

« INTRODUCTION TO UNIT EMR »

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

Laboratory of Electrical Engineering and Power (L2EP)



<http://l2ep.univ-lille1.fr/>



30 professors and associate professors, 42 PhD students,
11 technical and administrative staff, 24 non permanent staff



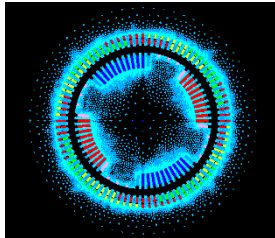
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- Research at L2EP -

EMR, Paris Sud, June 2014

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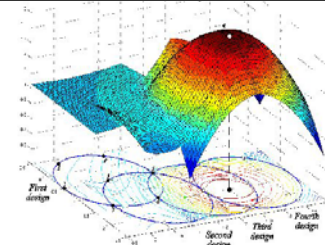
« Numerical Modelling »
Prof. S. Clénet



Prof. F. Piriou



« Optimisation »
Prof. P. Brochet



« Power Electronics »
Prof. P. Le Moigne



« Electrical grid »
Prof. B. Robyns



« Control »
Prof. B. Lemaire-Semail



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- “Control” team of L2EP -

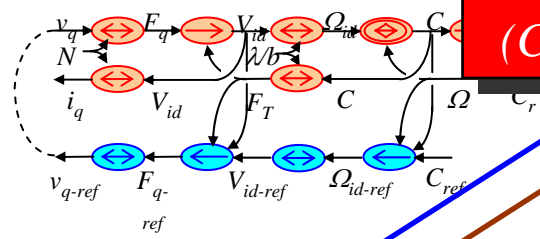
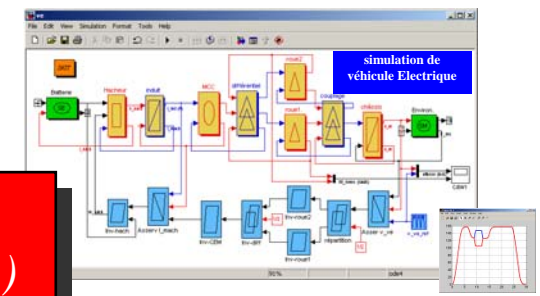
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- 3 Professors
- 5 Associate Professors
- 2 Engineers
- 3 Post-doctoral positions
- 10 PhD students

« Control »
Prof. B. Lemaire-Semal

Modelling and control tools
(COG, EMR, BMC, resonant controllers..)



B. Lemaire-Semal
« Electro-active actuators »

A. Bouscayrol
« Electricity and Vehicle »

E. Semail
« Multiphase machine »

X. Kestelyn
«Machine tools »

Formalisms bring solutions for new applications

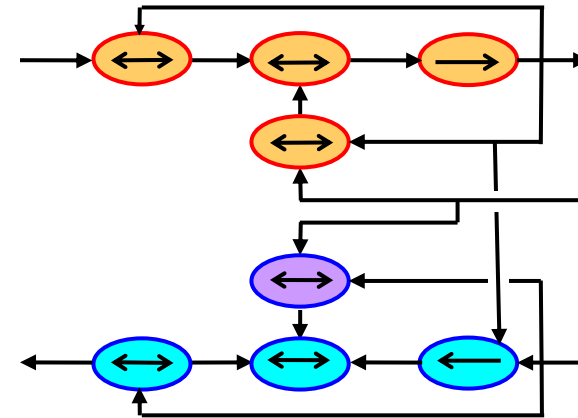
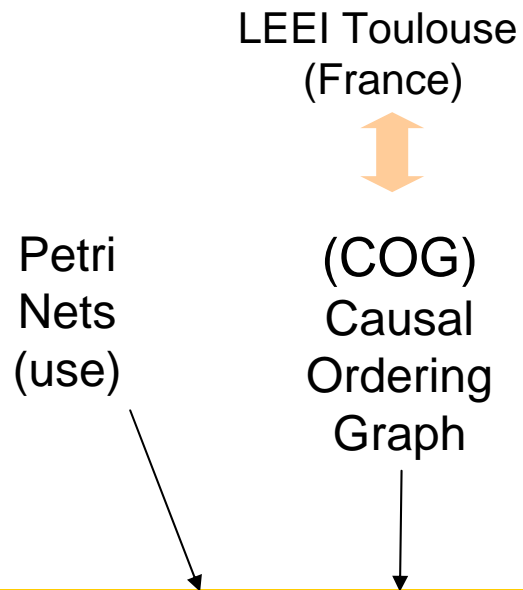
New applications lead to the improvement of formalisms

