

2019 POLYTECHNIQUE MONTRÉAL WINTER RESEARCH INTERNSHIP

POLYTECHNIQUE
MONTRÉAL

WORLD-CLASS
ENGINEERING



Founded in 1873, **Polytechnique Montréal** is a leading Canadian university for the scope and intensity of its engineering research and industrial partnerships. It is ranked #1 for the number of Canada Research Chairs in Engineering, the most prestigious research funding in the country, and is also first in Québec for the size of its student body and the scope of its research activities. Polytechnique Montréal has laboratories at the cutting edge of technology thanks to funding of nearly a quarter of a billion dollars from the Canada Foundation for Innovation over the past 10 years. In 2017, Montreal ranked **1st for best student cities!**

Research Internship Program

A research internship is a research activity that is an integral part of a visiting student's academic program at the home institution. Each year, Polytechnique's research units welcome more than 250 students from other universities wishing to put into practice the technical and scientific knowledge acquired in their studies. The research conducted is supervised by a professor of Polytechnique and is always related to needs expressed by society or companies, and can be made in laboratories or *in situ*.

Duration

The recommended duration of the internship is a minimum of 4 months, usually taking place between January and May 2019. Other duration or period can be negotiated to suit your university schedule.

Financial Arrangement

- Tuition fee waiver for the duration of the internship;
- Free transportation from the airport to your place of residence upon your arrival;
- Employer Compliance Fee of \$230 CAD covered by Polytechnique Montréal (once the internship is confirmed, the work permit applicant must pay the requested immigration fee).

Outstanding candidates may receive one of the 20 scholarships available! Amount of the scholarship: \$1000 CAD per month for a maximum of 4 months.

Eligibility Criteria

- Being enrolled in one of Polytechnique Montréal's partner universities;
- Having completed at least two years of an engineering undergraduate program or at least one year of a graduate program (Master or Ph.D.) according to projects' requirements as described in the following pages;
- Meet the specific skills required by the supervisor if any;
- Being fluent in French or in English (no language proficiency test is required).

Required Documents for Application

(in French or in English)

- Application Form;
- Letter of motivation including the following information (if you have selected 2 research projects, provide a letter of motivation for each project):
 - explanations of your interest in working in the selected project
 - your skills in respect to the project
- Curriculum vitae (CV);
- Copy of your most recent academic transcript;
- Proof of a full-time enrollment from your home institution (the letter must confirm that you are currently enrolled in a full-time program and will continue to be enrolled upon your return);
- If possible, a copy of an internship report made in the past.

To enhance your chances to be selected, choose 2 research projects. It can be 2 research projects from the list or 1 research project from the list and 1 supervisor from the Directory of Expertise!

Application Deadline

All documents must be sent electronically by **July 20, 2018** to the International Relations Office of Polytechnique Montréal: brin@polymtl.ca. Please specify in the subject "2019 Winter Research Internship Program". Note that a conference call via Skype may be organized if needed for final selection.

Announcement

The results will be announced in September 2018 to each candidate. Selected candidates will receive an "Offer of Employment to a Foreign National Exempt from a Labour Market Impact Assessment (LMIA)" and will have to apply for a Work Permit at the Canadian Visa office that serves the area they live in. It is possible that the new **Public Policy – Short-term (120-day) work permit exemption** for researchers will allow you to be exempted from a work permit.

For any questions regarding your application, please contact:

International Relations Office ■ brin@polymtl.ca

LIST OF RESEARCH PROJECTS

Click on numbers to access project description

Biomedical Engineering

- 1** Elastic Tendons for Artificial Fingers
- 2** Optimization, Fabrication and Test of an Adaptive Self-locking Gripper
- 3** Combined Optical Coherence Tomography and Hyper-spectral Imaging
- 4** Multimodal Optical Endoscopy
- 5** Conducting Polymers for Stretchable Bio Electrodes
- 6** Spatial Light Modulation for Two-photon Oxygen Imaging

Chemical Engineering

- 7** Self-healing Conducting Polymers
- 8** Debromination and Recycling of Styrenic Polymers
- 9** Technico-Economic Analysis of Melt Synthesis Process to Produce C-LiFePO₄
- 10** Methane Partial Oxidation: Design of Catalyst and High Pressure Reformer
- 11** Photochemical Surface Engineering of Nanomaterials

