

# 2021 POLYTECHNIQUE MONTRÉAL WINTER RESEARCH INTERNSHIP

**POLYTECHNIQUE  
MONTRÉAL**  
TECHNOLOGICAL  
UNIVERSITY



Founded in 1873, **Polytechnique Montréal** is a leading Canadian university for the scope and intensity of its engineering research and industrial partnerships. It is highly ranked 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. More than ever, society needs creative and innovative engineers, and that is where Polytechnique and its community truly shine, especially through its active research activities respectful of the health and safety measures issued by the Public Health Agency. Ranked #1 in 2017, Montréal is still among the best student cities in the world!

## 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, with arrivals between January and March. Once the admission to the program has been confirmed, no change in the duration and the dates can be made. Please confirm the research duration with your home institution supervisor before applying.

## Financial Arrangement

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

**Outstanding candidates may receive one of the 30 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;
- Having a minimum GPA of 2.75 out of 4;
- 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):
  - your interest in working in the selected project
  - your skills in respect to the project
- Curriculum vitae (CV);
- Copy of your passport;
- 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 Expertises!

## Application Deadline

All documents must be sent electronically by **July 31, 2020** to Polytechnique Montréal International : [point@polymtl.ca](mailto:point@polymtl.ca). Please specify in the subject "2021 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 early September 2020 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 Short-term (120) work permit exemption for researchers will allow you to be exempted from a work permit.

**For any question regarding your application, please contact:**  
Polytechnique Montréal International ■ [point@polymtl.ca](mailto:point@polymtl.ca)

## LIST OF RESEARCH PROJECTS

Click on numbers to access project description

### Aerospace Engineering

- [1](#) Additive manufacturing of 3D printing of multi-material composite systems
- [2](#) Aeroelastic vibration mitigation via 3D printed devices

### Biomedical Engineering

- [3](#) Deep learning for dynamic ultrasound localization microscopy
- [4](#) Simulation and control of a 3D-printed Exoskeleton of the Upper Limb
- [5](#) Real-time Quantification of Muscle Forces
- [6](#) Control of a Robotic Arm for Assisting Patients with Musculoskeletal Disorders
- [7](#) Standardization of biomaterial surface characterization
- [8](#) Biothermodynamics, tensegrity, resonance applied to biomechanics
- [9](#) Antimicrobial/antiviral filter
- [10](#) Portable artificial respirator
- [11](#) Stretchable, self-healable and printable hydrogel for biomedical applications

### Chemical Engineering

- [12](#) Self Healing Conducting Polymers
- [13](#) Metal oxide ion-gated transistors for sensing applications
- [14](#) Biodegradability and Self-Healing Ability of Conducting Polymers
- [15](#) Fabrication of carbon nanotube electrodes on stretchable substrate by spray coating
- [16](#) Large-Eddy simulation of canonical turbulent flows
- [17](#) GtL micro refinery unit: conversion of methane into liquid hydrocarbons
- [18](#) Fructose transformation to furan in fluidized bed reactor
- [19](#) Surface engineering of materials

### Civil, Geological and/or Mining Engineering

- [20](#) DEM simulations of hydro-mechanical degradation of rockfills
- [21](#) Laboratory experimental testing of partially saturated waste mining rockfill
- [22](#) UHPFRC : From material development to structural applications
- [23](#) Liquefaction triggering procedure for stable continental regions
- [24](#) UBER and taxis in Montreal: tariff schedule and congestion
- [25](#) Rare-earth elements (REE) in acid mine drainage: characterization, fate and recovery
- [26](#) Progressive reclamation of acid generating filtered tailings storage facilities

### Computer and Software Engineering

- [27](#) Multi-Robot Planetary Exploration System
- [28](#) High Fidelity Data Collection for Precision Agriculture with Drone Swarms
- [29](#) Failure-Tolerant Connectivity Maintenance for Robot Swarms
- [30](#) Merging semantic and feature maps
- [31](#) Optimization and implementation of binarized neural networks algorithms
- [32](#) API Usability of Machine Learning Libraries
- [33](#) Intelligent artifact mining for user interaction design
- [34](#) Intelligent mixed-reality solutions for management of user interaction design artifacts
- [35](#) Mining discussions in open source issue tracking systems
- [36](#) Understanding the Dynamics of Recurrent Neural Networks
- [37](#) Benchmarks for Model-Based Reinforcement Learning
- [38](#) Better training methods for Generative Neural Dialogue Systems
- [39](#) An adaptive data science platform for health data
- [40](#) Development of self-adaptive mechanisms of Blockchain platforms
- [41](#) MLOps - Support the development and operations of machine learning applications

### Electrical Engineering

- [42](#) Energy Optimization of Deep Learning Accelerators
- [43](#) Automation, decision-systems, distributed control systems, robotics

### Engineering Physics

- [44](#) Optical nose on chip

### Mathematics/Industrial

- [45](#) Digital twin for hydroelectric generating unit

### Mechanical Engineering

- [46](#) Sensitivity of flame structure to diffusion at various thermochemical states
- [47](#) Pipe Climbing Robot with Adaptive Clamps
- [48](#) Design and fabrication of a lightweight clamp with a twisting string actuation
- [49](#) Design and Experiment of a Bipedal Robot
- [50](#) Novel Twisting String Actuation for Robotic Grippers
- [51](#) Development of simulation tools for geothermal heat pump systems
- [52](#) Simulation and control of a 3D-printed Robot Ping Pong Player

## ADDITIONAL AREAS OF EXPERTISE



### You didn't find what you were looking for?

- Browse our professors' directory by area of expertise: [www.polymtl.ca/recherche/rc/en/expertises](http://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.
- Polytechnique Montréal International will try to find the appropriate match for you!

### Here are some ideas:

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

## PROJECT DESCRIPTION

### 2021 Winter Research Internship Scholarship Program

<b>Area of Expertise :</b>	<input checked="" type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input checked="" type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input checked="" type="checkbox"/> Mechanical <input checked="" type="checkbox"/> Physics
<b>Research Project Title :</b> <i>(max. 10 words)</i>	Additive manufacturing of 3D printing of multi-material composite systems
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Additive manufacturing, or three-dimensional (3D) printing, of composites is a grouping of different shaping processes that allows the fabrication of structures through robotic deposition of material by means of a computer model. This technology is a very promising avenue for the implementation of many mechanical and aerospace systems. My research team focuses on the development of advanced composite materials offering multiple functionalities (where multiple properties are desired for a given application) for additive manufacturing (e.g., FDM, SLA, solvent assisted, extrusion-based). My research team innovates with freeform, multi-material and multi-functional printing of complex mechanical/aerospace systems.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	The intern will assist a senior graduate student (MS or PhD) with the realization of his or her research project. The main tasks are: design of composites, mixing of fillers, characterization of various material properties, tailoring of printing parameters, design of experiments, CAD design, robot programming, and 3D printing.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>• Strong Mechanical/Aerospace Engineering or Material Sciences background</li> <li>• Interest for applied research, 3D printing technologies, CAD, robot programming</li> <li>• Interest for material characterization (e.g., optical microscopy, SEM, mechanical)</li> <li>• Good team worker with good communication skills</li> </ul>
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: Daniel Therriault  Title: Professor  Department: Mechanical Engineering  Website: www.polymtl.ca/lm2/en

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Aeroelastic vibration mitigation via 3D printed devices
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>Continuous flexible systems such as aircraft wings, pipelines, risers, bridges, power towers, and transmission lines are always subjected to unwanted vibrations induced by unsteady wind loading. The typical engineering solution is to add a tuned-mass damper to these structures. This typically works in removing the unwanted resonance, but it creates new problems as it adds two new natural frequencies. Here, we seek to develop a new class of dampers without a natural frequency, making them useful at damping vibrations over a broad spectrum of frequencies.</p> <p>Aeroelasticity, Fluid-Structure Interactions, Non-Linear Energy Sinks, Wind Tunnel Testing</p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<p>You will work with a PhD student to design, fabricate (3D-print, laser-cut, machine), and assemble new mechanisms of non-linear dampers. You will mount and test the effectiveness of these prototypes on a spring-mounted prism in the Polytechnique wind tunnel. You might contribute to modelling the dynamics of your prototypes.</p>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<p>A great interest in dynamics, vibrations and fluid-mechanics is necessary. Prior knowledge of some CAD software (Catia, Solidworks, ProE...) is necessary. Experience in manufacturing (CNC, laser-cutters, 3D-printers...) and in coding (Matlab, C, Fortran, Python...) is an asset. Curiosity is a must!</p>
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a <b>“Confidentiality Agreement”</b> be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an <b>“Assignment of Intellectual Property”</b> be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Frederick Gosselin Title:                      Associate Professor Department:      Mechanical Engineering Website:                www.fgosselin.com