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- Modeling and control tools -

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Causality principle
Inversion-based control

1980

1990

2000

2010

Power Electronics

Electric Drives

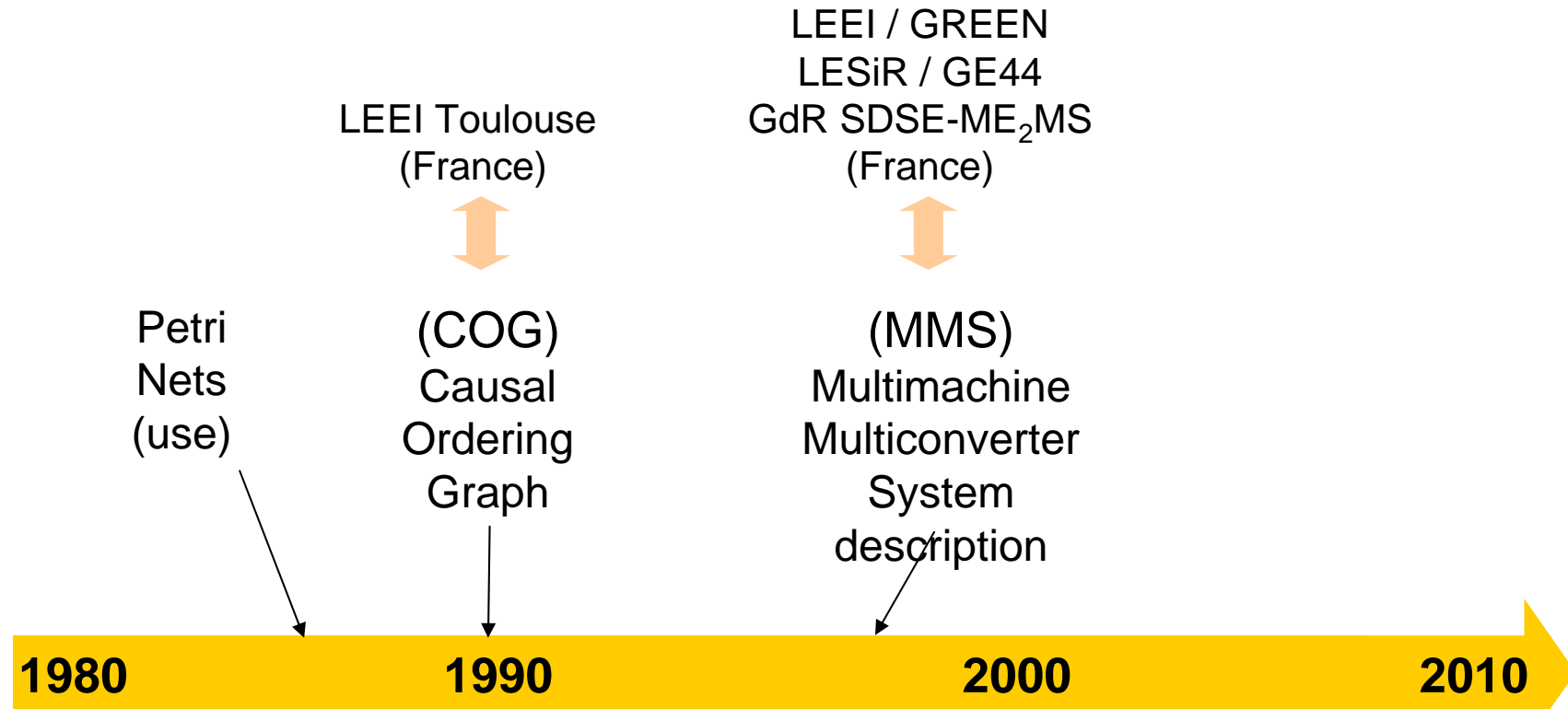
[Hautier 1996]

