RESEARCH INTERNSHIP PROGRAM

POLYTECHNIQUE MONTRÉAL

TECHNOLOGICAL UNIVERSITY

UT TENSIO SIC VIS

POLYTECHNIQUE MONTRÉAL

WINTER 2022

Polytechnique Montréal is one of Canada's leading applied-research universities. Highly ranked for the number of Canada Research Chairs in Engineering and the scope of its research activities, the university obtains the highest research funding among engineering schools in the country. Founded in 1873, Polytechnique has the largest engineering student body in Quebec, 30% of which are women. Over the last 10 years, the Canada Foundation for Innovation has funded Polytechnique's laboratories nearly a quarter of a billion dollars. The world needs creative and innovative engineers more than ever. Polytechnique is producing them, in Montreal – ranked among the top student cities in the world for the last 5 years!

RESEARCH INTERNSHIP PROGRAM

A research internship is an integral part of an international student's academic program at the home institution. Every year, Polytechnique's research units welcome over 250 students from other universities wishing to put into practice the technical and scientific knowledge acquired in their studies. The research conducted, respectful of the health and safety measures issued by the Public Health Agency, and supervised by a Polytechnique professor, emanates from a real societal or industrial need, and is made in the lab or *in situ*.

DURATION

The recommended duration of the internship is a minimum of 4 months, with 5 possible starting dates between January and March. Once the admission to the program has been confirmed, no change in the duration or 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 20 scholarships available! Maximum amount of the scholarship: $4000 CAD (calculated according to the duration of your stay).

ELIGIBILITY CRITERIA

- Enrolled in one of Polytechnique Montréal's partner universities

- 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

- Minimum GPA of 2.75 out of 4

- Specific skills required by the supervisor if any

- 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 clearly stating your GPA or cumulative average;

- Proof of 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 after your internship);

- If available, a copy of an internship report made in the past.

> To enhance your chances to be selected, choose 2 research projects (from the list or 1 research project from the list and 1 supervisor from the Directory of Expertise)

APPLICATION PROCEDURE

Click **here** to apply and send all required documents by July 31, 2021.

Note that an online conference call may be organized for final selection.

ANNOUNCEMENT

The results will be announced early September 2021 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.

LIST OF RESEARCH PROJECTS

AEROSPACE ENGINEERING

1. Reduced order model of cyclic symmetric structures with Code Aster
2. Numerical optimization of aircraft engine blades robust to contact interactions

BIOMEDICAL ENGINEERING

3. Epidermal patch electrodes for bioelectronics
4. Biodegradable conducting polymers
5. Self Healing Conducting Polymers
6. Simulation and control of a 3D-printed Exoskeleton of the Upper Limb
7. Control of a Robotic Arm for Assisting Patients with Musculoskeletal Disorders
8. Real-time Quantification of Muscle Forces

CHEMICAL ENGINEERING

9. Flexible organic rectifiers
10. Sustainable ion-gated transistors
11. Catalytic Depolymerisation of Poly(Methyl Methacrilate) to Methacrylic Acid
12. Capital cost estimation of plastic recycling plants-PMMA
13. Wet and molt agglomeration in a fluidized bed
14. Process dynamics and control of Fischer-Tropsch in Micro Refinery Unit
15. Oxi-dehydration of fructose to high-value added chemicals
16. Recycling Technologies for Polymer Automotive Components
17. Catalytic partial oxidation of natural gas at high pressure
18. Novel Catalyst Design and their activity in Fischer Tropsch Synthesis
19. Extrusion catalytic depolymerization of PMMA
20. Coatings for Surface Organic Fouling and Sulfur Corrosion Materials Protection
21. Surface engineering of materials

CIVIL, GEOLOGICAL AND/OR MINING ENGINEERING

22. Numerical modeling of open pit filling for mining closure
23. Environmental safety of Slag Steel Filters Regarding Metals Leaching Behavior
24. Biological resin and Gravity-driven membrane filtration for drinking water treatment
25. Evaluation of pathogenic content in bioaerosols from wastewater treatment plants
26. Screening of wastewater treatment plants as a source of legionellosis cases
27. UHPFRC : From material development to structural applications
28. Effect of mineralogy on cement stabilized tailings hydrogeochemical behaviour
29. Stability of acid generating mine wastes disposed of in open pits
30. Effect of climate change on the performance of mine drainage treatment systems

