

Master Programs in Canada: A Catalan-Canadian perspective (visió d'un professor)

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Energy Systems Design Lab

(www.esdlab.mece.ualberta.ca)

Mechanical Engineering Department

University of Alberta

2^a Jornada de Docència a l'ETSEIB

Dimecres, 8 de Febrer, 2017

Overview

- Why does traveling matter?
 - ❑ My experience from ETSEIB to Alberta (and out of Alberta)
- The logistics of an MSc in a Canadian university
 - ❑ University of Alberta MSc requirements
- What does an MSc in my research laboratory look like?
- UPC-UAlberta exchange program
- Conclusions

From ETSEIB alumni to UAlberta professor

- **1997-98:** First year in Mechanical Engineering (Engineering Industrial) @ ETSEIB
- **2000-01:** UPC-UVic (University of Victoria, Canada) undergraduate exchange program
- **2001-02:** Finish Engineering Industrial @ ETSEIB
- **2002-04:** Master of Applied Science @ UVic
- **2004-08:** Doctor of Philosophy (PhD) @ UVic
- **2008-09:** Post-doctoral fellow at NRC-IFCI (National Research Council Canada – Institute of Fuel Cell Innovation, Vancouver)
- **2009-15:** Assistant (09-14) and Associate professor at UAlberta (Edmonton, Canada)
- **2015-16:** Visiting scholar at Lawrence Berkeley National Laboratory (Berkeley, US)
- **2016-Present:** Associate professor @ UAlberta



Why does traveling matter?

➤ **Every trip resulted in new knowledge**

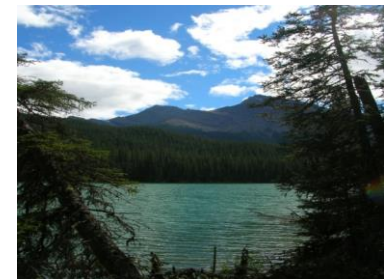
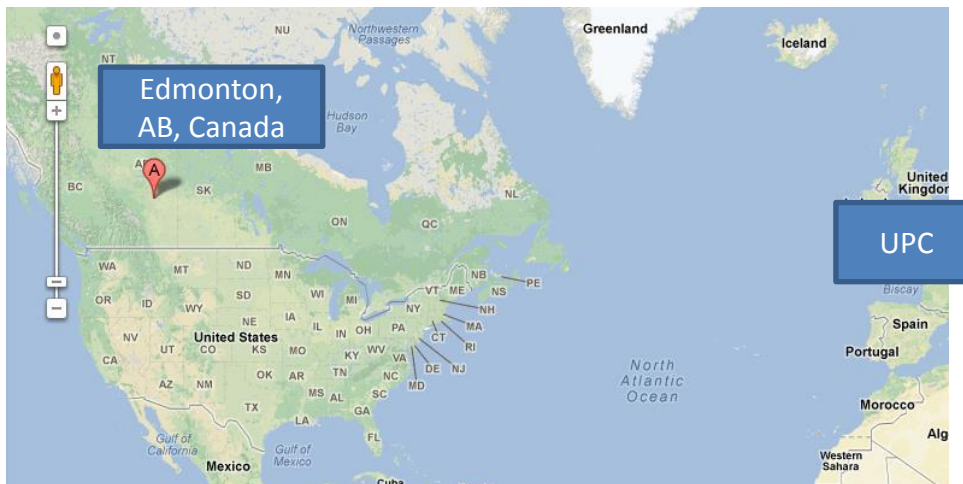
- English proficiency
- Numerical methods (finite elements/optimization/fuel cell analysis)
- Fuel cell testing
- My own research team: From independent research to being at the helm
- Three-dimensional characterization of porous media, x-ray imaging

