

« Modelling and control using
Energetic Macroscopic Representation
 Application to hybrid electric vehicles and others »

Ecole Polytechnique Fédérale de Lausanne

July, 4-6, 2011

Followed by EPFL's Energy doctoral school, July 6-8



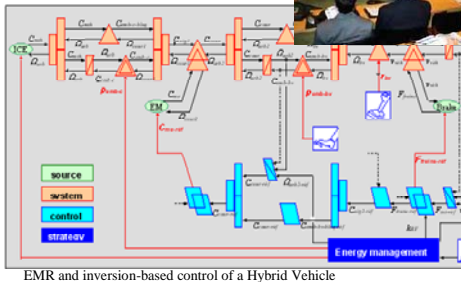
Lecture session, EMR'08, Harbin (China)



Lecture session, EMR'06, Lille (France)



Lecturers and part of attendees, EMR'09, Trois Rivières (Canada)



EMR and inversion-based control of a Hybrid Vehicle



Simulation session, EMR'08, Harbin (China)



ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE



Laboratoire d'Electronique Industrielle



Université Lille 1 Sciences et Technologies



applied magnetics
 electromagnetic and thermal analysis software



This workshop is a joint Summer School of Ecole Polytechnique Fédérale de Lausanne (Switzerland) and University Lille1, Sciences and Technology (France).

General chairs:

Prof. Alfred RUFER (Ecole Polytechnique Fédérale de Lausanne, LEI, Switzerland)
 Prof. Alain BOUSCAYROL (University Lille1, L2EP, MEGEVH, France)

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Dr. Philippe BARRADE (Ecole Polytechnique Fédérale de Lausanne, LEI, Switzerland)
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 Dr. Walter LHOMME (University Lille1, L2EP, MEGEVH, France)
 Prof. Pierre SICARD (Université du Québec à Trois-Rivières, GRÉI, Canada)

REGISTRATION

Due to the simulation training session, the number of attendees is limited to 50. A registration form is required. The registration fees include coffee breaks, lunches, the workshop booklet and the CD-ROM with the Matlab-Simulink® EMR library.

Students: 100 CHF
 Regular: 150 CHF

INFORMATION

Contact: philippe.barrade@epfl.ch

More information: <http://emr.univ-lille1.fr/>
 and <http://lei.epfl.ch/>

EMR'06, Lille (France), EMR'08, Harbin (China), EMR'09, Trois-Rivières (Canada).

WORKSHOP OBJECTIVES

This workshop is focused on the Energetic Macroscopic Representation (EMR) methodology for modelling and control of complex electromechanical systems.

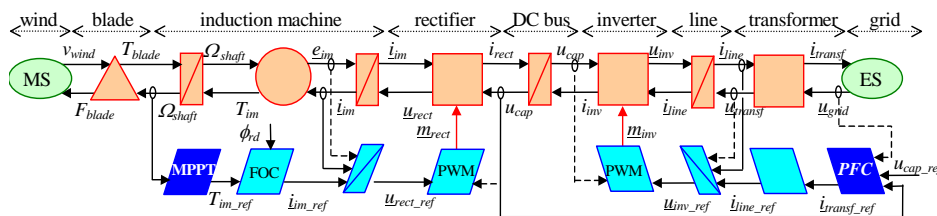
This Summer School is dedicated to Master and PhD students, Engineers and scientists, from both academia and industry, who have to model and control new electromechanical systems such as industrial multi-drive systems, traction and propulsion systems, hybrid electric vehicles, or renewable energy generation systems.

This year, the traditional summer school is linked to the EPFL doctoral school in Energy. The opportunity is given to the PhD students to follow this seminar (3 ECTS). They will take benefits from the practical exercises that will be proposed. They will have the possibility to use the EMR methodology on examples they will propose, solve and present.

EMR is a graphical modelling tool that was introduced in 2000 to describe complex electromechanical systems. EMR has since been extended to complex multiphysics systems (combining thermal science, electrochemistry, fluid mechanics ...). EMR is based on the action-reaction principle to organize the interconnection of sub-systems according to the physical causality (i.e. integral). This description highlights energetic properties of the system (energy accumulation, conversion and distribution). Moreover, an inversion-based control can be systematically deduced from EMR using specific inversion rules.

Compared with other causal modelling tools such as Bond Graphs or Causal Ordering Graphs (COG), EMR has a more global energetic view and contributes to system's control design. Differing from non-causal modelling tools such as Physic Modelling Language (PML) using Object-Oriented Modelling Language, which makes its libraries to be coupled in the same way as physical units, EMR is focused on the system function and not only on the system structure. EMR gives insights into the real energy operation of systems and allows a deep understanding of its potentialities from a dynamic point of view.

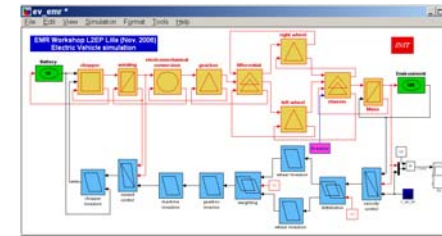
In short, the distinct features of EMR lie in its clarity of physical concepts, as well as their physical causality, and its functional modelling rather than a structural modelling, hence contributing significantly to the design of control and energy management of systems.



Energetic Macroscopic Representation of a Wind Energy Conversion System

SIMULATION TRAINING SESSIONS

The aim of this Summer School is to give first hand experience in practice of using EMR and inversion-based control. Thus, two afternoons will be dedicated to simulation training sessions using MATLAB-Simulink[®]. Attendees will simulate a complete system and its control using EMR methodology. They will choose to study an electric vehicle or a wind energy conversion system. An EMR library will be provided to all attendees.



Matlab-Simulink[®] model of an Electric Vehicle (orange) and its control (blue) derived from EMR

WORKSHOP SCHEDULE

— Monday 4 July 2011 —

9:00 – 12:30 am: Lectures on fundamentals on EMR and inversion-based control, basic examples
2:00 – 6:00 pm: Simulation training session (part I), modelling of the considered system

— Tuesday 5 July 2011 —

8:00 – 12:30 pm: Lectures on applications to complex systems (part I)
(Hybrid Electric Vehicles, Automatic subway traction systems, Fuel Cell systems...)
2:00 – 6:00 pm: Simulation training session (part II), control of the considered system

— Wednesday 6 July 2011 —

8:00 – 12:30 pm: Lectures on applications to complex systems (part II)
(wind energy conversion systems, PV systems, Piezoelectric actuators...)
2:00 – 6:00 pm: Practical works on an experimental set-up (doctoral school)

— Thursday 7 July 2011 —

8:00 am – 6:00 pm: Preparation of case applications (doctoral school)

— Friday 8 July 2011 —

8:00 – 12:00 am: Presentation of the case application (doctoral school)

The full program is available at <http://emr.univ-lille1.fr/>

LANGUAGE

Lectures will be presented in English. The simulation training session will be ensured in English.