COMPUTER AND SOFTWARE ENGINEERING

31. The Cognifly project
32. Semantics-based Collaborative Simultaneous Localization and Mapping
33. The Cognifly battery swap station
34. Augmenting user experience (UX) design of open source software
35. Intelligent image mining for user interaction design
36. Intelligent text mining of open source discussions
37. API Usability of Machine Learning Libraries

ELECTRICAL ENGINEERING

38. Planning and Operations for Electric Power Systems with Renewables
39. Simulating 5G Applications in very large smart cities
40. Problems in Green networking
41. Ultra reliable telecommunication networks
42. Algorithms for IP/optical network defragmentation
43. Communication System Design for Deep Space Networks: The Role of Metasurfaces
44. Secure Satellite Communication Systems: Design of Physical Layer Security Solutions
45. Binarized neural networks : implementation, optimization and explanation
46. Autonomous systems, control systems, robotics, navigation systems

ENGINEERING PHYSICS

47. Optical nose on chip

MATHEMATICS AND INDUSTRIAL ENGINEERING

48. Automated Fault Diagnostic Algorithm in Process Control on Human Performance

MECHANICAL ENGINEERING

49. Additive manufacturing of 3D printing of multi-material composite systems
50. Exploration of deep learning algorithms in computational fluid dynamics
51. Design and Experiment with an Underactuated Walking Robot
52. Design of a Tracking Device for Mobile Robots
53. Modeling and Mechanical Characterization of a Linkage for Robotic Walking
54. Design of a Twisting String Actuation Robotic Gripper
55. Design and construction of a continuous fiber 3D print-head
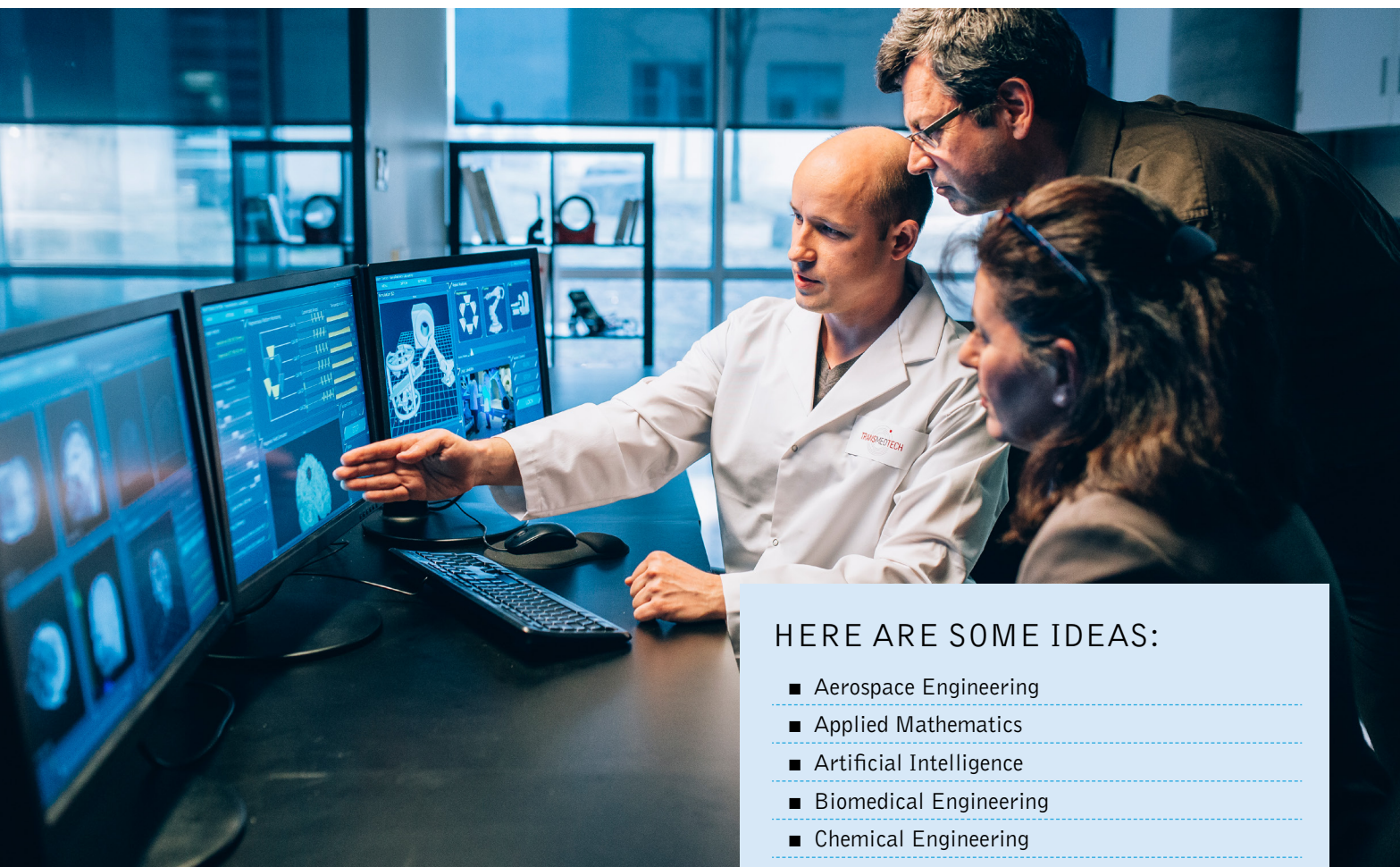
ADDITIONAL AREAS OF EXPERTISE

