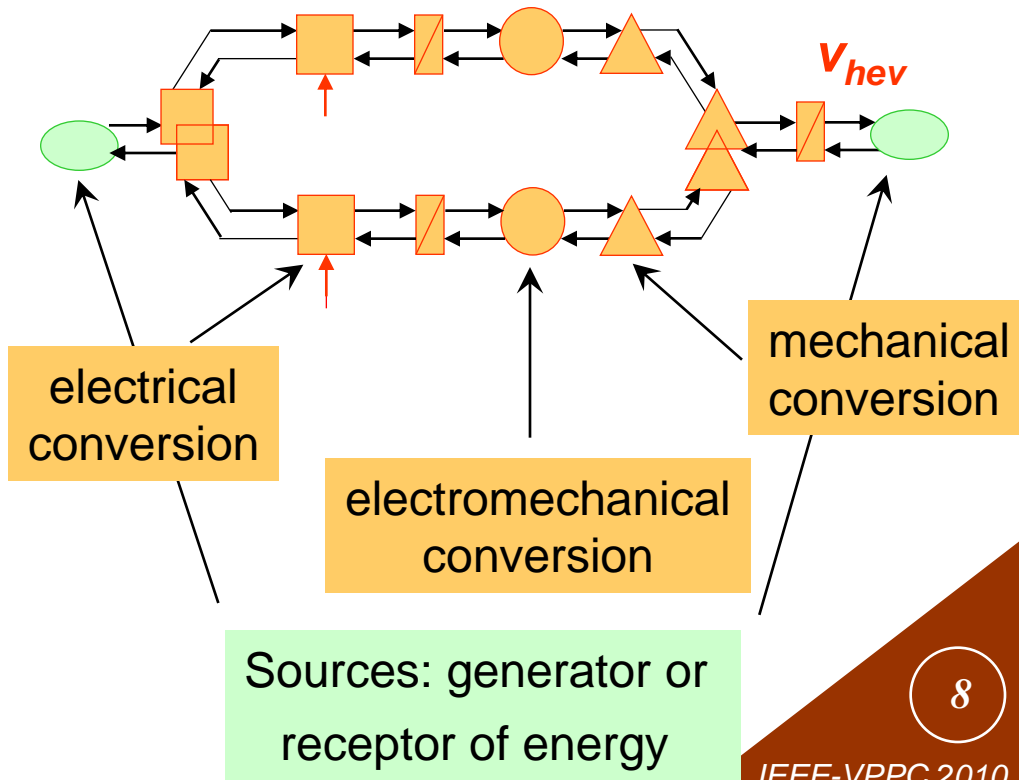
$\int x dt$ \Rightarrow surface \Rightarrow knowledge of past evolution **OK in real-time**

~~$\frac{dx}{dt}$ \Rightarrow slope \Rightarrow knowledge of future evolution **impossible in real-time**~~

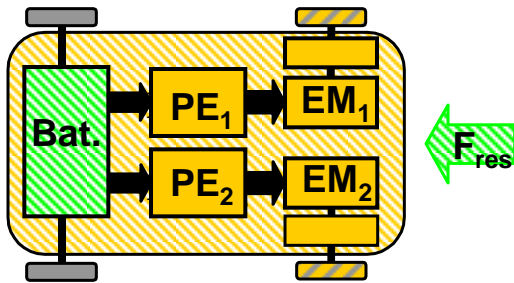
Energetic Macroscopic Representation (EMR)