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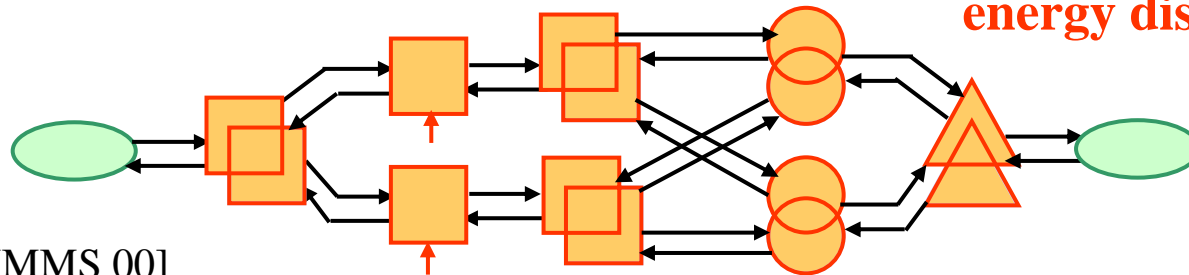
- Modeling and control tools -

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**action/reaction principle
energy distribution**



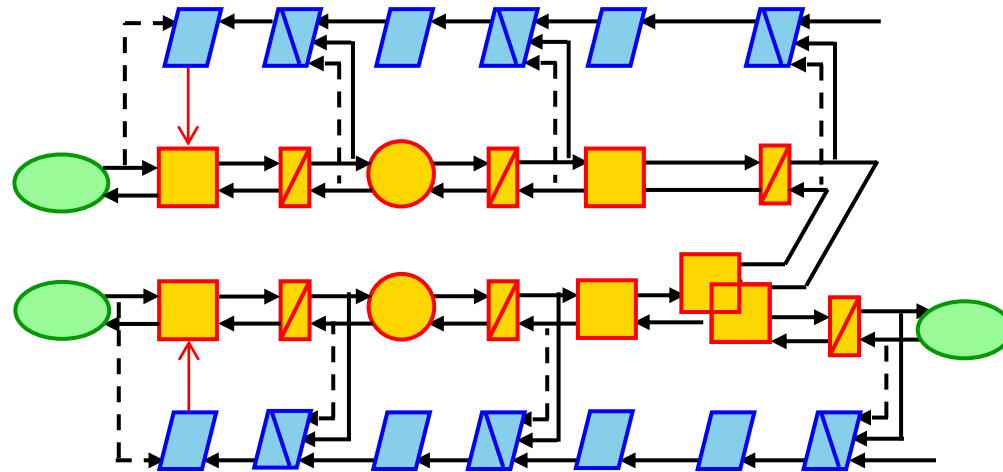
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- Modeling and control tools -

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Univ. Trois Rivières (Ca)
EPF Lausanne (CH)
FEMTO-ST
MEGEVH network



extension of inversion rules

(EMR)
Energetic
Macroscopic
Representation

1980

1990

2000

2010

Power
Electronics

Electric
Drives

Electromechanical
Systems

[Bouscayrol 2003]

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- Graphical description and Education -

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- **University of Lille, Polytech Lille, EC Lille**

- Master 1: COG - EMR initiation
- Master 2: COG - EMR further development

- **Other French Universities and Engineering Schools**

- COG: Toulouse, Cachan, Belfort, CNAM Paris
- EMR: Cachan (since 2004) Belfort (since 2006), ParisTech (2010)

- **Universities abroad France**

- Univ. de Québec Trois-Rivières (since 2002)
- EPF Lausanne (since 2005)
- Univ. Tsinghua (2008) / Univ. Barcelona (2010)
- Univ. Helsinki (2011) / Univ. Graz (2012)

- **EMR Summer Schools**

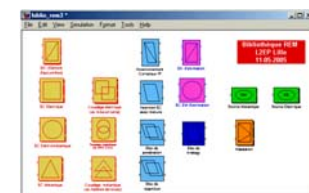
- EMR'06, Lille / EMR'08, Harbin (China)
- EMR'09, Trois Rivières (Canada) /
- EMR'11, Lausanne (Switzerland) / EMR'12, Madrid (Spain)
- EMR'13 Lille (France) / EMR'14 Coimbra (Portugal)