HERE ARE SOME IDEAS:

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

YOU DIDN'T FIND WHAT YOU WERE LOOKING FOR?

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

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☑ Aerospace ☐ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☑ Mechanical	☐ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Reduced order model of cyclic symmetric structures with Code Aster		
University Cycle :	☐ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☐ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Aircraft engines are made of a succession of bladed disks. Finite element models are commonly used to study their dynamical properties. These models contain millions of degrees of freedom. Their large size makes them not suitable for nonlinear analyses and reduction techniques are needed. The aim of this internship is to be able to build reduced order models that takes advantage of the cyclic symmetry property of bladed disks through an automated procedure. An extensive validation of the code will be carried out using existing models. These reduced order model will be used as an input of an in-house code dedicated to the study of contact nonlinearities in aircraft engines.		
Tasks during the Internship: *(max. 50 words)*	The tasks of the internship are: (1) import of .med file in Code Aster, (2) automated extraction of nodes lists from the .med file, (3) translation and adaptation of the reduction procedure, (4) addition of centrifugal effects in the reduction, (5) validation of the obtained reduced model.		
Required Skills for the Internship: *(max. 50 words)*	The intern should have an advanced knowledge of the finite element method. Also, the intern should have good programing skills. The code will be developed in Python. The prior knowledge of this programming language is a strong asset for the internship.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Alain Batailly Title: Associate Professor Department: Département de génie mécanique Website: http://lava.polymtl.ca		

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	☐ Civil, Geological, Mining	☐ Computer/Software	☐ Electrical
	☐ Mathematics/Industrial	☑ Mechanical	☐ Physics
Research Project Title : *(max. 10 words)*	Numerical optimization of aircraft engine blades robust to contact interactions		
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)		
Background Information: *(max. 100 words)*	In a very competitive context, the airline industry aims at minimizing its ecological footprint in order to support high long-term growth potential. Lower engine emissions may be achieved through the reduction of operating clearances between rotating blades and the surrounding casing. From an aerodynamic standpoint, clearance reduction is crucial to maximize efficiency; however, from a structural standpoint, this reduction unavoidably promotes contact interactions. As nonlinear vibrations resulting from such contacts may threaten the engine structural integrity, for safety, environmental and economical considerations, the design of aircraft engine blades robust to contact interactions is of strategic importance for manufacturers.		
Tasks during the Internship: *(max. 50 words)*	1) Use a dedicated numerical tool to generate CAD reference blade models from NASA reports data. 2) Conduct simulations campaigns to optimize the shape of blades with respect to several mechanical criteria. 3) Summarize the results and highlight the blade shapes robust to contact interactions.		
Required Skills for the Internship: *(max. 50 words)*	- Basic programming skills and interest for programming - Some experience of the Python progamming language and/or Linux would be an asset.		
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Research Project Title : *(max. 10 words)*	Epidermal patch electrodes for bioelectronics
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Epidermal patch electrodes are attracting many researchers in different fields such as human vital signs monitoring (e. g. electrocardiography (ECG), electromyography (EMG), and electroencephalography (EEG)), sweat analysis, and glucose tests. In this research, conductive polymers are used to fabricate epidermal electrodes which are self-healble and capable of recording ECG, EMG, and EEG signals.
Tasks during the Internship: *(max. 50 words)*	- Getting familiar with the subject by studying the related work - Participating in meetings to report progress or any potential issues - Delivering progress report end of each month - Conducting experiments and pushing one or two papers
Required Skills for the Internship: *(max. 50 words)*	- Having knowledge about conductive and electroactive polymers - Being able to do mechanical tests (e. g. tensile strength test) - knowledge about bio-potential signals processing
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Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Fabio Cicoira Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/iontronics/en/people