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Deep learning for dynamic ultrasound localization microscopy
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Microvascular dysfunction is central to many of our most pressing healthcare challenges, from heart failure to diabetes and neurodegenerative diseases. 2D vascular imaging using ultrasound has undergone multiple breakthrough innovations over the past 10 years. Recently, a novel technique called ultrasound localization microscopy (ULM) improved spatial resolution of the vasculature from hundreds to a few microns in vivo via the detection at thousands of frames per second of millions of individual microbubbles injected in the blood stream, enabling in vivo vascular images of unprecedented resolution with any imaging modality at large depth.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	The objective of the internship is to develop novel deep-learning tools to enhance the image formation process in dynamic ultrasound localization microscopy. - 60-70% of time: algorithm development + programming (matlab and/or python) - 30-40% of time: literature review, phantom development, and animal experiments
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	- leadership + independence - ability to work in a multidisciplinary environment - programming (or willingness to learn) - signal processing (or willingness to learn)
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Jean Provost  Title:                        Assistant Professor  Department:            Engineering Physics  Website: <a href="https://www.polymtl.ca/expertises/en/provost-jean">https://www.polymtl.ca/expertises/en/provost-jean</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Simulation and control of a 3D-printed Exoskeleton of the Upper Limb
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>According to <a href="https://magicarms.org/">https://magicarms.org/</a>, for the millions of children with neuromuscular disorders, debilitating weakness in the arms and shoulders makes everyday tasks nearly impossible. And no satisfying commercial solution has ever existed for them. But with the emerging innovative 3D-printed exoskeletons, the impossible becomes possible. We have developed an innovative gravity-balancing actuated upper limb exoskeleton, available to children who need it, thanks to 3D-printing (rapid prototyping). The objective of this project is to simulate and control this innovative exoskeleton of the upper limb, based on our expertise and infrastructure on rapid prototyping, robotics, and upper limb musculoskeletal modeling.</p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<p>Get familiarized with our upper limb exoskeleton model (and v-rep with C++, CAD) ; Simulate and control this innovative exoskeleton of the upper limb, for new populations, and analyze it; Prepare a demo video showing the ability of the exoskeleton; Technical Report.</p>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<p>Knowledge in robotics, C++ and CAD Software, ideally Solidworks; Interest in musculoskeletal modeling (biomechanics); Knowledge of musculoskeletal modeling (biomechanics) is a plus; Priority will be given to candidates enrolled in a mechanical engineering prog., a biomedical engineering prog. or an electrical engineering prog.</p>
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a <b>“Confidentiality Agreement”</b> be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Will the signature of an <b>“Assignment of Intellectual Property”</b> be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Others, please specify: Name: Technopole en réadaptation pédiatrique Address: 522 rue Bélanger Est, Montréal (Qc) H1T 1C9
<b>Supervisor:</b>	Name: Maxime RAISON / Sofiane ACHICHE Title: Full Professors Department: Mechanical Engineering Website: <a href="http://polymtl.ca/expertises/en/achiche-sofiane">polymtl.ca/expertises/en/achiche-sofiane</a> <a href="http://polymtl.ca/expertises/en/raison-maxime">polymtl.ca/expertises/en/raison-maxime</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Real-time Quantification of Muscle Forces
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	The major problem to assess individual muscle forces is to solve the muscle force redundancy problem, as several muscles overactuate each human body joint. To solve this problem, a novel non-invasive method was proposed by the lab by using musculoskeletal modeling and electromyographic (EMG) data. The objective is to contribute to the development of a novel tool for real-time quantification of muscle forces based on musculoskeletal modeling and electromyography, by either extending the musculoskeletal model or transforming the process in real-time, or both.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Get familiarized with our musculoskeletal modeling in MATLAB and ROBOTRAN ( <a href="http://www.robotran.be">www.robotran.be</a> ), efficient multibody dynamics software; Contribute to the development of a novel tool for real-time quantification of muscle forces based on musculoskeletal; Extend the musculoskeletal modeling; Technical Report.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Basic knowledge of coding in MATLAB but C++ is a plus; Basic knowledge about musculoskeletal modeling (biomechanics); Knowledge of optimization and ordinary differential equations is a must; Priority will be given to candidates enrolled in a computer science program or an electrical engineering program.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Others, please specify: Name:        Technopole en réadaptation pédiatrique Address:    522 rue Bélanger Est, Montréal (Qc) H1T 1C9
<b>Supervisor:</b>	Name:                      Sofiane ACHICHE / Maxime RAISON  Title:                      Full Professors  Department:    Mechanical Engineering  Website: <a href="http://polymtl.ca/expertises/en/achiche-sofiane">polymtl.ca/expertises/en/achiche-sofiane</a> <a href="http://polymtl.ca/expertises/en/raison-maxime">polymtl.ca/expertises/en/raison-maxime</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Standardization of biomaterial surface characterization
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>The reproducibility of results in different independent laboratories today presents inconsistencies that decrease the technology development process time.</p> <p>The need to create standardization protocols for biomaterial analysis, suggests an opportunity to evaluate the reproducibility of the synthesis and characterization processes of new biomaterials, such as antibacterial / antiviral filters, protection masks, etc.</p> <p>This project proposes the interdisciplinary collaboration between two research centers, which develop standardization guidelines in the analysis of materials in joint projects between both laboratories.</p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>- literary review of characterization techniques such as XPS, TOF-SIMS, AFM, FTIR</li> <li>- Protocol development</li> <li>- Materials characterization</li> <li>- Interpretation of results</li> </ul>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<p>Background: Materials science, biomaterial, chemical engineering</p> <p>Basis of characterization of materials</p> <p>Leadership, responsibility, teamwork, ability to work independently</p> <p>Good communication written and spoken in English</p>
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a “<b>Confidentiality Agreement</b>” be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Will the signature of an “<b>Assignment of Intellectual Property</b>” be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	<p>Name: L'Hocine Yahia</p> <p>Title: Professor (expertise in biomedical engineering)</p> <p>Department: Mechanical department</p> <p>Website: <a href="https://www.polymtl.ca/liab/en">https://www.polymtl.ca/liab/en</a></p>

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## PROJECT DESCRIPTION

### 2020 Summer Research Internship Scholarship Program

<b>Area of Expertise :</b>	<input type="checkbox"/> Aerospace <input checked="" type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input checked="" type="checkbox"/> Mathematics/Industrial <input checked="" type="checkbox"/> Mechanical <input checked="" type="checkbox"/> Physics
<b>Research Project Title :</b> <i>(max. 10 words)</i>	Biothermodynamics, tensegrity, resonance applied to biomechanics
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>A new paradigm has emerged that suggests long muscle chains could act similarly to organized muscle synergies, providing sensory neuromotor input and are linked together anatomically via soft tissue viscoelastic myofascial envelopment</p> <p>The term biotensegrity was adapted by Levin who hypothesized that pre-stressed tensional integrity could be the mechanism by which the body creates stability within different systems and organs, particularly the spine. Often locomotion involves resonance. Resonance helps to obtain maximum amplitudes at minimum input energy.</p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<p>-Literature review : Low back pain (LBP), resonance in biology, 3rd law of biothermodynamics, tensegrity applied to the spine</p> <p>-mechanism of action LBP, spine -Specification scope -Develop a mathematical model for the spine -Validate the model</p>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Biomechanics, Thermodynamics, complex systems, maths relative to spine, locomotion and low back pain. Person with leadership and team player skills, autonomous, motivated and with good communications. Detail oriented, active learner. Critical analysis.
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a “<b>Confidentiality Agreement</b>” be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “<b>Assignment of Intellectual Property</b>” be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: L'Hocine Yahia Title: Professor (expertise in biomaterials, biomechanics and bion Department: Mechanical department Website: <a href="https://www.polymtl.ca/liab/en">https://www.polymtl.ca/liab/en</a>