Simulation session, EMR'08, Harbin



Lecture session, EMR'12, Madrid



EMR Simulink library

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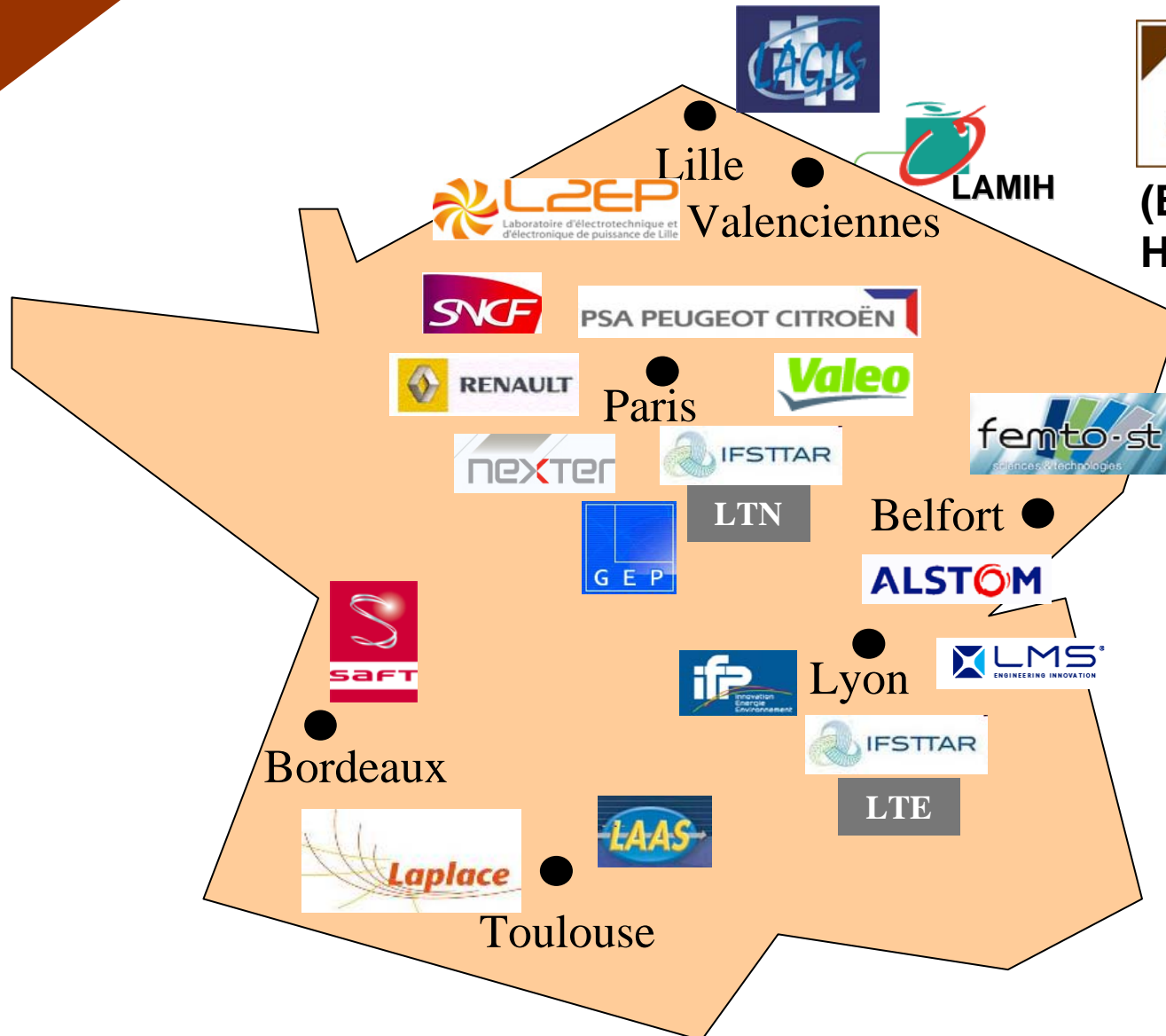
- Collaborations using graphical descriptions -