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Research Project Title : *(max. 10 words)*	Biodegradable conducting polymers
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	This research attempts to seal current knowledge gaps on the biodegradability of conducting polymers, and to develop high performance 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.
Tasks during the Internship: *(max. 50 words)*	Screen-printing of transistors, characterization of transistor performance, self-healing analysis of screen-printed conducting polymers, respirometry (biodegradability analysis) of polymers .
Required Skills for the Internship: *(max. 50 words)*	Chemical analysis, laboratory techniques, electronic device characterization, motivation, organization skills (not mandatory) . Strong motivation (required).
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Supervisor:	Name: Fabio Cicoira Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/cicoira-fabio

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Research Project Title : *(max. 10 words)*	Self Healing Conducting Polymers
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	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 effect will be study in a humid atmosphere using a robotic probe station.
Tasks during the Internship: *(max. 50 words)*	The student will perform microfabrication, synthesis of self healing conducting polymers, electrical measurements.
Required Skills for the Internship: *(max. 50 words)*	Motivation to work in a multidisciplinary field. Background in chemistry, chemical engineering, physics or mechanical engineering.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
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	☐ Civil, Geological, Mining	☐ Computer/Software	☑ Electrical
	☐ Mathematics/Industrial	☑ Mechanical	☐ Physics
Research Project Title : *(max. 10 words)*	Simulation and control of a 3D-printed Exoskeleton of the Upper Limb		
University Cycle :	☑ 1st cycle (Undergraduate)	☐ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	According to https://magicarms.org/, 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.		
Tasks during the Internship: *(max. 50 words)*	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.		
Required Skills for the Internship: *(max. 50 words)*	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.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Maxime RAISON / Sofiane ACHICHE Title: Full Professors Department: Mechanical Engineering Website: polymtl.ca/expertises/en/achiche-sofiane polymtl.ca/expertises/en/raison-maxime		

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Research Project Title : *(max. 10 words)*	Control of a Robotic Arm for Assisting Patients with Musculoskeletal Disorders
University Cycle :	☑ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Robotic arms for assistance, such as JACO(TM) developed by the Canadian company Kinova. The time to reach certain objects with the arm can be long and complex, causing fatigue and frustrations. It is therefore necessary to consider simplifications of the command. To achieve this, we propose the use gaze supported robotic control. A robotic arm is available in our research laboratory as well as a low-cost eye-tracker. The objective of this project is to semi-automate the control of the robotic arm through the control of the orientation of the effector with respect to the user, in order to reduce the time of completion of everyday tasks. We expect to reduce the time to reach objects by over 50 %.
Tasks during the Internship: *(max. 50 words)*	Identify and categorize the most common / useful trajectories among users of the robotic arm; Determine optimal usage of a low cost eye-tracker; Develop a code to direct the end-effector in real time using the eyetracker information; Technical Report.
Required Skills for the Internship: *(max. 50 words)*	Basic knowledge of coding in MATLAB but C++ is a plus; Basic knowledge about design; Knowledge of robotics and/or image processing is a must; Priority will be given to candidates enrolled in a mechatronics program or an electrical engineering program.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
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Supervisor:	Name: Sofiane ACHICHE / Maxime RAISON Title: Full Professors Department: Mechanical Engineering Website: polymtl.ca/expertises/en/achiche-sofiane polymtl.ca/expertises/en/raison-maxime