➤ **Every trip resulted in a new (life) experience**

- From living with family to new roommates (and how independence leads to happiness)
- From living with roommates to girlfriend/wife (a.k.a. why commitment is important)
- From girlfriend/wife to new roommates (a.k.a. you must escape “the comfort zone” trap)
- In between many, many lab mates from all over the world (a.k.a. why everyone deserves respect irrespective of race, religion and culture)
 - My lab composition: Canada, Catalonia, India, China, Germany, Russia, Ghana, US

University of Alberta

- The University of Alberta is a public research university located in Edmonton, Alberta, Canada.
 - ❑ Number of undergraduate and graduate students: 30,626 and 7,204
 - ❑ The Academic Ranking of World Universities, the QS World University Rankings and the Times Higher Education World University Rankings rate it as:
 - one of the top five universities in Canada
 - one of the top 100 universities worldwide.



Graduate Studies at the University of Alberta

- MSc and PhD students are **not** undergraduate students
 - ❑ Undergraduate students registered in the Faculty of Engineering
 - ❑ MSc and PhD students register in the Faculty of Graduate Studies (even though they do their degree in the Faculty of Engineering)
- MSc and PhD students constitute a **select** percentage of the student population
 - ❑ Faculty of Engineering:
 - Graduate to undergraduate ratio (in engineering): **1:4**
 - Ratio of PhD and MSc students per faculty (in engineering): **1:3.3** and **1:2.7**

Graduate Studies at UAlberta: Mechanical Engineering

- Six programs: Mechanical Engineering and Engineering Management
 - ❑ Master of Engineering (M.Eng.) – course-based program
 - ❑ Master of Science (M.Sc.) – thesis-based program
 - ❑ Doctor of Philosophy (Ph.D.)
- The Fall 2016 enrolment consisted of 265 students across the six programs
- My focus today: Master of Science (M.Sc.) – thesis-based program

MSc at UAlberta: Mechanical Engineering

- Minimum GPA requirement to enter the program is 3.0
 - ❑ Equivalent to having grades that are at least in the top 50% of the class
 - Only the most qualified/interested should attend graduate school
- Students in all programs are required to complete
 - ❑ Five graduate level courses.
 - Students must maintain a minimum cumulative grade point average of 3.0 on the 4.0 scale.
 - ❑ Formal ethics and academic integrity training.
 - ❑ An individualized professional development plan (IDP) and undertake 8 hours of professional development training
 - ❑ A thesis (100-150 page summary of a one-year research project)
 - Examples: See <http://www.esdlab.mece.ualberta.ca/publications.php#theses>
 - ❑ Oral thesis defense
- For more info see the graduate manual:
<http://www.mece.engineering.ualberta.ca/en/~media/mece/Graduate/Documents/GraduateProgramManualMechanicalEngineering.pdf>

MSc at UAlberta: Mechanical Engineering

- MSc (and PhD) students transition from students to colleagues
 - ❑ MSc and PhD students have the following financial resources available
 - Research assistantship
 - Teaching assistantship
 - Scholarships (both for domestic and international students)
 - ❑ For students to receive funding they must be registered in the UAlberta program

Energy Systems Design Laboratory (ESDLab)

➤ MSc at UAlberta

❑ Learning is achieved via mentoring:

- Weekly meetings with research team
- Bi-weekly meetings with research advisor to discuss progress
- Monthly reports to supervisor (me) to assess progress and gather feedback

❑ Schedule:

- **First day:** Student gets assigned a desk, computer and introduced to the program and my research team
- **Year 1:** Courses and start research
 - Fall: Take two courses, laboratory safety training and discussion on research topic
 - Winter: Take two courses, starts research and teaching assistantship
 - Summer: Student works full time on research
- **Year 2:** Research only
 - Fall: Student takes last graduate course and continues research
 - Winter: Research and teaching assistantship
 - Summer: Write thesis and journal publications

Energy Systems Design Laboratory (ESDLab)