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## PROJECT DESCRIPTION

### 2021 Winter Research Internship Scholarship Program

<b>Area of Expertise :</b>	<input type="checkbox"/> Aerospace <input checked="" type="checkbox"/> Biomedical <input checked="" type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input checked="" type="checkbox"/> Mechanical <input checked="" type="checkbox"/> Physics
<b>Research Project Title :</b> <i>(max. 10 words)</i>	Antimicrobial/antiviral filter
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	The project aim to design an antibacterial/antivirus air filter suitable for the commercial aeronautical industry. Indeed, current filters generally consist of matrices with defined pores, the particles are captured in a direct, inertial or diffuse manner. However, by combining these three mechanisms, it is established that the interval for which the filters are least effective is that of 0.1 to 0.3 µm (note that the sizes of bacteria can vary between 0.1-4µm and the viruses between 0.01-0.3 µm). The solution must replace or integrate with a HEPA filter on a commercial aircraft, have antibacterial/antiviral capability, meet standards established in the commercial aircraft industry, and be at least as effective as the HEPA filters used today while remaining accessible to air carriers in terms of cost and level of maintenance.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Litterature review (filters, antibacterial/antiviral strategies) - Review current mechanical design of filters - Suggest new approaches (redesign the filter, apply coating...) - Design a filter that filter out bacteria, viruses and other unwanted particles and neutralize the bacteria/viruses that accumulate in the filter. Test and validate the solution.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Surface characterization techniques (SEM, TEM, XPS, TOF-SIMS...) CAD-Blender Person with leadership and team player skills, autonomous, motivated and with good communications. Detail oriented, active learner. Critical analysis.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a “ <b>Confidentiality Agreement</b> ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an “ <b>Assignment of Intellectual Property</b> ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: L’Hocine Yahia  Title: Professor (expertise in biomaterials, biomechanics and bion  Department: Mechanical Department  Website: <a href="https://www.polymtl.ca/liab/en">https://www.polymtl.ca/liab/en</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Portable artificial respirator
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	the artificial respirator with non-invasive ventilation: this involves designing a miniaturized artificial respiration system. Respirators are medical assistive devices used to provide artificial ventilation to the lungs of a patient. The relevance of this project is to design a portable respirator since the current respirators are of large sizes. There are many applications for this project, even outside of a global pandemic. For example, the respirator designed could be used as a home emergency respirator for people with predispositions to respiratory complications or for patients who are receiving treatment at home, since current respirators are quite expensive, at \$ 5,000 to \$ 50,000 US.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Electro-Mechanical design of the respiratory diffusion unit. Design of the graphical interface. Tests and Validation
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Labview CAD - Blender Person with leadership and team player skills, autonomous, motivated and with good communications. Detail oriented, active learner. Critical analysis.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: L’Hocine Yahia  Title: Professor (expertise in biomaterials, biomechanics and bion  Department: Mechanical Department  Website: <a href="https://www.polymtl.ca/liab/en">https://www.polymtl.ca/liab/en</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Stretchable, self-healable and printable hydrogel for biomedical applications
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Conducting polymer poly(3,4-ethylenedioxythiophene):poly(styrene sulfonate) (PEDOT:PSS) has been widely-used in the wearable electronics and bioelectronics due to its high conductivity, stability, ease of processability and biocompatibility. However, most applications rely on the PEDOT:PSS thin films, which are totally mismatched to biological tissue physically and mechanically. Thus, this project targets the conductive hydrogels, which are soft and similar to tissues, solving the mismatch between the tissue/electronics interface. PEDOT:PSS will be used as the conductive medium in the presence of polyvinyl alcohol (PVA) network. The ionic liquids or electrolytes will be added to enhance the mechanical property and ionic conduction.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	The rheology and swelling of hydrogel will be studied for injectable and printable bioelectronics. The electrochemical property will be studied by electrochemical workstation, and quartz crystal microbalance. The hydrogel will be printed as the channels for transistors and patch electrodes for Electromyography signal recording.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Motivation to work in a multidisciplinary fields. Background in chemistry (especially organic chemistry), chemical engineering, physics or mechanical engineering.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a “ <b>Confidentiality Agreement</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an “ <b>Assignment of Intellectual Property</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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<b>Supervisor:</b>	Name: Fabio Cicoira  Title: Associate Professor  Department: Chemical Engineering  Website: <a href="https://www.polymtl.ca/iontronics/en">https://www.polymtl.ca/iontronics/en</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Self Healing Conducting Polymers
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <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
<b>Tasks during the Internship:</b> <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).
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Motivation to work in a multidisciplinary field. Background in chemistry, chemical engineering, physics or mechanical engineering.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: Fabio Cicoira  Title: Associate Professor  Department: Chemical Engineering  Website: <a href="https://www.polymtl.ca/iontronics/en">https://www.polymtl.ca/iontronics/en</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Metal oxide ion-gated transistors for sensing applications
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Ion-gated transistors (IGTs) are attractive for chemo- and bio-sensing, wearable electronics and bioelectronics, because of their ability to detect the ions, and low voltage operation (< 1 V). Metal oxides are of interest as transistor channel materials in IGTs due to their high mobility, chemical stability and ease of process in the air at relatively low temperatures. TiO <sub>2</sub> and SnO <sub>2</sub> are the abundant metal oxides and can be used as a channel material in n-type IGTs. IGTs use ionic gating media (ionic liquids, polymer electrolytes and aqueous electrolytes) to modulate the charge carrier density in the transistor channel.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Preparation of metal oxide thin films (TiO <sub>2</sub> and SnO <sub>2</sub> ) through hydrothermal and sol-gel synthesis. Assembly of ion-gated transistors (including the preparation of gating medium and gate electrode). Transistor and electrochemical testing of metal oxide thin films
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Experience in wet-chemical techniques such as solution processing method for the preparation of metal oxide films (not mandatory).
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a “ <b>Confidentiality Agreement</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an “ <b>Assignment of Intellectual Property</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: Fabio Cicoira  Title: Associate Professor  Department: Chemical Engineering  Website: <a href="https://www.polymtl.ca/iontronics/en">https://www.polymtl.ca/iontronics/en</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Biodegradability and Self-Healing Ability of Conducting Polymers
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	This research attempts to seal current knowledge gaps on the biodegradability of conducting polymers, and to develop performant conducting polymer-based devices using biodegradable constituents e.g. substrates, electrodes and electrolytes, with the devices' localization at end-of-life in mind. Furthermore, this project aims to enumerate on conducting polymer poly(3,4-ethylenedioxythiophene)-poly(styrenesulfonate) (PEDOT: PSS) inherent properties such as electronic self-healing ability and conductivity enhancement through blending with additives.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Screen-printing of transistors, characterization of transistor performance, self-healing analysis of screen-printed conducting polymers, respirometry (biodegradability analysis) of polymers (at NRC)
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Chemical analysis, laboratory techniques, electronic device characterization, motivation, organization skills (not mandatory) . Strong motivation (required).
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>"Confidentiality Agreement"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>"Assignment of Intellectual Property"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Others, please specify: Name:          National Research Council Canada (NRC) Address:      6100 Royalmount Ave, Montreal, QC H4P 2R2
<b>Supervisor:</b>	Name:                  Fabio Cicoira  Title:                    Associate Professor  Department:      Chemical Engineering  Website: <a href="https://www.polymtl.ca/expertises/en/cicoira-fabio">https://www.polymtl.ca/expertises/en/cicoira-fabio</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Fabrication of carbon nanotube electrodes on stretchable substrate by spray coating
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Recently, demand for stretchable and low-cost electronic devices have encouraged many researchers to use methods with scaling up possibilities. In construction of conventional organic transistors metal electrodes are being used as a source and drain electrode. Fabrication of metal electrodes needs photo-lithography procedure which is time consuming and costly procedures. Here, we will fabricate carbon nanotube (CNT) based electrodes instead of metal electrodes through deposition of CNT on substrate by spray coating method.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Using spray coating method for deposition of CNT on the substrate. Transistor characterization.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	To be familiar with organic electronics. To have a good team work ability. Student in chemical or material engineering, chemistry or physics.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a “ <b>Confidentiality Agreement</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an “ <b>Assignment of Intellectual Property</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: Fabio Cicoira  Title: Associate Professor  Department: Chemical Engineering  Website: <a href="https://www.polymtl.ca/iontronics/en/people">https://www.polymtl.ca/iontronics/en/people</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Large-Eddy simulation of canonical turbulent flows
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Hydrodynamic turbulence remains a fundamental challenge in engineering. Outside of the classical examples of the reduction of drag in transportation, the dynamic of turbulence plays a considerable role in other engineering applications. In chemical engineering, a better understanding of turbulent fluid motion is necessary to improve thermo-fluid equipment (i.e heat-exchangers) and to predict the kinetics and yields in reactors whether they be in a plug-flow state or within continuously stirred vessels. In general, this accuracy cannot be reached by traditional Reynolds Averaged Navier-Stokes model and this requires the use of Large Eddy Simulation (LES), which can capture the turbulent cascade.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>- Benchmark an open-source high-order computational fluid dynamics software on canonical turbulent flows</li> <li>- Develop and program post-processing capacities (in C++ and Python)</li> <li>- Develop guidelines for implicit LES simulation of turbulent flows</li> </ul>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Applicants should be curious, autonomous and have a keen interest for simulation, fluid mechanics and computational fluid dynamics. Some basic knowledge of the Linux command shell (bash) and some programming experience (C++, Python) are suggested as this project will require some software development.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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<b>Supervisor:</b>	Name:                      Bruno Blais  Title:                      Assistant Professor  Department:            Chemical Engineering  Website: <a href="https://www.polymtl.ca/expertises/en/blais-bruno">https://www.polymtl.ca/expertises/en/blais-bruno</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	GTL micro refinery unit: conversion of methane into liquid hydrocarbons
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Gas-To-Liquid (GTL) processes convert light hydrocarbons like natural gas from oil production, landfills, and bio-sources, to liquid fuels and chemicals   methanol, diesel, dimethyl ether, and gasoline. Often, the first step produces syngas, a mixture of hydrogen and carbon monoxide, and the most common second step is the polymerization/hydrogenation of CO to high molecular weight hydrocarbons via Fischer Tropsch synthesis
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	The intern will support the team working on building and operating the micro unit. Fluid dynamic tests, catalytic tests, data acquisition, experimental planning and literature research will be part of the work.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Team-work. Process simulation (Aspen). Catalysis.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a “ <b>Confidentiality Agreement</b> ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an “ <b>Assignment of Intellectual Property</b> ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Gregory Patience  Title:                      Full Professor  Department:          Chemical Engineering  Website: <a href="https://www.polymtl.ca/expertises/en/patience-gregory-scott">https://www.polymtl.ca/expertises/en/patience-gregory-scott</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Fructose transformation to furan in fluidized bed reactor
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Biomass is the new oil. The components of lignocellulosic biomass are promising biological raw materials for the synthesis of functionalized compounds. Fructose represents a high potential raw material for synthesizing 5-hydroxymethyl furfural (HMF), 2,5-furandicarboxylic acid (FDCA), levulinic acid (LEV), furfural (FUR), dimethyl furfural (DFF) and lactic acid. We developed a fluidized bed reactor for the oxodehydration of hexoses into 2,5-furandicarboxylic acid (FDCA), which is a monomer for the manufacture of green plastic (polyethylene furanoate ). We tested some catalysts in different conditions and characterized them.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	After carrying out a full experiment plan (more than 30 experiments), the student will develop a kinetic model in order to better understand the reaction. He will participate in the writing of an article.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	The student must have the basics in chemical engineering (kinetics, organic, catalysis...), know how to analyze and solve a problem by himself. And knowing how to respect essential safety in a laboratory.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a “ <b>Confidentiality Agreement</b> ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an “ <b>Assignment of Intellectual Property</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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<b>Supervisor:</b>	Name:                      Gregory S. Patience  Title:                      Profesor  Department:          Chemical engineering  Website: <a href="https://www.polymtl.ca/expertises/en/patience-gregory-scott">https://www.polymtl.ca/expertises/en/patience-gregory-scott</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Surface engineering of materials
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Often, we need the surface of a material to serve a different function from what its native properties allow. Photo-initiated chemical vapour deposition (PICVD) and Dip-dip-dry (DDD) show promise as scalable processes to facilitate surface engineering, to meet the needs of a various processes. Work at Polytechnique Montreal's PhotoSEL (photochemical surface engineering laboratory) has focused on adapting these methods to tailor the surface properties of metal surfaces, polymers and nanoparticles of various types at both small and large scales. This internship would aim to modify a variety of surfaces finding use in agriculture, advanced materials, 3D printing, and water harvesting.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Plan and execute experiments, analyze experimental results, construct/adapt reactors, write progress reports, present results orally.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Reactor engineering (a must), photochemistry (or a desire to learn), nanomaterials (or willingness to learn), chemical analysis (basics)
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      TAVARES, Jason Robert  Title:                      Associate Professor  Department:          Chemical Engineering  Website:                jasontavares.ca or via LinkedIn