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Research Project Title : *(max. 10 words)*	Real-time Quantification of Muscle Forces
University Cycle :	☑ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	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.
Tasks during the Internship: *(max. 50 words)*	Get familiarized with our musculoskeletal modeling in MATLAB and ROBOTRAN (www.robotran.be), 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.
Required Skills for the Internship: *(max. 50 words)*	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.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
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Research Project Title : *(max. 10 words)*	Flexible organic rectifiers		
University Cycle :	☑ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Recently, demand for high frequency and low-cost rectifiers as a major compartment of radio frequency identification (RFID) tags have encouraged many researchers to use organic semiconductors for rectifiers. Commercial silicon based rectifying circuits consist of a diode and a capacitor to rectify alternating current (AC) signals collected by antennas and produce direct current (DC) to power electronic devices. We are fabricating transistor-based rectifier with a three-terminal configuration. This type of rectifier requires to have an asymmetry structure to show rectifying effect in device which can be induced by using different metals with different work function as source or drain.		
Tasks during the Internship: *(max. 50 words)*	Contribute to the fabrication process of rectifier which includes carbon nanotube deposition on silicone wafer by vacuum filtration method, Analysis of semiconductor characterizations, Be responsible for conducting new process for rectifier fabrication.		
Required Skills for the Internship: *(max. 50 words)*	Basic knowledge of semiconductor materials. Good team work ability.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No		
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Supervisor:	Name:　　Fabio Cicoira Title:　　Professor Department:　Chemical Engineering Website:　　https://www.polymtl.ca/iontronics/en/people		