- Three main research areas with numerical and experimental expertise

Computational Design and Optimization of Energy Systems

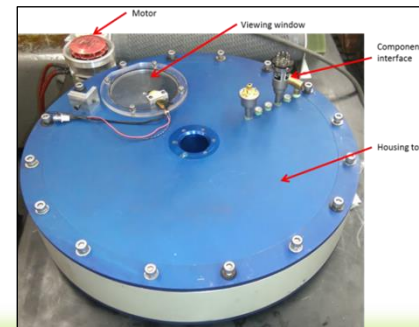
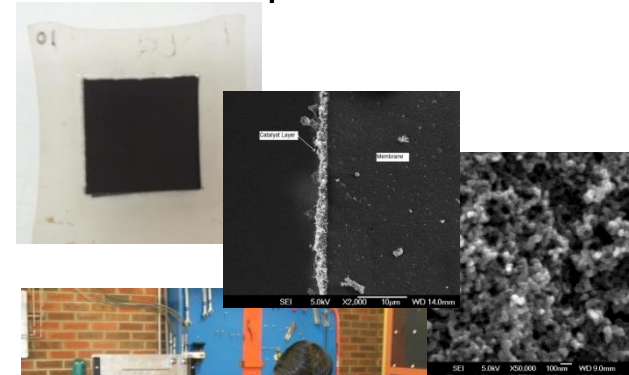
- Fuel cell parameter estimation
- Fuel cell and flywheel optimization

Computational Analysis of Energy Systems

- Fuel cells
- Flywheels
- Numerical experiments

Experimental Testing of Energy Systems

- Fuel cells
- Electrolyzers
- Flywheels
- Ex-situ characterization



UPC – UAlberta exchange program

- In 2010, UPC-ETSEIB and UAlberta signed a memorandum of understanding to permit two students to spend one year at the host institution:
 - ❑ 2 master students in the area of Energy spend a year at UAlberta to write their thesis
 - ❑ Students pay tuition at UPC-ETSEIB but are registered as students at UAlberta
 - Tuition at UAlberta: \$8,790 (international)
 - ❑ Students present master thesis in Alberta and submits at ETSEIB

Conclusions

- Traveling to other countries (for extended periods of time) is a great way to learn engineering and grow as an individual
- In Canada, master programs are optional and only taken by a selected few
- Master students are trained by a combination of courses and mentorship
- Master students are expected to perform independent research (unless it is a course-based master)
- If you want to experience what it is like to be a graduate student in Canada, there is a program for you
 - ❑ Traveling abroad can lead to new opportunities and career paths

Acknowledgements

Visiting MSc student

Visiting MSc student



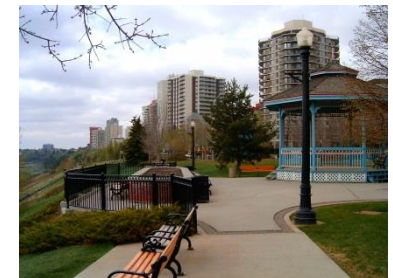
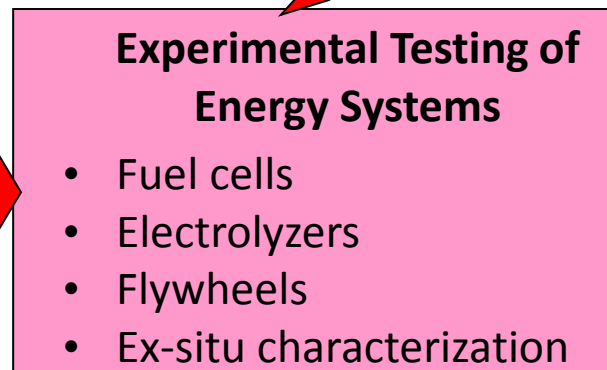
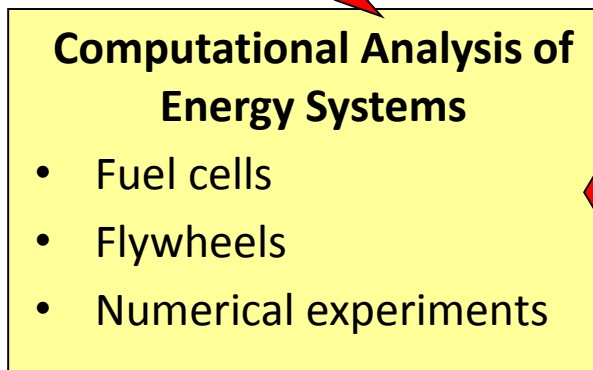
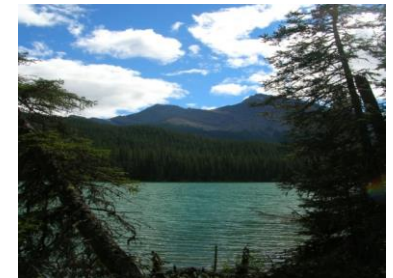
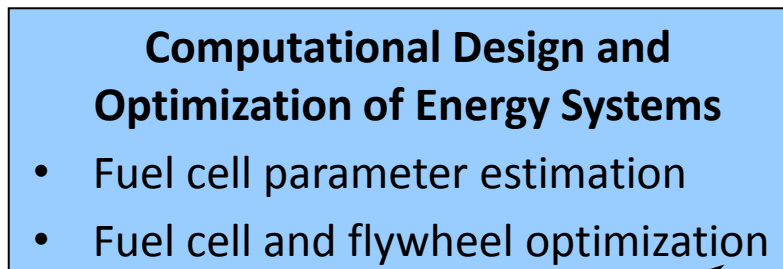
Post-doctoral fellow