Civil, Geological and/or Mining Engineering

- 12** Development of UHPFRC and Characterization of their Mechanical Properties
- 13** Durability of Fiber Reinforced Concretes in Realistic Conditions Found in Structures
- 14** A Critical Comparison of Household Water End-Use Between Cape Town and Montreal
- 15** Integrated Mine Waste Management to Prevent Acid Mine Drainage (AMD)

- 16** Scale Effects on Hydrogeotechnical Properties of Coarse Waste Rock
- 17** Effect of Climate Change on the Reclamation of Mine Sites
- 18** Mesh-free Particle Modelling of Multiphase Flows
- 19** High Performance Computing and Simulation of Fluid Flow

Computer and Software Engineering

- 20** Engineering and Operations of a Data-Intensive Software System
- 21** Development of an Online Platform for Complex Training in Neuroscientific Research
- 22** Control of Swarms of Mini-quadcopters
- 23** Current Challenges in Robotic Perception, Machine Learning and AI
- 24** Automatic Generation of Behavioral Code for Swarm Robotics
- 25** Refactoring and Optimization of Mesh Generation Software Data Structures
- 26** The Treatment of Autism
- 27** Medical Rehabilitation in VR
- 28** Adaptation of Demos Software in Virtual Reality or Augmented Reality
- 29** Cutting a Mesh used for an Interactive Simulation

Mechanical Engineering

- 30** Design and Fabrication of Differential Cable Robot: Phase II

You didn't find what you were looking for?

- Browse our professors' directory by area of expertise: www.polymtl.ca/recherche/rc/en/expertises.
- Submit the area of expertise you would like to work on and provide the names of 2-3 professors working in this field.
- Explain in your letter of motivation why you would like to do a research internship in this area.
- The International Relations Office will try to find the appropriate match for you!

Here are some ideas:

- | | | |
|-------------------------------------|---------------------------------------|---------------------------------|
| ■ Aerospace Engineering | ■ Electric and Electronic Engineering | ■ Mechanical Engineering |
| ■ Applied Mathematics | ■ Environmental Engineering | ■ Mining and Mineral Processing |
| ■ Artificial Intelligence | ■ Fluid Mechanics | ■ Nuclear Engineering |
| ■ Biomedical Engineering | ■ Fuel and Energy Technology | ■ Physics Engineering |
| ■ Chemical Engineering | ■ Hydrology | ■ Robotics |
| ■ Civil Engineering | ■ Industrial Engineering | ■ Structural Engineering |
| ■ Computer and Software Engineering | ■ Information Technology | |
| ■ Design and Manufacturing | ■ Materials Science and Technology | |

PROJECT DESCRIPTION

2019 Winter Research Internship Scholarship Program

Area of Expertise :	<input type="checkbox"/> Aerospace <input checked="" type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input checked="" type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Combined Optical Coherence Tomography and Hyper-spectral Imaging
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Optical coherence tomography (OCT) is a medical imaging technique which uses laser light to image biological tissues in depth and in 3D. It allows us to visualize tissue structure below the surface up to several millimeters deep into the sample. It is very useful to detect the early development of diseases. However, OCT is less suited to detect the chemical composition of the tissue. In order to improve this, we combine OCT with another optical technique called hyper-spectral imaging (HSI), which is more adapted to detect molecular content. Both of these techniques are combined into endoscopes which can image inside the human body in a non-invasive manner. In particular we focus on imaging the esophagus to detect esophageal cancer which is a very deadly form of cancer.
Tasks during the Internship: <i>(max. 50 words)</i>	The project includes many facets including: optical design, endoscopic probe development & fabrication, software development, data processing, electronic circuits, simulations to predict light/tissue interactions, image processing to convert acquired data back into useful images
Required Skills for the Internship: <i>(max. 50 words)</i>	Basic/intermediate programming (Labview, Matlab, Python or other) for data analysis, image processing & software development, knowledge of optics (geometrical optics, wave optics, fiber optics), experimental rigor, team-work, communication
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Caroline BOUDOUX Title: Associate Professor Department: Engineering Physics Website: http://www.polymtl.ca/expertises/en/boudoux-caroline