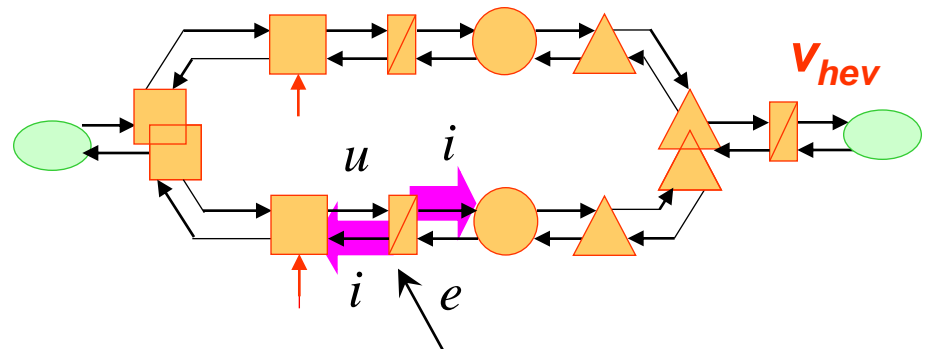
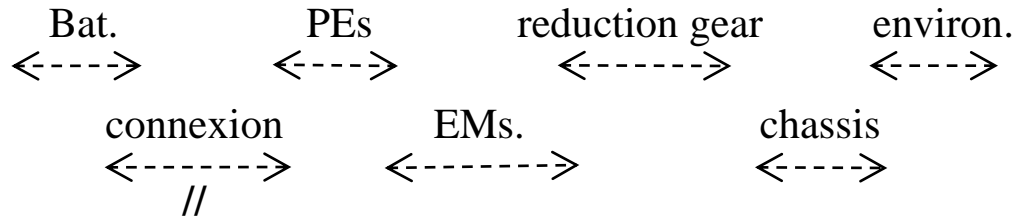
➤ Functional Representation



Energetic Macroscopic Representation (EMR)



- Functional Representation
- Causal modeling



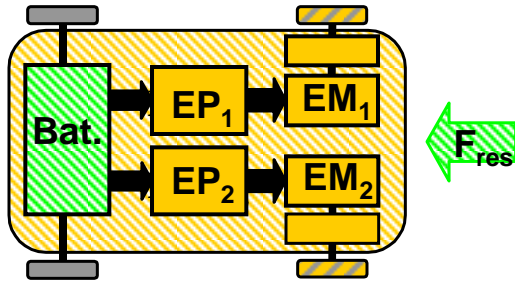
accumulation of energy

$$\text{output} = \int \text{input}$$

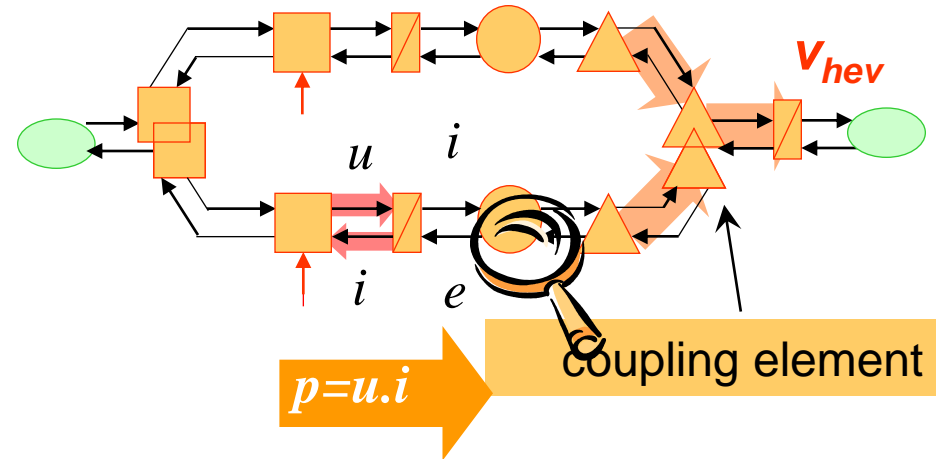
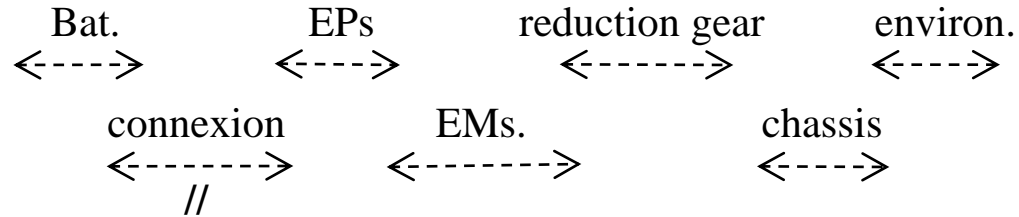
i state variable

$$E = \frac{1}{2} L i^2$$

Energetic Macroscopic Representation (EMR)

