Electricity and Vehicles (e-V)

The objective of **e-V** platform is the real-time validation of energy management for new vehicle concepts, for more efficient and less polluting transport systems. It makes possible to study also new fault tolerant drives such as multiphase drives.

Electrical Power Managment Lab (EPM Lab)

EPM-lab is a collaborative platform dedicated to the study of new means of energy production and storage around a real-time simulator reproducing the behaviour of an electrical grid. It aims to address different kinds of topics : smart grids, transmission system with large penetration of power electronic converters and also some hardware tests.

Software tools

code_Carmel is a 3D finite element code devoted to study low frequency electromagnetism problems. It is developed with Edf R & D since 2008 within a joint laboratory, **LAMEL**.
Sophemis platform is an optimization supervisor for electrical machines in their environment. It offers many multi-objective, multi-physical and multi-granular methodologies.

Other tools

Energetic Macroscopic Representation (EMR), Generalized Vector Formalism (GVF), storage characterization, magnetic materials characterization, piezoelectric systems control, EMC platform, fast-components' chracterization

PHD Theses

About 15 PhD students per year join the laboratory to conduct PhD thesis. They can be funded either by scholarships form high education institutions, or by industrial partners (CIFRE grants), or carried out in co-supervision with a foreign university (Brazil, China, Canada, etc.). They can also be partly granted by the region "Hauts-de-France" , ADEME French Agency projects, etc.

MASTER degrees : specialization

- E2SD, « Electrical Engineering for Sustainable Development » aims at training students in the field of electrical engineering for sustainable development in view of their enrolment as PhD students further. This master is co-organized by Université de Lille, Centrale Lille and Arts & Métiers ParisTech.
- VIE, intelligent electric vehicles.
- GR2E, management of electrical grids.
- MVE, mobility and electric vehicles
- SYSPEC, training on new energies management.

Engineer schools

Electrical engineering courses in Polytech'Lille, Centrale Lille, Arts & Métiers Paris-tech and HEI.

LAMEL

In order to structure their collaboration around field calculation and jointly contribute to the development of code_Carmel calculation code, EDF R&D and L2EP set up a joint laboratory in 2006 : LAMEL (Laboratory for Modelling of ELectrical materials).

MEGEVH

MEGEVH cluster (Modelling and Energy manaGement of Electric Vehicles & Hybrid vehicles) is a national scientific network whose objective is to initiate collaborations between academic and inductrial partners on energy managemnt for hybrid and electric vehicles.

Inductrial partners :ALTSOM, LMS, Nexter Systems, PSA Peugeot Citroën, Renault, Saft, Sherpa Eng., SNCF, Valeo.
Academic laboratories : Ampère, CRIStAL, Femto-ST, GeePs, IFP-EN, LAMIH, LAPLACE, LTE-IFSTTAR, LTN-IFSTTA.

CARNOT ARTS Institute

L2EP is part of the Carnot ARTS Institute (Research Actions for Technology and Society), a national initiative that aims to increase partnership research for companies, promote innovation and develops technology transfer.