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Research Project Title : <i>(max. 10 words)</i>	Multimodal Optical Endoscopy
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Detecting diseases early is often just as important as having effective medicine to fight the sickness. A key part of medical imaging is endoscopy, which allows us to image internal organs and tissues in a non- invasive manner. Currently, many endoscopy procedures use video endoscopes. However, these have limitations as some sub-surface diseases are simply invisible to the camera. Our research focuses on the development of endoscopes which use optical coherence tomography (OCT) to see tissues structures in 3D and up to several millimeters below the surface. Furthermore, we combine this technique with other techniques in order to obtain endoscopes providing the maximum amount of information and strongest sensitivity to various diseases.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	The project includes many facets: optical design, probe design/ fabrication/ characterization, software development, data & image processing, numerical simulations to model and predict light/tissue interactions , electronic circuits
Required Skills for the Internship: <i>(max. 50 words)</i>	Basic/intermediate programming (Labview, Matlab, Python or other) for data analysis, image processing & software development, knowledge of optics (geometrical optics, wave optics, fiber optics), experimental rigor, team-work, communication
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
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Research Project Title : <i>(max. 10 words)</i>	Conducting Polymers for Stretchable Bio Electrodes
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Organic polymers are very attractive candidates for applications at the interface with biology. The main objectives of this internship is to fabricate novel bio electrodes based on conducting polymers, to monitor body signals. The fabrication of the electrode will be performed by electrochemical polymerization or lithographic patterning on flexible and stretchable substrates. The polymers will be processed by electrospinning or solution casting.
Tasks during the Internship: <i>(max. 50 words)</i>	The student will perform microfabrication, electrochemical polymerization as well as of electrochemical measurements (electrochemical impedance spectroscopy, cyclic voltammeter, scanning ion conductance microscopy).
Required Skills for the Internship: <i>(max. 50 words)</i>	Motivation to work in a multidisciplinary field. Background in chemistry, chemical engineering, physics, biomedical engineering or biology.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Fabio CICOIRA Title: Associate Professor Department: Chemical Engineering Website: http://www.polymtl.ca/iontronics/en

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Research Project Title : <i>(max. 10 words)</i>	Spatial Light Modulation for Two-photon Oxygen Imaging
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	This project aims to develop a two photon microscope based on spatial light modulation aimed at in-vivo oxygen imaging applications. Using a phase modulator, femtosecond laser pulses will be shaped spatially to address multiple spatial locations simultaneously. Using recently synthesized phosphorescent probes, oxygen will be quantified in vivo in rodents using the system by measuring phosphorescent lifetime decay.
Tasks during the Internship: <i>(max. 50 words)</i>	Develop the optical design and a control interface for the microscope. Validate spatial resolution, frame rate and signal to noise ratio in phantoms. In preliminary experiments, measure oxygen during in vivo experiments.
Required Skills for the Internship: <i>(max. 50 words)</i>	Optical design, Matlab and C++ programming, signal and image processing.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Frédéric LESAGE Title: Professor Department: Biomedical/Electrical Engineering Website: http://image.liom.polymtl.ca

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Research Project Title : <i>(max. 10 words)</i>	Self-healing Conducting Polymers
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Self-healing materials possess the ability to repair a mechanical damage. We will explore the self-healing properties of conducting polymer films included between two metal electrodes. A voltage will be applied between the electrodes to permit a current flow in the films. The films will be successively cut with a sharp object. The damage will likely interrupt the current flow. If the material is self-healable, the current is expected to recover after a certain time. We will also investigate healing assisted by liquids or vapors. The healing mechanism will be studied by optical microscopy, scanning electron microscopy and Scanning Electrochemical Microscopy.
Tasks during the Internship: <i>(max. 50 words)</i>	The student will perform microfabrication, synthesis of self healing conducting polymers, electrical and electrochemical measurements (electrochemical impedance spectroscopy, cyclic voltammeter, scanning ion conductance microscopy).
Required Skills for the Internship: <i>(max. 50 words)</i>	Motivation to work in a multidisciplinary field. Background in chemistry, chemical engineering, physics or mechanical engineering.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Fabio CICOIRA Title: Associate Professor Department: Chemical Engineering Website: http://www.polymtl.ca/iontronics/en