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## PROJECT DESCRIPTION

### 2021 Winter Research Internship Scholarship Program

<b>Area of Expertise :</b>	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Civil, Geological, Mining <input type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input type="checkbox"/> Physics
<b>Research Project Title :</b> <i>(max. 10 words)</i>	DEM simulations of hydro-mechanical degradation of rockfills
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>Rockfills are largely used in civil engineering works, such as dams, coarse drains and mine waste rock dumps, for instance. However, data on their mechanical properties are quite scarce because of the lack and high cost of the required large laboratory devices.</p> <p>The main scope of the project is to study the micromechanics of the hydromechanical degradation of rockfills subjected to extreme environmental conditions, in order to develop numerical predictive discrete models for rockfills.</p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	A series of DEM simulations in an existing numerical model will be carried out in order to study the effects of particle shape, grading and particle crushing in the mechanical response.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Knowledge in soil mechanics, brittle solid fracture and computer numerical simulations.
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a “<b>Confidentiality Agreement</b>” be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “<b>Assignment of Intellectual Property</b>” be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: Carlos Ovalle Title: Assistant Professor Department: Civil, Geological and Mining Engineering Website: <a href="https://www.polymtl.ca/expertises/en/ovalle-carlos">https://www.polymtl.ca/expertises/en/ovalle-carlos</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Laboratory experimental testing of partially saturated waste mining rockfill
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>Rockfills are largely used in civil engineering works, such as dams, coarse drains and mine waste rock dumps, for instance. However, data on their mechanical properties are quite scarce because of the lack and high cost of the required large laboratory devices.</p> <p>The main scope of the project is to study particle size effects on the mechanical degradation of rockfills subjected to extreme environmental conditions. A series of shearing and compression tests will be carried out on large laboratory devices.</p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Carry-out a series of shearing and compression tests on a direct shear for samples sized 300/300/150mm and a large triaxial cell for samples of 300mm in diameter and 600mm in height.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Knowledge in laboratory experimental geotechnics.
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a “<b>Confidentiality Agreement</b>” be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “<b>Assignment of Intellectual Property</b>” be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: Carlos Ovalle Title: Assistant Professor Department: Civil, Geological and Mining Engineering Website: <a href="https://www.polymtl.ca/expertises/en/ovalle-carlos">https://www.polymtl.ca/expertises/en/ovalle-carlos</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	UHPFRC : From material development to structural applications.
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	In the last decade ultra-high performances fiber reinforced concretes (UHPFRC) have been developed. They present very high mechanical properties, and very low porosity and permeability. One UHPFRC have been developed at Polytechnique Montreal. The goal of the internship will be either : to modify the UHPFRC mix in order to reduce its CO2 emissions and increase its mechanical properties by using special mineral admixture, or to develop and test in laboratory structural applications designed with the UHPFRC. The types of activities to be carried out will be adapted according to the academic background of the candidate (1st, 2nd or 3rd cycles).
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>• Produce UHPFRC mixes or structural applications at the laboratory</li> <li>• Measure UHPFRC properties at fresh and hardened states with standard lab. tests or measure the structural behavior of applications with specific tests</li> <li>• Analysis of results and production of a technical report</li> </ul>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>• Excellent leadership and be autonomous to manage technical activities</li> <li>• Good knowledge of concrete production and properties, lab experience is an asset</li> <li>• Good dexterity and be familiar with manual works to carry out lab activities</li> <li>• Excellent knowledge of Excel and Word software in order to analyze results</li> </ul>
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a “ <b>Confidentiality Agreement</b> ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an “ <b>Assignment of Intellectual Property</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Jean-Philippe Charron  Title:                      Full Professor in Civil Engineering  Department:          Civil, Geological and Mining Engineerings  Website: <a href="https://www.polymtl.ca/expertises/charron-jean-philippe">https://www.polymtl.ca/expertises/charron-jean-philippe</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Liquefaction triggering procedure for stable continental regions
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Simplified liquefaction triggering procedures based on previous observations of liquefaction in active tectonic regions, are routinely used in practice. These procedures correlate the soil's resistance to penetration to its cyclic resistance, and compare it to the demand induced by the design earthquake. However, some of the assumptions are not applicable to stable continental regions (SCR), and using such procedures might lead a mis-estimation of the liquefaction hazard. For instance, the design earthquake is modified to account for duration effects using a magnitude scaling factor (MSF) derived based on recordings from active tectonic regions that are significantly different from recordings in SCR.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>- Literature review on the existing liquefaction simplified procedure</li> <li>- Analyze recorded ground motions in SCR</li> <li>- Modify the simplified method to use in SCR, including creating a new MSF</li> <li>- Formulate recommendation for the use of such procedures in practice</li> </ul>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>- Elementary knowledge of soil behavior (i.e. the student must have followed an undergraduate soil mechanics class)</li> <li>- Minimum coding skills are required (the student will use Matlab)</li> <li>- Understanding of basic statistical analysis</li> </ul>
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a <b>"Confidentiality Agreement"</b> be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an <b>"Assignment of Intellectual Property"</b> be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: Samuel Yniesta Title: Assistant Professor Department: Civil, Geological and Mining Engineering (CGM) Website: samuel.yniesta.com