THANK YOU

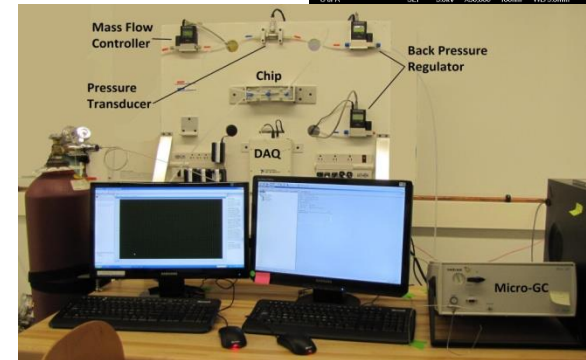
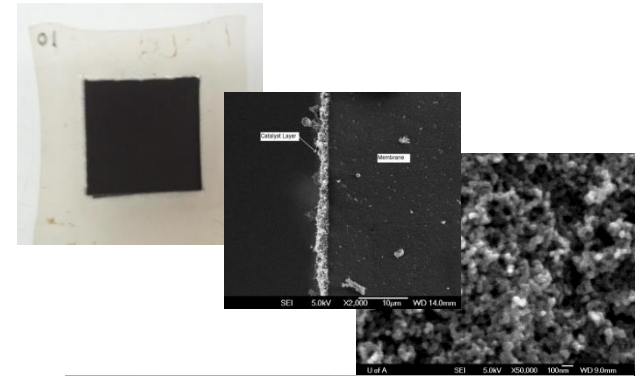
Energy Systems Design Laboratory (ESDLab)

- Located in
 - ❑ University of Alberta (top 5 in Canada)
 - ❑ Edmonton, AB, Canada
 - ❑ 4 hours to Jasper and Banff National Parks
- Three main research areas:



Experimental Facilities

- *Wet laboratory for catalyst layer fabrication*
 - Ultrasonication bath and homogenisers
 - Hot press for decal transfer
 - Automatic film coat applicators
 - Material inkjet printer for CL deposition
 - Access to SEM, TEM, Microfab lab
- *Porous media characterization*
 - Mercury intrusion porosimetry
 - Permeability and effective oxygen diffusivity determination setup
 - Liquid permeation
- *Fuel cell in-situ and ex-situ testing*
 - Fuel cell assembly facilities
 - 2 Fuel cell testing systems
 - 2 Potentiostats/Galvanostats
- *Other*
 - Environmental chamber
 - Access to high performance computing