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Research Project Title : <i>(max. 10 words)</i>	Methane Partial Oxidation: Design of Catalyst and High Pressure Reformer
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>We will produce syngas from natural gas by catalytic partial oxidation (CPOX) of methane. This reaction is not currently in use industrially due to the fact that there is not a technology that allows to operate in an economic convenient way. Its implementation has tremendous advantages:</p> <p>1- It is exothermic, thus the heat generated decreases the energy requirements; 2- the products of the reaction, CO and H₂, are already in the appropriate ratio for Fischer-Tropsch (FT); 3- Air can be used to supply the required reagent and diluent (O₂ and N₂).</p>
Tasks during the Internship: <i>(max. 50 words)</i>	Carry on experiments at high pressure to study the features of the catalyst. Study the effects of the feeding temperature on the overall reaction. Understand if an alternative way to feed the reactants may effect the carbon deposition on the catalyst.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Hard working - High motivation and objects oriented - Strong interest on the topic - Strong motivation on coming up with solution
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Others, please specify: Name: NRC, Ecole Polytechnique Montreal Address: Montreal
Supervisor:	Name: Gregory S. PATIENCE Title: Professor Department: Chemical Engineering Website: http://www.polymtl.ca/expertises/en/patience-gregory-scott

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Research Project Title : <i>(max. 10 words)</i>	Photochemical Surface Engineering of Nanomaterials
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Often, we need the surface of a material to serve a different function from what its native properties allow. In that case, we must engineer the surface to meet the needs of a given process. Photo-initiated chemical vapour deposition (PICVD) shows promise as a scalable process to facilitate surface engineering. Work at Polytechnique Montreal's PhotoSEL (photochemical surface engineering laboratory) has focused lately on adapting this method at near atmospheric pressure and under mild conditions to tailor the surface properties of metal surfaces, polymer substrates and nanoparticles of various types at both small and large scales. This internship would aim to modify nanomaterials in a fluidized bed configuration
Tasks during the Internship: <i>(max. 50 words)</i>	Plan and execute experiments, analyze experimental results, construct/adapt reactor s, write progress reports, present results orally.
Required Skills for the Internship: <i>(max. 50 words)</i>	Reactor engineering (a must), photochemistry (or a desire to learn), nanomaterials (or willingness to learn), chemical analysis (basics)
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Jason Robert TAVARES Title: Associate Professor Department: Chemical Engineering Website: http://www.jasontavares.ca

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Research Project Title : <i>(max. 10 words)</i>	Durability of Fiber Reinforced Concretes in Realistic Conditions Found in Structures
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Durability of concrete structures depends mainly on concrete quality, presence of cracks within concrete and environmental expositions. Durability of concrete is generally evaluate on uncracked concrete specimens, which is not representative of real structure conditions. The goal of the internship will be to realize standard durability tests on cracked concrete specimens in order to provide unique and more realistic information on the durability of structures. The type of activities that will be carried out will be adapted according to the background of the candidate (1st, 2nd or 3rd cycles).
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> • Produce fiber reinforced concrete mixes at the laboratory • Carry out tensile tests to damage concrete specimens and durability tests on damaged specimens (permeability, absorption or migration tests) • Analyze test results • Produce a technical report
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> • Excellent leadership and be autonomous to manage technical activities • Good knowledge of concrete production and properties, lab experience is an asset • Good dexterity and be familiar with manual works to carry out lab activities • Excellent knowledge of Excel and Word software to analyze results
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Jean-Philippe CHARRON Title: Professor Department: Civil, Geological and Mining Engineering Website: http://www.polymtl.ca/expertises/en/charron-jean-philippe