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	UBER and taxis in Montreal: tariff schedule and congestion
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	In 2018, the Economist reported that the ride-hailing sector (including companies such as UBER and Lyft) has led to more congestion, vehicle-miles travelled and deaths on the road in the US. By using a theoretical model of tariff and road congestion, we project to calibrate the model with data for Montreal, Quebec. The objective is to determine whether the social cost of ride-hailing induced congestion and vehicle-miles travelled justifies restricting the number of ride-hailing cars on the streets, as New York did. This brings back the old question of “medallions”, or supply control in the taxi industry, jeopardized by the entry of ride-hailing services.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Get familiar with the literature. Formulate a research question. Develop and/or adapt a theoretical model of competition between the ride-hailing and taxi industries, considering tariff and congestion. Collect Montreal-specific data to calibrate the model. Run the model under various scenarios. Analyse the results.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	At least one course in microeconomics Autonomous in Matlab or a similar program (R, Mathematica, Python, etc.)
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a “ <b>Confidentiality Agreement</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an “ <b>Assignment of Intellectual Property</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Sophie BERNARD (and Geneviève BOISJOLY)  Title:                      Associate professor (and assistant professor)  Department:    Industrial (and civil)  Website:                www.polymtl.ca/expertises/en/bernard-sophie

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Rare-earth elements (REE) in acid mine drainage: characterization, fate and recovery
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>Rare-earth elements (REE) are strategic minerals that are used in many sectors of the economy and have contributed to technological advances in many areas. In reality, these are not rare elements and constitute about 0.08% of the Earth's crust. However, their hydrometallurgical treatment is complex and the source of important contamination. A promising approach consists in recovering REE elements from acid mine drainage (AMD) generated in base metals and gold mines.</p> <p>This project is a collaboration with UQAT (Canada), Seoul National University (SNU) and Korea Institute of Geoscience and Mineral Resources (KIGAM).</p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<p>Characterization of leachate from different AMD generating mine sites.</p> <p>Numerical simulations of REE reactive transport in mine waters.</p> <p>Evaluation and small scale testing of recovery approaches (laboratory).</p>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<p>Basic knowledge in geochemistry and hydrogeology.</p> <p>Depending on the student's background and interests, the internship may focus on REE speciation and transport, laboratory testing and/or numerical developments.</p> <p>Opportunities also for graduate students.</p>
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a <b>"Confidentiality Agreement"</b> be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Will the signature of an <b>"Assignment of Intellectual Property"</b> be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Thomas Pabst  Title:                      Professor, Scientific Director of RIME Polytechnique  Department:          Civil, Geological and Mining Engineering Department  Website: <a href="http://www.irme.ca/en/">http://www.irme.ca/en/</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Progressive reclamation of acid generating filtered tailings storage facilities
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>One of the most critical issues faced by the mining industry is the management and safe disposal of the large quantities of mine wastes produced during operations. Geotechnical instabilities of tailings storage facilities still regularly occur. Filtered tailings management (i.e. dewatering) presents many advantages, such as an improved water recovery and greater mechanical properties. However, filtered tailings are more susceptible to generate acid mine drainage (AMD) and therefore require the development of innovative progressive reclamation approaches.</p> <p>This project is a collaboration with the Norwegian Geotechnical Institute (NGI, Oslo).</p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Hydrogeotechnical characterization of filtered tailings produced at partner mine sites. Set up of laboratory physical models to evaluate water balance in filtered tailings storage facilities. Calibration and validation of numerical simulations. Quantitative evaluation and comparison of various reclamation techniques.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Basic knowledge in mining engineering, geotechnique and/or hydrogeology. Depending on the student's background and interests, the internship may focus on tailings geotechnical behaviour, risk analysis and/or simulations of water balance. Opportunities also for graduate students.
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a <b>"Confidentiality Agreement"</b> be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Will the signature of an <b>"Assignment of Intellectual Property"</b> be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: Thomas Pabst Title: Professor, Scientific Director of RIME Polytechnique Department: Civil, Geological and Mining Engineering Department Website: <a href="http://www.irme.ca/en/">http://www.irme.ca/en/</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Multi-Robot Planetary Exploration System
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	The aim of this project is to develop the software infrastructure needed for one (or more) human(s) and a swarm of robots to collaborate in the exploration of hardly accessible planetary environments. We are currently working with NASA and ESA to develop a multi-robot mission to explore a lava tube on the moon. As the robots advance, they shall map the environment, place themselves so that network connectivity is guaranteed, and relay data. The overall goal is to increase the performance as well as the safety of the humans involved in the exploration.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Help in the preparation of a field mission for the exploration of a lava tube on the island of Lanzarote: write code, perform experiment with rovers and flying robots.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Python and/or C/C++ skills are preferable. If you are new to programming, don't worry you can learn to code with robots at MIST lab.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>"Confidentiality Agreement"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>"Assignment of Intellectual Property"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Giovanni Beltrame  Title:                      Professor  Department:      Computer and Software Engineering  Website: <a href="https://mistlab.ca">https://mistlab.ca</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	High Fidelity Data Collection for Precision Agriculture with Drone Swarms
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	The world needs more food. What can we do to improve the way food is produced? This project proposes to improve productivity and sustainability by increasing the precision of the data collected with the use of Artificial Intelligence (Deep Convolutional Neural Networks) powered autonomous drone swarms capable to fly among crops. There are many exciting challenges to be overcome here: SLAM, Visual Inertial Odometry, Image Segmentation (and Classification), Sensor Fusion and drone design/optimization. Much of the work developed here will be useful for other cool research fields like self-driving cars, industrial robots, search and rescue, and even space exploration!
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	We will have many cool and exciting possible tasks where the intern will be able to learn more about: TensorFlow (deep learning/machine learning), dataset creation and augmentation, operating/building drones (UAVs), ROS/Robotics and electronics in general, Buzz (robot swarms), Computer Vision and Motion Tracking.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	The skills will depend on the task, but in general terms the minimum skills are: Python (the deeper the better), C/C++ (basic knowledge is fine), sh/bash, Linux (Ubuntu/Debian), linear algebra (for computer vision and machine learning) and basic knowledge on electronics (for operating/building drones).
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Giovanni Beltrame  Title:                      Professor  Department:    Computer Engineering  Website:              http://mistlab.ca

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Failure-Tolerant Connectivity Maintenance for Robot Swarms
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	In many real-world applications, robots need communication between each other to coordinate. For the information to propagate, robots need to be connected, i.e. there has to be a communication path between all the robots in a team. We have designed a decentralized connectivity-preserving algorithm and validated using the ARGOS multi-robot simulator. The connectivity-preserving algorithm has to be ported on to a fleet of Khepera IV (ground robots) and CrazyFlies (small indoor drones).
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Develop software for a group of ground robots and small indoor drones, and port the connectivity maintenance algorithm from simulation to reality.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Python and/or C/C++ skills are preferable. If you are new to programming, don't worry you can learn to code with robots at MIST lab.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>"Confidentiality Agreement"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>"Assignment of Intellectual Property"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Giovanni Beltrame  Title:                      Professor  Department:      Computer and Software Engineering  Website: <a href="https://mistlab.ca">https://mistlab.ca</a>