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- MEGEVH network -



MEGEVH
French network on HEV's
(Energy management of Hybrid Electric Vehicles)

Coordination:
Prof.A. Bouscayrol

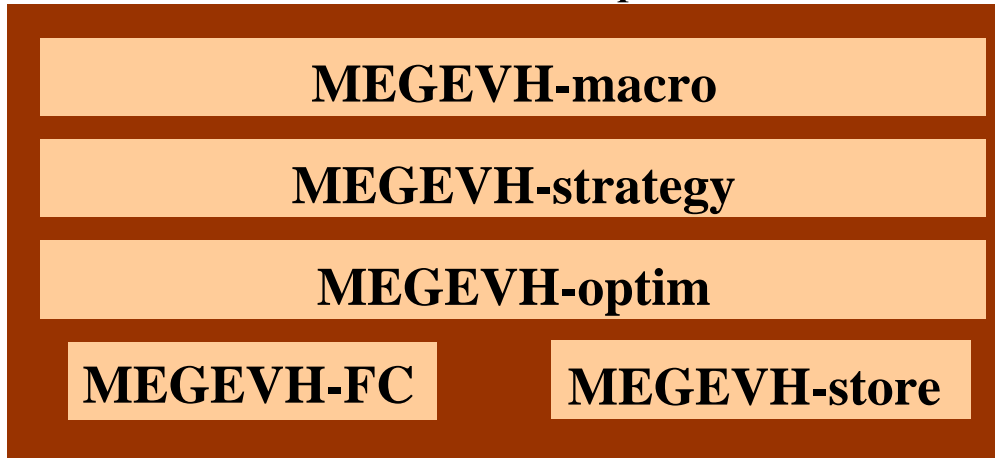
6 projects in progress
3 PhDs in progress
12 PhDs defended
1 HDR defended

8 industrial partners
10 academic Labs

<http://l2ep.univ-lille1.fr/megevh.htm>

- MEGEVH philosophy -

theoretical developments



Development of modelling and energy management methods

independently of the kind of vehicle

↕ *experimental plateforms* ↕



↕ *Reference vehicle* ↕



Paper Prize Award of IEEE-VPPC'08



Paper Prize Award of IEEE-VPPC'12

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- [Bouscayrol 11] A. Bouscayrol, P. Barrade, L. Boulon, K. Chen, Y Cheng, P. Delarue, F. Giraud, B. Lemaire-Semail, T. Letrouvé, W. Lhomme, P. Sicard, "Teaching drive control using Energetic Macroscopic Representation – Summer schools", *EPE'11 ECCE Europe*, Birmingham (UK), September 2011 (common paper of L2EP, Univ Québec Trois Rivières, EPF Lausanne and Harbin Institute of Technology).
- [Barre 06] P. J. Barre, A. Bouscayrol, P. Delarue, E. Dumetz, F. Giraud, J. P. Hautier, X. Kestelyn, B. Lemaire-Semail, E. Semail, "Inversion-based control of electromechanical systems using causal graphical descriptions", *IEEE-IECON'06*, Paris, November 2006
- [Hautier 96] J. P. Hautier, J. Faucher, "Le graphe informationnel causal", (text in French), *Bulletin de l'Union des Physiciens*, vol. 90, juin 1996, pp. 167-189.
- [Hautier 04] J. P. Hautier, P. J. Barre, "The causal ordering graph – A tool for modeling and control law synthesis", *Studies in Informatics and Control Journal*, December 2004, Vol. 13, no. 4, pp. 265-283.
- [MMS 00] MMS project, A. Bouscayrol, B. Davat, B. de Fornel, B. François, J. P. Hautier, F. Meibody-Tabar, M. Pietrzak-David, "Multimachine Multiconverter System: application for electromechanical drives", *European Physics Journal - Applied Physics*, vol. 10, no. 2, May 2000, pp. 131-147 (common paper GREEN Nancy, L2EP Lille and LEEI Toulouse, in the framework of the MMS national project of GdR-SDSE of CNRS).

More references at <http://www.emrwebsite.org/>