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Research Project Title : <i>(max. 10 words)</i>	Integrated Mine Waste Management to Prevent Acid Mine Drainage (AMD)
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	One of the most critical issues for the mining industry remains the management and safe disposal of the important quantities of solid wastes (mine tailings and waste rock) produced during extraction. These materials often contain sulfides which can oxidize upon contact with oxygen (air) and water, producing acidic effluent with high concentrations of sulfates and heavy metals (known as acid mine drainage, AMD). Reclamation of reactive waste disposal sites is best achieved when it is planned in advance and integrated into the mining production cycle. Integrated mine waste management is therefore at the core of the research carried out at the Research Institute on Mines and Environment (RIME) UQAT-Polytechnique.
Tasks during the Internship: <i>(max. 50 words)</i>	Characterization of hydrogeological, geotechnical and geochemical properties of different mine wastes. Physical model (medium scale) experiments in the laboratory. Support to Master's and PhD students. Initiation to numerical modelling.
Required Skills for the Internship: <i>(max. 50 words)</i>	Basic knowledge in hydrogeology, geotechnical engineering and/or geochemistry. Depending on the student's background and interests, the internship may focus on co-disposal of mine tailings and waste rocks in open pits, valorization of waste rocks in roads, dams and cover systems, and/or effects of climate change on mine sites.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Thomas PABST Title: Assistant Professor Department: Civil, Geological and Mining Engineering Website: http://www.irme.ca/en/

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Research Project Title : <i>(max. 10 words)</i>	Scale Effects on Hydrogeotechnical Properties of Coarse Waste Rock
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Waste rock can contain particles which size ranges from clay size grains to meter wide boulders. The characterization of the hydrogeotechnical properties of such material is therefore very complex. Laboratory tests usually require sieving the material which can modify its properties. To better evaluate the properties of coarse grained materials in the field, new relations between mechanical properties and maximum grain size need to be established and validated. In this project, new and relatively unique geotechnical equipment recently acquired by the Research Institute on Mines and Environment (RIME) UQAT-Polytechnique will be used. Large scale triaxial and shear tests will be carried out on various fractions of waste rock and compared to properties measured in the field.
Tasks during the Internship: <i>(max. 50 words)</i>	Characterization of hydrogeological and geotechnical properties of coarse waste rock. Large scale triaxial (30 cm diameter) and shear box (30 cm diameter, 15 cm height) tests in the RIME-laboratory at Polytechnique. Possibly field work on mine sites. Support to Master's and PhD students. Initiation to numerical modelling.
Required Skills for the Internship: <i>(max. 50 words)</i>	Basic knowledge in geotechnical engineering and hydrogeology. Some laboratory or field experience could be useful. Depending on the student's background and interests, the internship may focus on the use of coarse waste rocks in roads, dams and/or drainage systems.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Thomas PABST Title: Assistant Professor Department: Civil, Geological and Mining Engineering Website: http://www.irme.ca/en/

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Research Project Title : <i>(max. 10 words)</i>	Effect of Climate Change on the Reclamation of Mine Sites
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Mine wastes often contain sulfides which can generate acid mine drainage (AMD), characterized by low pH and high concentrations of sulfates and metals. Reclamation of reactive waste disposal sites are usually based on oxygen barrier covers which are very sensitive to in situ water balance. However, climate models predict an intensification of droughts during summer periods by 2100 in some mining regions of Canada. Longer and more intense drought periods could reduce the performance of reclamation. The objective of this project is therefore to assess the effect of climate change and propose solutions to improve the sustainability of reclaimed mine sites. This project is part of a large research program at the Research Institute on Mines and Environment (RIME) UQAT-Polytechnique.
Tasks during the Internship: <i>(max. 50 words)</i>	Characterization of hydrogeological, geotechnical and geochemical properties of different mine wastes. Physical model (medium scale) experiments in the laboratory. Initiation to numerical modelling. Support to Master's and PhD students. Collaboration with climatologists.
Required Skills for the Internship: <i>(max. 50 words)</i>	Basic knowledge in hydrogeology and/or geochemistry. Depending on the student's background and interests, the internship may focus on laboratory experiments and/or numerical simulations. Therefore, some experience in the lab or with numerical models could be useful.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Thomas PABST Title: Assistant Professor Department: Civil, Geological and Mining Engineering Website: http://www.irme.ca/en/