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## PROJECT DESCRIPTION

### 2021 Winter Research Internship Scholarship Program

<b>Area of Expertise :</b>	<input checked="" type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input checked="" type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input checked="" type="checkbox"/> Mechanical <input type="checkbox"/> Physics
<b>Research Project Title :</b> <i>(max. 10 words)</i>	Merging semantic and feature maps
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Mapping is the fundamental requirement for autonomous robot navigation, which is also important for operators to visualize and understand the environment. With the help from machine learning, semantic meaning can enhance a map with high-level knowledge of the world. In this project, we want to merge the semantic meaning into a point cloud map to build a 3D semantic map. In other words, combine the objects recognized with a given point cloud, i.e. some points stand for a chair and some other points stand for a table. Given this high-level map, robots can navigate based on the compact path planning commands, i.e. go to the table.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Use the robots in the lab to get semantic meaning and 3D point maps. Explore the way to fuse these information together.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Python and/or C/C++ skills are preferable. Knowledge about robots navigation and/or mapping will help a lot. If you are new about these, don't worry you can learn to code with robots at MIST lab.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>"Confidentiality Agreement"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>"Assignment of Intellectual Property"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Giovanni Beltrame  Title:                      Full Professor  Department:      Department of Computer and Software Engineering  Website: <a href="https://mistlab.ca/">https://mistlab.ca/</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Optimization and implementation of binarized neural networks algorithms
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>My students and I are working on the efficient implementation of neural networks on FPGAs, processors and GPUs. We are particularly interested in binary neural networks, deep neural networks (DNN) and convolutional neural networks (CNN). Our laboratory is equipped with multiple prototyping systems in the field of FPGAs, GPUs, microcontrollers and processors. This is an excellent opportunity to train in the field of artificial intelligence (AI). The student will proceed to the implementation and optimization of AI algorithms. They will also measure the performances. The results could lead to publication in a conference or international journal.</p> <p><a href="https://scholar.google.com/citations?user=yVubPz4AAAAJ&amp;hl=en&amp;oi=sra">https://scholar.google.com/citations?user=yVubPz4AAAAJ&amp;hl=en&amp;oi=sra</a></p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<p>Write code for Artificial Intelligence (AI)</p> <p>Test algorithms for AI</p> <p>Write report/paper</p>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<p>Some background in AI (neural networks)</p> <p>Python, ideally some background with PyTorch</p> <p>C/C++</p>
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a “<b>Confidentiality Agreement</b>” be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Will the signature of an “<b>Assignment of Intellectual Property</b>” be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Jean Pierre David  Title:                      Professor  Department:          Electrical Engineering  Website: <a href="https://www.polymtl.ca/expertises/david-jean-pierre">https://www.polymtl.ca/expertises/david-jean-pierre</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	API Usability of Machine Learning Libraries
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	API usability specifies how easy, efficient, error-preventing, and pleasant an API of a software library is from its users' perspective. With machine learning (ML) techniques becoming increasingly powerful and pervasive, many non-programmers and casual users (e.g. domain experts in medicine or geography) started to explore ML libraries. However, many find them challenging to use because of bad API design. This project aims to investigate the API of ML libraries through the lens of user-centered design. The knowledge gathered will help developers of ML libraries improve their APIs and establish preliminary methodologies to evaluate API usability of ML libraries.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	We will focus on (1) conducting usability analysis on popular machine learning libraries, (2) comparing the API usability among several libraries, and (3) creating and evaluating heuristics for fixing API usability problems in machine learning libraries.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>- Motivated learner, critical thinker, and team contributor</li> <li>- Programming skill in python</li> <li>- Knowledge about one or more machine learning library</li> <li>- Knowledge and/or interests about user-centered approaches and usability</li> </ul>
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a “ <b>Confidentiality Agreement</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an “ <b>Assignment of Intellectual Property</b> ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Jinghui Cheng  Title:                      Assistant Professor  Department:      Computer and Software Engineering  Website:              http://jhcheng.me

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Intelligent artifact mining for user interaction design
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	User-centered design (UCD) is widely adopted to create interactive systems that satisfy user needs and characteristics. During this process, designers create and access a large number of design artifacts, including sketches, design examples, and mockups. With little tool support, however, designers are usually frustrated when managing a huge collection of artifacts. This project aims at addressing this challenge by using computer vision techniques to identify patterns and relationships among design artifacts. This knowledge will enable new technologies that help interaction designers organize, reuse, and retrieve design knowledge from these artifacts.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	We will explore (1) automated methods for identifying interactive elements in the design artifacts (images of UI design), (2) automated matching of the interactive elements and their relationships to established interaction design patterns (e.g. those in Tidwell's patterns), (3) design of tools that leverage these methods.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>- Motivated learner, critical thinker, and team contributor</li> <li>- Experience and/or skills in machine learning and computer vision techniques</li> <li>- Programming skill in python</li> <li>- Knowledge and/or interests in user-centered interaction design</li> </ul>
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>"Confidentiality Agreement"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>"Assignment of Intellectual Property"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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<b>Supervisor:</b>	Name:                      Jinghui Cheng  Title:                      Assistant Professor  Department:          Computer and Software Engineering  Website: <a href="http://jhcheng.me">http://jhcheng.me</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Mining discussions in open source issue tracking systems
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Open source software (OSS) development teams often use Issue Tracking Systems (ITs) to manage bug reports, new feature requests, tasks to be completed, and other affairs or cases during the development process. Most modern ITs for OSS projects allow users to add comments to issues. Over time, these comments accumulate into discussion threads embedded with rich information about the software project, which can potentially satisfy the diverse needs of OSS stakeholders. However, discovering and retrieving relevant information from the discussion threads is a challenging task, especially when the discussions are lengthy and the number of issues in ITs are vast.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	We will explore the design of a role-based, AI-enabled, human-in-the-loop tool to support diverse OSS stakeholders in discovering and retrieving information that is relevant to their goals and needs from the ITs. We will design and implement both the back-end algorithms and the user interaction of the tool.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>- Motivated learner, critical thinker, and team contributor</li> <li>- Knowledge and/or experience in open source development</li> <li>- Knowledge and/or interests in natural language processing</li> <li>- Web app development skills (e.g. HTML, CSS, Node.js, Angular, MongoDB)</li> <li>- Experience and/or interests in user-centered interaction design techniques</li> </ul>
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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<b>Supervisor:</b>	Name:           Jinghui Cheng  Title:           Assistant Professor  Department:   Computer and Software Engineering  Website:       http://jhcheng.me

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Understanding the Dynamics of Recurrent Neural Networks
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Recurrent Neural Networks are one of the most successful classes of architectures for sequential problems. However, they are difficult to train due to the problem of vanishing and exploding gradients. This project aims to understand the learning dynamics of RNNs to improve their training. We will explore the challenges in training very deep RNNs with the goal of achieving better performance than Transformer networks.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Implementing recurrent architectures, analyze their learning, design new algorithms for training RNNs.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Basic Machine Learning knowledge, experience in using pyTorch, experience with RNNs.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Others, please specify: Name:        Quebec AI Institute (Mila) Address:    6666, St Urbain St, Montreal, Quebec H2S 3H1
<b>Supervisor:</b>	Name:                      Sarath Chandar  Title:                      Assistant Professor  Department:    Department of Computer and Software Engineering  Website: <a href="http://sarathchandar.in">http://sarathchandar.in</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Benchmarks for Model-Based Reinforcement Learning
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Model-based Reinforcement Learning (MBRL) is one of the longstanding goals of Reinforcement Learning. Learning the model of the world has several benefits when the agent has to deal with multiple tasks. However, most of the existing MBRL benchmarks only focus on sample efficiency in a single task. The goal of this project is to design challenging benchmarks for MBRL which involves multiple tasks and transfer learning between these tasks.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Designing new benchmark tasks, implementing the tasks in openAI Gym format, implementing and benchmarking existing MBRL methods with the new benchmark.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Basic Deep Learning and Reinforcement Learning knowledge, experience in using pyTorch, strong coding skills.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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<b>Supervisor:</b>	Name:                      Sarath Chandar  Title:                        Assistant Professor  Department:    Department of Computer and Software Engineering  Website: <a href="http://sarathchandar.in">http://sarathchandar.in</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Better training methods for Generative Neural Dialogue Systems
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Designing neural language generation models for dialogue systems is one of the challenging problems in Natural Language Processing. The search for useful objective functions for the models to optimize that can improve the quality of the generated text is still an open research problem. In this ongoing research, we will explore alternative objective functions that neural dialogue models can use to improve their performance on specific objectives.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Implementing neural dialogue models, understanding their limitations, proposing new objective functions for training neural dialogue models, benchmarking the proposed solutions using standard dialogue datasets.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Basic ML and NLP knowledge, experience in implementing sequence-to-sequence models, experience in using pyTorch, strong coding skills.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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<b>Supervisor:</b>	Name:                      Sarath Chandar  Title:                      Assistant Professor  Department:    Department of Computer and Software Engineering  Website: <a href="http://sarathchandar.in">http://sarathchandar.in</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	An adaptive data science platform for health data
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Millions of patient records are now easily accessible by medical professionals and they can be shared and examined easily and securely to facilitate diagnosis and treatment. Nevertheless, this availability comes with challenges including great volume and variability of data and increased need for security and privacy. These challenges require modern solutions to allow the efficient storage and analytics of the data, its controlled and secure accessibility. The objective of this project is to prototype tools for a modern and adaptive data science platform that will allow efficient storage and secure access to patient records, flexible analytics, and management of machine learning models that enable the analyses of the records.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<ol style="list-style-type: none"> <li>1. Data cleaning of patient records and other health data.</li> <li>2. Evaluation of NoSQL platforms for data storage.</li> <li>3. Design and development of data ingestion software architectures</li> </ol>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ol style="list-style-type: none"> <li>1. Big Data (NoSQL)</li> <li>2. Cloud computing (Docker)</li> <li>3. Data analytics (Spark, Kafka)</li> </ol>
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Marios Fokaefs  Title:                      Assistant Professor  Department:      Computer and Software Engineering  Website:              www.polymtl.ca/expertises/en/fokaefs-marios-elefterios