Course Offerings: Mechanical Engineering

- MEC E 537 Aerodynamics
- MEC E 539 Applied Computational Fluid Dynamics
- MEC E 541 Combustion Engines
- MEC E 551 Mechanics and Control of Robot Manipulators
- MEC E 553 Acoustics and Noise Control
- MEC E 563 Finite Element Method for Mechanical Engineering
- MEC E 564 Design and Simulation of MEMS
- MEC E 569 Mechanics and Design of Composite Materials
- MEC E 606 Photonics Measurement Systems in Fluid Mechanics
- MEC E 607 Optical-Mechanical Sensing
- MEC E 615 Control Methods in Partial Differential Equations
- MEC E 620 Combustion

Course Offerings: Mechanical Engineering (2)

- MEC E630 Fluid Dynamics
- MEC E631 Microfluidics and Nanofluidics
- MEC E632 Turbulent Fluid Dynamics
- MEC E633 Particle Engineering
- MEC E634 Aerosol Science and Technology
- MEC E635 Mechanics of Respiratory Drug Delivery
- MEC E636 Environmental Fluid Mechanics
- MEC E637 Colloidal Hydrodynamics
- MEC E638 Vortex Flows
- MEC E639 Computational Fluid Dynamics
- MEC E640 Analytical Thermodynamics
- MEC E643 Renewable Energy Engineering and Sustainability

Course Offerings: Mechanical Engineering (3)

- MEC E645 Transport and Kinetic Processes in Electrochemical Systems
- MEC E650 Analytical Dynamics
- MEC E651 Advanced Robotics: Analysis and Control
- MEC E653 Signal Processing of Time and Spectral Series
- MEC E655 Dynamics of Structures
- MEC E656 Wave Propagation in Structures
- MEC E662 Introduction to Polymer Microfabrication
- MEC E663 Theory and Applications of Finite Element Method
- MEC E664 Advanced Design and Simulation of Micro and Nano Electromechanical Sensors (MEMS/NEMS)
- MEC E667 Life Cycle Assessment
- MEC E668 Design of Experiments in Mechanical Engineering
- MEC E671 Heat Conduction

Course Offerings: Mechanical Engineering (4)

- MEC E673 Heat Convection
- MEC E680 Continuum Mechanics
- MEC E681 Elasticity
- MEC E682 Nanomechanics
- MEC E683 Statistical Mechanics with Applications
- MEC E684 Static and Dynamic Stability
- MEC E685 Macro Fracture Mechanics
- MEC E687 Introduction to Impact Dynamics of Materials
- MEC E688 Mechanics of Biological Tissues
- MEC E690 Analytical Techniques in Engineering
- MEC E692 Fundamentals of Numerical Analysis

Course Offerings: Engineering Management

- ENG M 501 Production and Operations Management
- ENG M 508 Energy Auditing and Management
- ENG M 510 Quality Engineering and Management
- ENG M 514 Reliability Engineering
- ENG M 516 Maintenance Management
- ENG M 530 Engineering Project Management
- ENG M 540 Intro to Optimization Models and Algorithms
- ENG M 541 Modeling and Simulation of Engg Systems
- ENG M 558 Ergonomics and Work Design
- ENG M 605 Computer-Aided Product Modeling
- ENG M 607 Lean Manufacturing
- ENG M 611 Design/Integration of Standardized Systems

Course Offerings: Engineering Management (2)

- ENG M 612 Quality Assurance and Assessment Systems
- ENG M 620 Engineering Economic Analysis
- ENG M 630 Project Management Techniques
- ENG M 632 Project Risk Management
- ENG M 641 Optimization of Large Scale Linear Problems
- ENG M 643 Energy Simulation and Modeling
- ENG M 646 Engineering Optimization
- ENG M 650 Managing in a Technology Environment
- ENG M 655 Personality Theory and Technical Management
- ENG M 657 Interpersonal Skills for Project Managers
- ENG M 665 Intellectual Property & Tech. Commercialization
- ENG M 666 Knowledge Management