MEDEE Technological hub

The technological research cluster MEDEE (Motors and Electrical Devices for Energiy Efficiency) is a structure that brings together academics, companies ans SMEs from the Hauts-de-France region in a context of research partnership. More than 100 partners are involved in MEDEE.
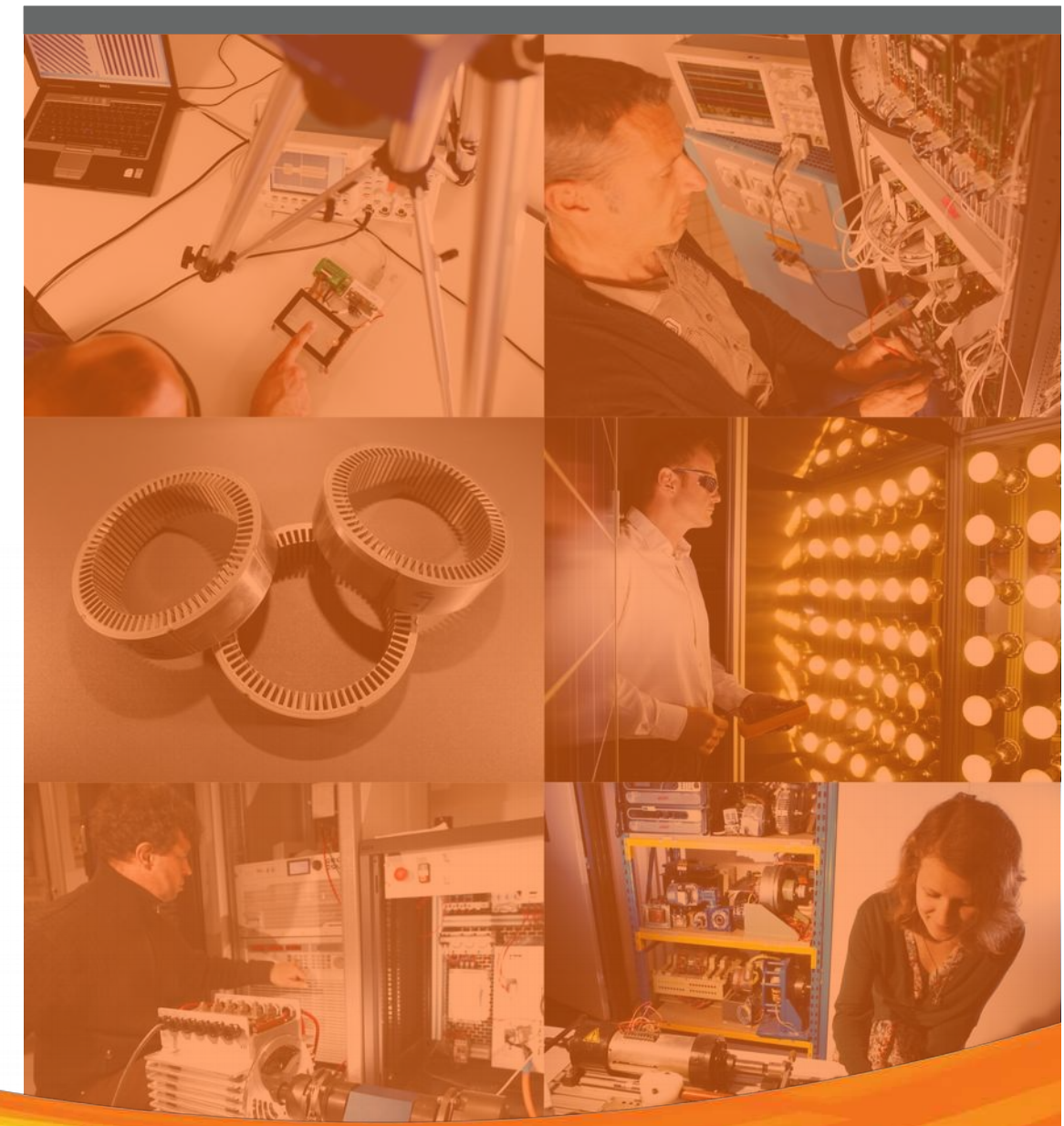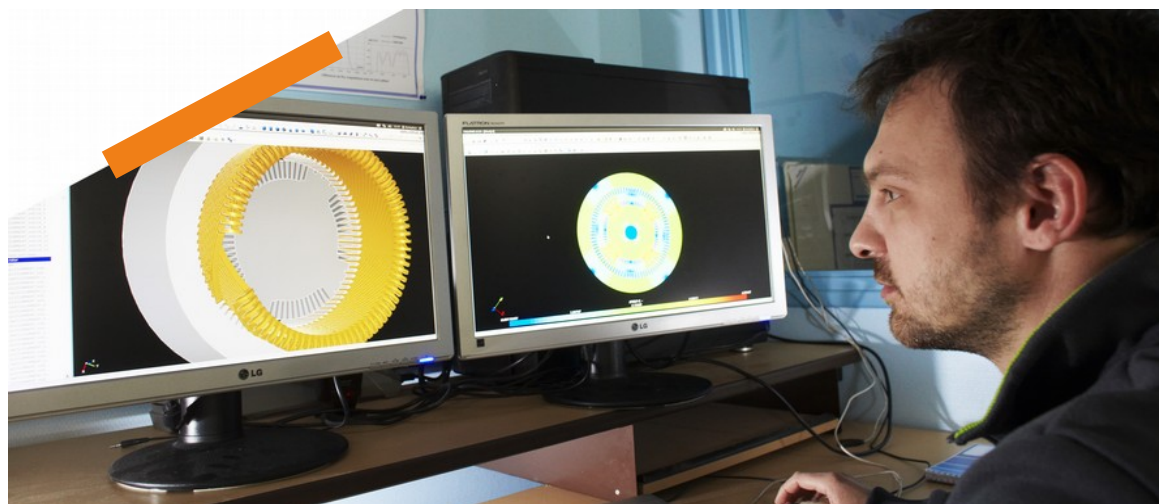
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L2EP
Laboratoire d'électrotechnique et d'électronique de puissance de Lille

Université de Lille · HEI · yncréa · centralelille · Arts et Métiers Institute of Technology

LABORATORY OF ELECTRICAL ENGINEERING AND POWER ELECTRONICS LILLE

A strategic roup

Created in 1989, the laboratory L2EP (EA 2697) gathers the active forces in electrical engineering and power electronics from Université de Lille, Centrale Lille, Arts & Métiers ParisTech and HEI.
Located in Lille, with an international influence, the L2EP is organized within 4 research teams whose works cover all inherent aspects in the field of electrical energy.