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Development of self-adaptive mechanisms of Blockchain platforms
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>Full title: Development of self-adaptive mechanisms of the management of performance, energy consumption and security of Blockchain platforms</p> <p>Blockchain could address three main concerns in distributed systems including confidentiality, integrity, and availability. Although Blockchain could be the solution for addressing several user privacy and reliability challenges, the technology itself can prove rather inefficient due to its high energy consumption and processing overheads, which are undesirable for large scale distributed systems. High power consumption can lead to system failures, which by default will compromise the system's reliability, integrity and availability.</p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<ol style="list-style-type: none"> <li>1. Improvement of workload generation engine for IoT devices.</li> <li>2. Development of driver software for the ingestion of data in various Blockchain platforms.</li> <li>3. Experiments and evaluation of Blockchain platforms under the given workload.</li> </ol>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ol style="list-style-type: none"> <li>1. Blockchain</li> <li>2. Data science</li> <li>3. Programming (bash, python)</li> </ol>
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a <b>"Confidentiality Agreement"</b> be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an <b>"Assignment of Intellectual Property"</b> be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
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<b>Supervisor:</b>	Name:                      Marios Fokaefs Title:                      Assistant Professor Department:          Computer and Software Engineering Website:                www.polymtl.ca/expertises/en/fokaefs-marios-elefterios

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	MLOps - Support the development and operations of machine learning applications
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Software configuration management (SCM) is a formal process that guides the development and evolution of software. Among others, the process includes tasks such as version control, change management, and release engineering. SCM is part of the general software quality assurance (SQA) process. DevOps specifies several tasks and tools to implement and facilitate the SCM for continuous integration, continuous deployment and continuous delivery. Currently, the SCM and SQA of software and AI models are separate, which does not allow the full potential of AI applications to be fully exploited. For this reason, our goal is to integrate and combine SCM and SQA with software and AI aspects against quality indexes and version control.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<ol style="list-style-type: none"> <li>1. Conduct an empirical study on open-source ML/AI projects and identify how they handle the evolution of models, data and software at the same time.</li> <li>2. Develop tools to support the parallel evolution of models, data and software.</li> </ol>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ol style="list-style-type: none"> <li>1. DevOps</li> <li>2. AI/ML</li> <li>3. Data Science</li> <li>4. Programming (python, Java)</li> </ol>
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Marios Fokaefs  Title:                      Assistant Professor  Department:      Computer and Software Engineering  Website:              www.polymtl.ca/expertises/en/fokaefs-marios-elefterios

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Energy Optimization of Deep Learning Accelerators
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Algorithms based on deep neural networks achieve outstanding performance on a long list of difficult tasks such as image classification and segmentation, speech recognition, playing complex games, and many others. However, to obtain such outstanding results, very large networks are required, containing several million parameters or more. As a result, such algorithms require a significant amount of energy to run, making it difficult to deploy them on portable systems, as well as representing an economic and environmental burden. Our research work seeks to dramatically reduce this energy consumption by building deep learning accelerators based on energy-efficient but unreliable circuits.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Your tasks during the internship will be adjusted based on your level and preference for software- or hardware-level work, and can include developing custom training routines and/or new deep neural network architectures, and developing and analyzing hardware architectures.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	You must be already familiar with either: python programming and training deep neural networks OR digital system design, verification and VHDL/verilog coding. Knowledge of introductory statistics (random variables, probability distributions, etc.) is also required.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name: François Leduc-Primeau  Title: Assistant Professor  Department: Department of Electrical Engineering  Website: <a href="https://www.gr2m.polymtl.ca/en/francois-leduc-primeau-en/">https://www.gr2m.polymtl.ca/en/francois-leduc-primeau-en/</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Automation, decision-systems, distributed control systems, robotics
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Internships are possible that are related to my group's activities on - decision-making under uncertainty - multi-agent and networked control systems - application of mean-field games to multi-agent systems - control under information constraints - autonomous robotic networks - safe control of autonomous systems with machine learning in the loop - intelligent bi-directional human-robot interfaces Interested applicants can contact me to discuss in more details.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Tasks can range from theoretical studies to experimental robotics. TBD based on the profile of the candidate.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Some training in one area among: control theory, robotics, signal processing, machine learning for perception, applied mathematics, human-machine interaction, etc.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>"Confidentiality Agreement"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>"Assignment of Intellectual Property"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Le Ny, Jerome  Title:                      Associate professor  Department:          Electrical Engineering  Website: <a href="http://www.profsesseurs.polymtl.ca/jerome.le-ny/">http://www.profsesseurs.polymtl.ca/jerome.le-ny/</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Optical nose on chip
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>Optical noses integrated on chip present numerous advantages over electronic noses such as low power requirements, robustness, and immunity to electromagnetic fields, remote sensing and lower price. Miniaturized on-chip sensor, designed to detect air-borne compounds, are essential for inexpensive monitoring systems that are portable and deployable on a large scale. We demonstrated that it can monitor several volatile organic compounds (VOCs), that it operates in a reversible fashion, under different environmental conditions, and that it detects concentrations in the order of parts per million (ppm). See: <a href="http://polymtl.ca/carrefour-actualite/en/innovatio/optical-nose-analyzing-gas-mixtures">polymtl.ca/carrefour-actualite/en/innovatio/optical-nose-analyzing-gas-mixtures</a></p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<p>Assembly of the optical nose. Taking optical measurements on different gas compositions.</p>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	optical experiments, gas handling, polymer synthesis, electronic control, data acquisition
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a “<b>Confidentiality Agreement</b>” be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “<b>Assignment of Intellectual Property</b>” be required?  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Yves-Alain Peter Title:                      Professor Department:          Engineering Physics Website: <a href="http://www.polymtl.ca/pomp/en">www.polymtl.ca/pomp/en</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Digital twin for hydroelectric generating unit
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	<p>We are developing the Digital Twin of a hydro unit, which will combine live sensor data with physics-based modeling through artificial intelligence to achieve real-time simulation. It will allow predicting failures, optimizing maintenance schedules, and simulate scenarios of usage and wear of the equipment.</p> <p>To this end, we are using Physics-Informed Neural Networks and Proper Generalized Decomposition to develop reduced-order models of academic model systems exhibiting some of the same physics as hydro units. At the same time, we are designing, building and instrumenting experimental setups to validate the models.</p>
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	You will join a team to work on the modeling or the experimental side of the project according to your strength and interests. Your tasks will vary between deriving equations, coding models, training neural networks, running simulations or designing, sizing, manufacturing, assembling and testing an experimental setup.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<p>Skills are optional, motivation and will to learn are mandatory!</p> <p>Modeling: coding (python, matlab, C), vibration and dynamics, finite element analysis, neural networks, reduced order modeling.</p> <p>Experimenting: CAD (Catia, Solidworks), designing, machining, instrumentation.</p>
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a <b>“Confidentiality Agreement”</b> be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Will the signature of an <b>“Assignment of Intellectual Property”</b> be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Frederick Gosselin Title:                      Associate Professor Department:      Mechanical Engineering Website:              www.fgosselin.com