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Research Project Title : <i>(max. 10 words)</i>	Mesh-free Particle Modelling of Multiphase Flows
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Multiphase flow of water and associate materials (e.g. air, sediment, etc.) in natural and engineering systems such as rivers, estuaries, and coasts play a central role in the economy and environment yet can be the source of many devastating natural and man-made hazards (e.g., floods, tsunamis etc). Due to their multiphase and often high-dynamic nature, they suffer from a lack of accurate and efficient predictive tools. This research aims to develop state-of-art numerical tools, based on a promising generation of numerical techniques, the mesh-free particle methods, to bring a new understanding to these multiphase flow systems.
Tasks during the Internship: <i>(max. 50 words)</i>	Contributing to the development of an existing mesh-free fluid modeling code for simulation of complex multiphase flows with the special focus on complex flow of the water and associate materials in river and coastal systems.
Required Skills for the Internship: <i>(max. 50 words)</i>	Required: Knowledge and relevant expertise in fluid mechanics, and good programming skills is required. Desired (NOT mandatory): Knowledge of the numerical methods and computation of fluid dynamics, and parallel programming
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Ahmad SHAKIBAEINIA Title: Assistant Professor Department: Civil Engineering Website: http://www.polymtl.ca/expertises/en/shakibaeinia-ahmad

PROJECT DESCRIPTION

2019 Winter Research Internship Scholarship Program

Area of Expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input checked="" type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	High Performance Computing and Simulation of Fluid Flow
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The latest advances in computers and the multi-core parallel CPUs (Central processing units) and GPUs (graphics processing units) technologies has provided a unique opportunity for real-life large-scale simulation many fluid flow problems (with a scale ranging from global ocean circulation to flow in a nano-tube). The purpose of this project is to take advantage of such computational powers by developing the high-performance parallel codes and tools for simulation of complex fluid flows, with a focus on water and hydro-environmental problems.
Tasks during the Internship: <i>(max. 50 words)</i>	Contributing to (1) the parallelization of an existing mesh-free fluid simulation code on either parallel CPUs (using MPI programming library) or GPUs (using CUDA-C library) and (2) simulation and study of example hydro-environmental fluid problems
Required Skills for the Internship: <i>(max. 50 words)</i>	Basic knowledge of shared/distributed memory parallel programming, and familiarity with C++ language, and CUDA-C and/or MPI libraries
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Ahmad SHAKIBAEINIA Title: Assistant Professor Department: Civil Engineering Website: http://www.polymtl.ca/expertises/en/shakibaeinia-ahmad

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Research Project Title : <i>(max. 10 words)</i>	Engineering and Operations of a Data-Intensive Software System
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Modern web applications like Facebook, Netflix or Tinder are "data-intensive", i.e., they train and use data mining models to, for example, predict the next Facebook page the user should click on. Each user has her own model, which needs to be updated on-the-fly as new activity of the user and her friends stream in. While algorithmically simple, the software engineering repercussions of updated models are far less clear. Which software architecture do data-aware applications require? What is the optimal deployment strategy to make a new model available to the end user as soon as it is built? How should one manage the operations of such a system?
Tasks during the Internship: <i>(max. 50 words)</i>	The project basically consists of empirical studies on "real" data-intensive web installations. Our lab has significant expertise in such studies as well as the necessary tools and infrastructure. To get up to speed, the project will start with a survey of books and blog posts on data-intensive web applications and release strategies.
Required Skills for the Internship: <i>(max. 50 words)</i>	The student needs the motivation to quickly dive through source code, data and documentation to understand the major components and dependencies of a data-intensive system. The student should be familiar with typical scripting languages and should have the desire to learn R to statistically analyze and visualize data.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Bram ADAMS Title: Associate Professor Department: Computer and Software Engineering Website: http://mcis.polymtl.ca/index.html

PROJECT DESCRIPTION

2019 Winter Research Internship Scholarship Program

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Research Project Title : <i>(max. 10 words)</i>	Development of an Online Platform for Complex Training in Neuroscientific Research
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	In recent years, musical training has emerged as a model paradigm to study how the human brain changes both its structure and function in response to experience (Herholz & Zatorre, Neuron, 2012). Musicianship-related plasticity in the human auditory and motor systems support development, language, and maintain function in aging, however, naturalistic training over longer periods is difficult to control outside of the lab and resource-intensive to undertake within it. This project involves developing an online platform to support neuroscientific studies of complex task learning, within the user's home.
Tasks during the Internship: <i>(max. 50 words)</i>	Working closely with software experts and with neuroscientists, the successful candidate will develop an online platform that allows for piano-like training on the user's computer using the inbuilt keyboard. The system must be responsive (i.e. small, consistent delays), log performance data, and allow for study parameters to be varied.
Required Skills for the Internship: <i>(max. 50 words)</i>	The candidate must have knowledge of software development for online use. He or she must be organized, and able to work in an interdisciplinary team. An interest or willingness to learn about the neuroscience of musical experience is desirable.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Giovanni BELTRAME Title: Associate Professor Department: Computer and Software Engineering Website: www.mistlab.ca