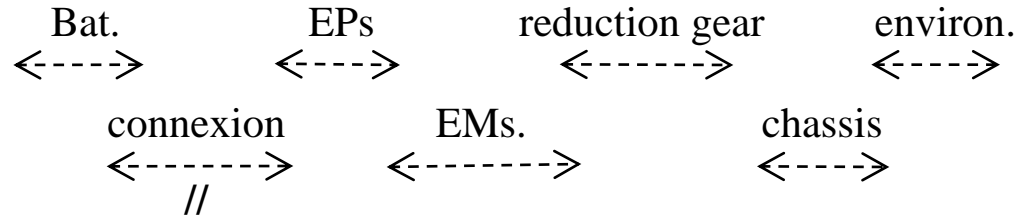
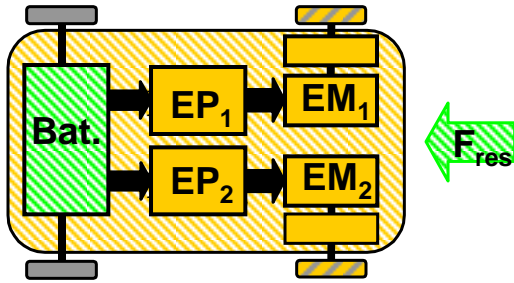


- Functional Representation
- Causal modeling
- Global energetic view
- Energy distributions emphasized by coupling elements



action / reaction principle

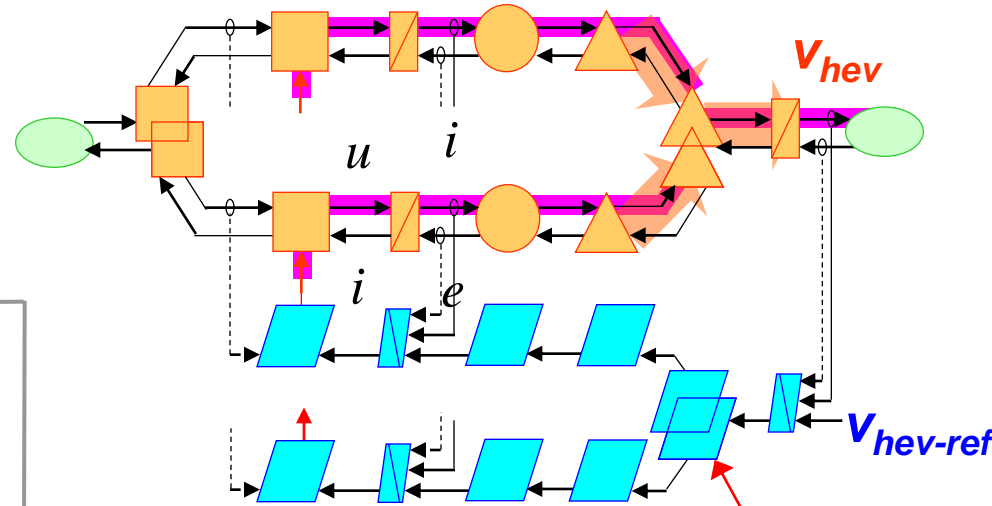
Energetic Macroscopic Representation (EMR)