Complementary skills

- Electrical energy management for e-mobility, EMR formalism
- 3D numerical modeling of electromechanical systems, reduced modeling, uncertainties
- Optimization, magnetic material characterization
- Energy conversion, power electronics, electromagnetic compatibility and HF components
- Electrical energy transmission network, HVDC transmission, renewable energy, smart grids
- Multi-phases drives, fault tolerant systems, piezo-electric devices applied to tactile feedback

International collaborations

Belgium : Liège, Gand
Netherlands : Eindhoven
Swiss : Lausanne
Italy : Torino

UK : Birmingham
Denmark : Aalborg
Finland : Aalto

Russia : Moscow
Poland : Poznan

Japan : Saitama

Canada : Montréal, Sherbrooke
Trois-Rivières, Québec,
Mac Gill, Toronto
USA: Akron

Spain: Madrid, Terassa, Sevilla

China : Pekin, Harbin

Algeria : Alger, Bejia
Tunisia ; Tunis, Sfax

Brazil : Florianopolis
Argentina : Cordoba

Director :
Pr. Betty LEMAIRE-SEMAIL

- 110 Peoples
- 36 Professors and Associate Professors
- 16 Technical & Administrative Staff
- 40 PhD Students
- 18 Post-doc

- Electrical engineering expert
- More than 25 years of experience in R&D
- 50 publications in scientific journal per year
- 4 partners institutions
- 4 complémentary teams

Control team

The Control team is focused on the development of formalisms for modelling and control of energy conversion systems. The **Energetic Macroscopic Representation (EMR)** and the **Vectorial Generalized Formalism (FVG)** are multi-physic formalisms which allow to handle a wide field of applications : multiphase drives, piezo-electric actuators and electrified vehicles.
The Control team leads the **MEGEVH** network as well as the CNRS cluster **TACT** (Touch sense: analysis, simulation and evaluation) linked to the STIMTAC project on haptic surfaces in IRCICA.
The Control team works in close collaboration with international academic partners. An Associated International Laboratory, « e-Campus », has been created between Université de Lille and Université Québec Trois Rivières to study electro-mobility applied on university campus. Moreover, the team is coordinator of H2020 European project **PANDA** .

Keywords : Causal modelling, EMR, inversion-based control, electric drives, piezo-electric actuators, hybrid electric vehicles, multi-phase drives, fault tolerant systems

Academic partnership : CRIStAL, FEMTO-ST, GeepS, IEMN, IRCICA, IRENAV, LAMIH, LPMT, LTE-IFSTTAR, TVES
Industry partnership : GoTouchVR, Hap2U, Nexter System, PSA peugeot Citroen, Siemens, SNCF, Sherpa, Thales, Valeo

Alain BOUSCAYROL - alain.bouscayrol@univ-lille.fr

Power Electronics team

The team is working on the evolution of **clean** and **economic** conversion structures. It focuses on the **frequency rise in conversion structures and their close control**. The objective is to take into account the new large gap components. The study, characterization and modeling of semiconductors, magnetic components, storage components are therefore developed. Then converter models are set up in order to improve them, both in terms of energy performance and EMC.

Keywords : Power electronics, wide bandgap, HF converters, power density, PWM, HF filtering, planar magnetic components, storage components, EMC

Academic partnership : Ampère, ESTACA, G2Elab, GREMAN, IEMN, IFSTTAR, ICube, IMT Lille-Douai, IETR, LAMIH .

Industry partnership : Decathlon, Schneider Toshiba Inverter Europe, Safran, Thales, Valeo

Philippe LE MOIGNE - philippe.lemoigne@centralelille.fr

Numerical Tools and Methods team

The team Numerical Tools and Methods works on the development of numerical models and effective methodologies for the optimal design and study of electromagnetic devices within their environment.
The topics are : characterization and modelling of the electromagnetic behaviour of magnetic materials taking into account the impact of manufacturing processes, development and implementation of advanced numerical methods to reduce computation time, considering uncertainties, multi-level, multi-scale optimization methodologies and strategies, optimal design of electrical machines including multi-physics issues.
The results are capitalized in a software platform which includes the **Sophemis** optimization code and **code_Carmel** finite element code. The latter is co-developed with EDF within the joint **LAMEL** laboratory.

Keywords : 3D finite element, magnetic characterization, uncertainties, model reduction, error estimation, conception with optimization, diagnostic, multi-objective optimization

Academic partnership : AMPERE, CRIStAL, FEMTO-ST, G2Elab, IREENA, Paul Painlevé, LAPLACE, LAMIH, LMSP, LSEE, Roberval, SATIE

Industry partnership : Alstom-Transport, Auxel, EDF, IREQ, Jeumont Electric, Moteurs Fox, Renault, Valeo

Abdelmounaim TOUNZI - abdelmounaim.tounzi@univ-lille.fr

Power System team

The Power System Team contributes to the evolution of power systems towards smart-grids through its scientific development concerning their architecture design and energy management with new technologies.
The Power System Team stands out for : its multi-objective methodologies for the energy management of electrical systems, particularly in **smart grids**, its work on high penetration of power electronic converters in transmission power system, its associated experimental approaches, its knowledge in real-time modeling and simulation of electrical networks, as well as on the control of **HVDC transmission systems.**

Keywords : Energy management, renewable energies, electrical energy storage, power grid, embedded network, ancillary services, power electronics in transmission power system

Academic partnership : G2elab, IRT Railenium, LEM, Supelec, Supergrid Institute
Industry partnership : EDF, Enedis, Engie, GB Solar, Renault, RTE, Seolis, SNCF, Spherea

Benoît ROBYNS - benoit.robyns@yncrea.fr