PROJECT DESCRIPTION

2019 Winter Research Internship Scholarship Program

Area of Expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	The Treatment of Autism
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Researchers want to improve the treatment of their autistic patients.</p> <p>Part 1: Develop and publicize population communication tools to improve the understanding of parents, teachers, health professionals, employers and the general population about autism.</p> <p>Part 2: Developing tools to improve coping skills, self-efficacy and independence in adolescents, young adults and adults with autism. Ex.: https://www.youtube.com/watch?v=DgDR_gYk_a8</p>
Tasks during the Internship: <i>(max. 50 words)</i>	Create new VR environments or adapt some VR apps already developed to present an autistic reality to a non-autistic person.
Required Skills for the Internship: <i>(max. 50 words)</i>	C++, OpenGL, Unity3D.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Benoit OZELL Title: Associate Professor Department: Computer and Software Engineering Website: http://www.polymtl.ca/rv/Stages/

PROJECT DESCRIPTION

2019 Winter Research Internship Scholarship Program

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Research Project Title : <i>(max. 10 words)</i>	Medical Rehabilitation in VR
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The Pediatric Rehabilitation Research Center wishes to better intervene with their patients. Neuropsychologists would like to design virtual environments that can be applied in intervention in neuropsychology and psychology (eg classroom, library, street) allowing us to work visual heminegligence, memory impairment secondary to brain damage as well as functions executive (eg organization, working memory, attention) with us patients. The ideal environments would be modifiable according to the cognitive progression of the patients.
Tasks during the Internship: <i>(max. 50 words)</i>	Create new VR environments or adapt some VR apps already developed to better fit the daily work of the medical personnel.
Required Skills for the Internship: <i>(max. 50 words)</i>	C++, OpenGL, Unity3D.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Benoit OZELL Title: Associate Professor Department: Computer and Software Engineering Website: http://www.polymtl.ca/rv/Stages/

PROJECT DESCRIPTION

2019 Winter Research Internship Scholarship Program

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Research Project Title : <i>(max. 10 words)</i>	Adaptation of Demos Software in Virtual Reality or Augmented Reality
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Several software apps have been developed by students attending the Virtual Reality course in the past and it would be relevant to keep and ameliorate a few of these environments (the most interesting ones!) and add them to a demonstration environment suite.
Tasks during the Internship: <i>(max. 50 words)</i>	Understand the purpose of each software app; refactorize as needed; improve a few of them.
Required Skills for the Internship: <i>(max. 50 words)</i>	Unity3D, OpenGL, Direct3D. computer graphics.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Benoit OZELL Title: Associate Professor Department: Computer and Software Engineering Website: http://www.polymtl.ca/rv/Stages/

PROJECT DESCRIPTION

2019 Winter Research Internship Scholarship Program

Area of Expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Cutting a Mesh used for an Interactive Simulation
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The SOFA and Unreal environment is currently used to simulate soft tissue deformities surrounding vertebrae. We want to add features to the library to allow cutting the mesh used representing the soft tissues. The goal is to modify or add a haptic tool to the solver environment in order to simulate a tool that cuts soft tissue: when the tool cuts the fabric, we must modify the mesh to divide elements that were linked to each other. One must therefore find what has to be cut, and separate the elements at this point and restart the simulation.
Tasks during the Internship: <i>(max. 50 words)</i>	Use OpenGL and CUDA/OpenCL to optimize the visual and haptic rendering.
Required Skills for the Internship: <i>(max. 50 words)</i>	C++, OpenGL, computer graphics.
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
Supervisor:	Name: Benoit OZELL Title: Associate Professor Department: Computer and Software Engineering Website: http://www.polymtl.ca/rv/Stages/2-Vertebre_Simulation/