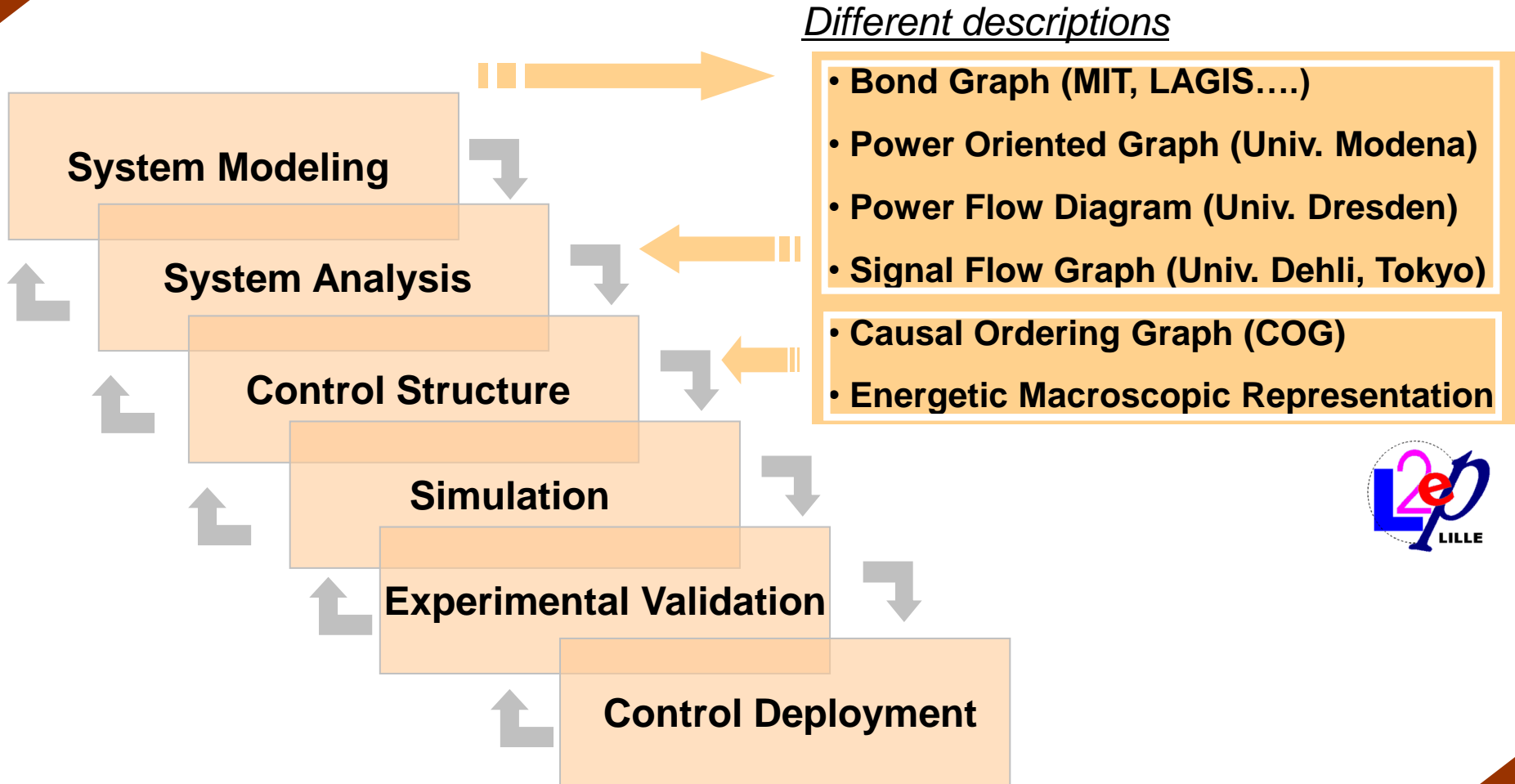
- Functional Representation
- Causal modeling
- Global energetic view
- Energy distributions emphasized by coupling elements