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Sensitivity of flame structure to diffusion at various thermochemical states
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	The aim of the study is to understand the role of diffusion on the structure of flames at autoignitive conditions, with a focus on its sensitivity to thermochemical conditions. This problem is of direct relevance to modern internal combustion engines and gas turbines, in which combustion takes place at high, autoignitive temperatures. Under these conditions, flames evolve through both self-sustained propagation (owing to diffusion) and autoignition, which can lead to drastic variations in the flame structure. Predicting these variations is essential to enable the development of new clean combustion strategies in internal combustion engines and gas turbines.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Perform a series of simulations of laminar flames at autoignitive conditions, go through a short literature review on the topic, develop a clear analysis of the results using, e.g., Python, generate meaningful graphs, write a comprehensive report and make use of appropriate theory to support the analysis.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	An engineering background with a strength in at least one of the following topics is desired: combustion, chemistry, thermodynamics, programming, fluid mechanics. High marks in any of the courses taken on the above topics is expected.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Bruno Savard  Title:                      Assistant Professor  Department:      Mechanical Engineering  Website:              www.polymtl.ca/expertises/en/savard-bruno

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Pipe Climbing Robot with Adaptive Clamps
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	The aim of the project is to create a robot who can crawl along pipes of varying diameters. The robot will use two adaptive clamps alternately: when one clamp is grasping the pipe, the other is released and translated in the direction of the motion. The robot will move like a caterpillar/worm. The clamps have been designed during previous projects and are based on underactuated graspers that can adapt to pipes of various sizes. However to design the mobile robot, an actuation/release mechanism is required as well as a translation stage.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Design of the robot and its controller. Fabrication of a prototype, benchmark and testing.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>- Solid mechanics, CAD</li> <li>- Control of small power electric motors using embedded microcontrollers</li> <li>- Good with DIY techniques and general fabrication, experience with 3D printing</li> </ul>
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Lionel Birglen  Title:                      Professor  Department:    Department of Mechanical Engineering  Website:              www.polymtl.ca/labrobot/en/

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Design and fabrication of a lightweight clamp with a twisting string actuation
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	A twisting string actuation (TSA) device uses wire(s) attached to a motor to produce a pulling force onto a load. When the motor rotates the wires are twisting around each and the overall length of these wires is reduced thereby providing the actuation force. Compared to traditional transmission unit, TSA are very lightweight and generate a large mechanical advantage. The aim of the project is to design a lightweight TSA system to actuate an underactuated clamp to create a portable grasping device.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Mathematical modeling of the TSA and design of the underactuated grasper. Design optimization with respect to the weight. Fabrication of a prototype and experiments.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	- Solid mechanics, CAD software - Familiarity with Matlab - Fabrication, 3D printing
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a “ <b>Confidentiality Agreement</b> ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an “ <b>Assignment of Intellectual Property</b> ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Lionel Birglen  Title:                        Professor  Department:    Department of Mechanical Engineering  Website:                www.polymtl.ca/labrobot/en/

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Design and Experiment of a Bipedal Robot
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	The aim of this project is to improve the design of one of our robotic leg (see <a href="https://youtu.be/2zo5aSJEjHY">https://youtu.be/2zo5aSJEjHY</a> ). This leg is able to mechanically adapt its walking pattern in reaction to a collision without any sensor or high-level control. The objective of this internship is to update the mechanical design of the leg (reinforcements and stiffeners are needed) and duplicate this revised version to obtain a bipedal robot. Then, a testbed consisting of various simple terrains will be needed to evaluate the efficiency of the resulting robot when traversing these terrains. Experiments will be conducted to collect data about the most efficient walking gaits and robot configuration.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>- CAD, solid mechanics and stress of materials</li> <li>- Dynamic simulations (possibly)</li> <li>- Prototyping and data collection</li> </ul>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ul style="list-style-type: none"> <li>- Mechanical Design (Catia or Inventor preferred)</li> <li>- Dynamic and FEM Simulations (MSc Adams / Ansys preferred)</li> <li>- Good practical skills (mechanical assembly, electronic soldering, etc.)</li> <li>- Excellent analytical skills</li> </ul>
<b>Confidentiality and Intellectual Property *</b>	<p>Will the signature of a <b>“Confidentiality Agreement”</b> be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Will the signature of an <b>“Assignment of Intellectual Property”</b> be required?  <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Lionel BIRGLEN  Title:                      Full Professor  Department:      Mechanical Engineering  Website: <a href="http://www.polymtl.ca/labrobot/en/">http://www.polymtl.ca/labrobot/en/</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Development of simulation tools for geothermal heat pump systems
<b>University Cycle :</b>	<input type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input checked="" type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Design and simulation of geothermal systems rely on accurate predictions of soil and fluid temperature variations due to the operation of the heat pump over the system's life-span. Typically, temperatures are calculated from the spatial and temporal superposition of analytical thermal response functions, considering the heat extraction and rejection history of the system since the start of operation. The temporal superposition method is critical to the accuracy of temperature predictions and computational efficiency of the simulation. The objective of this project is to implement and assess the accuracy and efficiency of higher order temporal superposition techniques.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	<ol style="list-style-type: none"> <li>1. Identify and implement higher order temporal superposition techniques for the simulation of geothermal systems</li> <li>2. Assess the accuracy and computational efficiency of the implemented methods, and recommend parameters for practical simulations</li> </ol>
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	<ol style="list-style-type: none"> <li>1. Knowledge of Object-Oriented Programming (Python)</li> <li>2. Experience or relevant courses in : Heat transfer, Numerical methods in engineering, Partial differential equations</li> </ol>
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>"Confidentiality Agreement"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  Will the signature of an <b>"Assignment of Intellectual Property"</b> be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Others, please specify: Name: Address:
<b>Supervisor:</b>	Name:                      Massimo Cimmino  Title:                      Asisstant Professor  Department:          Mechanical Engineering  Website: <a href="https://www.polymtl.ca/expertises/en/cimmino-massimo">https://www.polymtl.ca/expertises/en/cimmino-massimo</a>

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<b>Research Project Title :</b> <i>(max. 10 words)</i>	Simulation and control of a 3D-printed Robot Ping Pong Player
<b>University Cycle :</b>	<input checked="" type="checkbox"/> 1 <sup>st</sup> cycle (Undergraduate) <input type="checkbox"/> 2 <sup>nd</sup> cycle (Master) <input checked="" type="checkbox"/> 3 <sup>rd</sup> cycle (Ph.D.)
<b>Background Information:</b> <i>(max. 100 words)</i>	Our lab has developed several affordable assistive robotic devices and computer vision solutions to control them. To merge these innovations, an idea came to develop a 3D-printed serial Robotic Ping Pong Player, and beat some World records in ping pong game (maximal number of ping pong shots, in either one minute or with no time limit), as a technological showcase. The objective of this project is to simulate (potentially in V-rep/CoppeliaSim) and control (potentially with Arduino-Dynamixel) this Ping Pong Robot, on the basis of our expertise and infrastructure on robotics, computer vision, rapid prototyping, and upper limb musculoskeletal modeling.
<b>Tasks during the Internship:</b> <i>(max. 50 words)</i>	Get familiarized with our Ping Pong Robot (and v-rep/CoppeliaSim with C++, CAD) ; Simulate and control this Ping Pong Robot, attempt to beat previous records and analyze them; Prepare a demo video showing the ability of the Ping Pong Robot Technical Report.
<b>Required Skills for the Internship:</b> <i>(max. 50 words)</i>	Knowledge in robotics, Arduino, and computer vision; Interest in v-rep/CoppeliaSim with C++, multibody dynamic equations, 3D printing, and CAD Software, ideally Solidworks ; Priority will be given to candidates enrolled in a mechanical engineering program, or an electrical engineering program.
<b>Confidentiality and Intellectual Property *</b>	Will the signature of a <b>“Confidentiality Agreement”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  Will the signature of an <b>“Assignment of Intellectual Property”</b> be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>Location:</b>	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Others, please specify: Name: Technopole en réadaptation pédiatrique Address: 522 rue Bélanger Est, Montréal (Qc) H1T 1C9
<b>Supervisor:</b>	Name: Maxime RAISON / Sofiane ACHICHE  Title: Full Professors  Department: Mechanical Engineering  Website: <a href="http://polymtl.ca/expertises/en/achiche-sofiane">polymtl.ca/expertises/en/achiche-sofiane</a> <a href="http://polymtl.ca/expertises/en/raison-maxime">polymtl.ca/expertises/en/raison-maxime</a>

*\* Please consult your advisor at the Office of Research & Centre for Technological Development to determine whether the proposed project raises issues with regard to confidentiality or intellectual property.*