➤ Inversion-based control

➤ Degrees of freedom emphasized by the inversion of coupling elements



Model-based control design process



Oral Session Outline

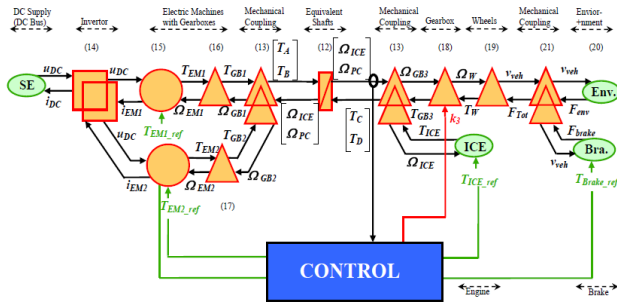
1. The Bond Graph - an excellent modelling tool to study abstraction level and structure comparison
G.-H. Geitner (Technical University Dresden, Germany)

2. The Power-Oriented Graphs Technique: system modeling and basic properties

R. Zanasi (Univ. Modena and Reggio Emilia, Italy)

3. An Energetic Based Method Leading to Merged Control Loops for the Stability of Input Filters

P. Barrade. & al. (EPF Lausanne, Switzerland)

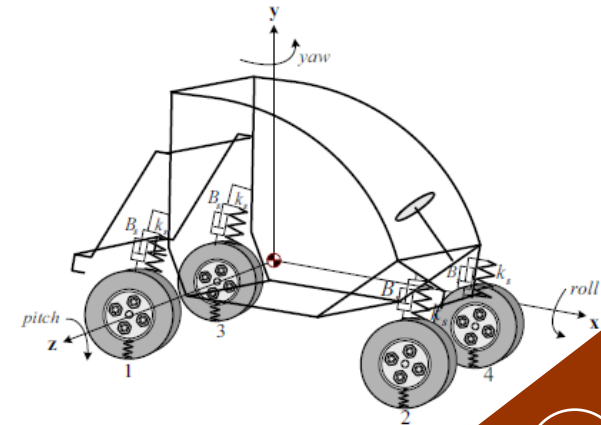


4. Modelling of Power Split Device for Heavy-Duty Vehicles

S.A.Syed & al. (Univ. Lille, France, **MEGEVH**)

5. Practical Control Structure of a Heavy Duty Hybrid Electric Vehicle

J. Solano-Martínez & al. (Univ. Franche Comté & Army General Direction, France)



Dialogue Session Overview

Friday, September 3, 2010, 9h30-10h30

- 1. Comparison between Forward and Backward approaches for the simulation of an Electric Vehicle**, M. Delavaux & al. (Univ. Lille, France)
- 2. Control Strategy with Saturation Management of a Fuel Cell/Ultracapacitors Hybrid Vehicle**, T. AZIB& al. (LGEP, France)
- 3. EMR and inversion-based control of a virtual reality bicycle trainer**, M.-A. LEBLANC & al. (Univ. Québec à Trois-Rivières, Canada)
- 4. Energetic Macroscopic Representation and PSIM simulation: application to a DC/DC converter input filter stability**, P. Barrade & al. (EPF Lausanne, Switzerland)

Dialogue Session Overview

Friday, September 3, 2010, 9h30-10h30

5. **Energetic Macroscopic Representation of a Solid Oxide Fuel Cell for Stirling Engine combined cycle in High-efficient Powertrains**, C. Gay & al.
(Univ. Franche-Comte, France)
6. **Modeling of Electric Vehicles Dynamics with Multi-Bond Graphs**, L. I. Silva & al (Universidad Nacional de Rio Cuarto, Argentina)
7. **Modelling, Simulation and Validation of an Electrical Zero Emission Off-Road Motorcycle**, T. Bäuml (AIT Austrian Institute of Technology, Austria)
8. **Energetic Macroscopic Representation and Maximum Control Structure of Electrical Vehicles Charging Photovoltaic System**, F. Locment & al
(Univ. Technologie de Compiègne)