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Research Project Title : *(max. 10 words)*	Sustainable ion-gated transistors
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Ion-gated transistors (IGTs) are attractive for chemo- and bio-sensing, wearable electronics and bioelectronics, because of their ability to detect the ions and their 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 . Among the metal oxides, In2O3 shows superior performance, but the availability of indium is limited in the earth's crust. TiO2 and SnO2 are the earth-abundant, better replacement for the expensive indium oxide-based channel materials and can be used as a channel material in n-type IGTs.
Tasks during the Internship: *(max. 50 words)*	Reparation of metal oxide films such as TiO2 and SnO2 through hydrothermal and sol-gel synthesis. Assembly of ion-gated transistors (including the preparation of gating medium and gate electrode). Electrical and electrochemical testing of IGTs and perform data analysis.
Required Skills for the Internship: *(max. 50 words)*	Basic knowledge of transistors. Knowledge and experience about wet-chemical techniques such as solution processing method for the preparation of metal oxide films.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
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Main area of expertise :	☐ Aerospace ☐ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☑ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Catalytic Depolymerisation of Poly(Methyl Methacrilate) to Methacrylic Acid		
University Cycle :	☐ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)		
Background Information: *(max. 100 words)*	At present recycling of PMMA is limited to depolymerisation of PMMA into MMA. Direct synthesis of MAA from PMMA in the gas phase in the same reaction volume is a novel process. We will study kinetics of catalytic transformation of poly(methyl methacrylate) into methacrylic acid in a lab scale catalytic fluidized bed reactor. These studies include: - experimental investigation of catalytic activity of catalysts - experimental studies of kinetics of depolymerisation reaction - development of simulation model and reaction mechanism - process optimiaation and process scaling.		
Tasks during the Internship: *(max. 50 words)*	The intern will be involved in the studies of catalytic activity, reaction kinetics which will be carried out using a lab scale reactor, as well as process simulation and data analysis.		
Required Skills for the Internship: *(max. 50 words)*	- Problem solving and decision making - Goal oriented - Teamworking		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Prof Gregory S. Patience Title: Full professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace	☐ Biomedical	☑ Chemical
	☐ Civil, Geological, Mining	☐ Computer/Software	☐ Electrical
	☐ Mathematics/Industrial	☐ Mechanical	☐ Physics
Research Project Title : *(max. 10 words)*	Capital cost estimation of plastic recycling plants-PMMA		
University Cycle :	☑ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	The challenge is to develop a cost-effective depolymerization technology that repurpose PMMA (polymethylmethacrylate) scrap (containing fillers) and end-of-life PMMA, with minimum environmental impact. For any process to make it to the large scale, it has to be economically viable. At the early-stage, the most suitable capital cost estimation methods are the power law, the factorial, the functional unit, and the thermodynamic estimation methods. Unfortunately, most of those are tailored for the OIL/Gas and petrochemical industry. Especially when the processes are at an early stage, with very few at commercial scale (if none), usual estimation methods may not be adequate.		
Tasks during the Internship: *(max. 50 words)*	Literature review on capital cost estimation methods and plastic recycling processes. Collect and analyze patents, companies communications, white papers and technical reports to collect capital costs data on existing plants. Write Heat and Mass balances for selected processes, and retrofit capital costs estimation methods with real data.		
Required Skills for the Internship: *(max. 50 words)*	fundamentals of process economics, Heat and mass balance calculations. Excel, coding (Matlab, Phyton) is an asset, but not mandatory.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Gregory S. Patience Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☑ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : (max. 10 words)	Wet and molt agglomeration in a fluidized bed
University Cycle :	☐ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: (max. 100 words)	Poly(methyl methacrylate) (PMMA), known as acrylic or acrylic glass as well as the Crylux, Plexiglas, and Acrylite is a transparent thermoplastic and an alternative to glass. The market size for this polymer is growing but, recycling technologies are inadequate to handle the different PMMA wastes. In the last 30 years the chemical depolymerization of PMMA to its monomer (MMA) has emerged as the leading candidate among all the recovery methods. Molten-lead, stirring-tank, extruder, dry distillation and fluidized beds are the state of the art. Fluidized beds would separate and recover expensive fillers, but they are prone to agglomeration induced depolymerization.
Tasks during the Internship: (max. 50 words)	Characterization of cold agglomerates (wet) and hot agglomerates (molt) in a fluidized bed. Effect of temperature, nozzle design and bed particles on agglomerate size and shape. If remote: DEM (discrete element method) to predict molt induced agglomeration of PMMA (DOI: 10.1080/01430750.2019.1594367)
Required Skills for the Internship: (max. 50 words)	Fundamentals of fluidization. Laboratory Hands-on attitude. If remote: fundamentals of numerical methods, coding is required (matlab, phyton) but not mandatory
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Gregory S. Patience Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☑ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Process dynamics and control of Fischer-Tropsch in Micro Refinery Unit
University Cycle :	☐ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	We intend to produce Liquid hydrocarbon as fuel in a GTL pilot via Fischer-Tropsch process which is a well-known technology to convert synthesis gas (Carbon monoxide + Hydrogen) obtained from natural gas and get an appropriate fuel for vehicles (C5+). We will carry on some experiments at high pressure in a pilot plant to study the features of the applicable catalysts, study the effects of the operating parameters on the overall yield of reaction and control the temperature of Fischer-Tropsch reaction not only to prevent coking of the catalyst but also to improve the conversion of synthesis gas to C5+
Tasks during the Internship: *(max. 50 words)*	Working on micro-refinery unit pilot setup, Simulation by ASPEN software, Programming by MATLAB and /or Python
Required Skills for the Internship: *(max. 50 words)*	1- Thermodynamics and the kinetics of catalytic reactions, 2- Expert in one of the process simulators, particularly ASPEN PLUS, 3- MATLAB and Python 4- Process control
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☑ Other, please specify: Montreal ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Gregory S. Patience Title: Full professor, Canada research chair Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☑ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Oxi-dehydration of fructose to high-value added chemicals		
University Cycle :	☐ 1st cycle (Undergraduate)	☐ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Biomass is a renewable, sustainable, and clean source of energy, and has the potential to replace fossil fuel sourced products. Bio-based carbohydrates including C6 sugars dehydrate to 5-hydroxymethyl furfural (HMF), which is an intermediate building block for a range of valuable chemicals including 2,5-diformyl furan (DFF) and 2,5-furandicarboxylic acid (FDCA). Expensive metals and toxic reagents/high-boiling point solvents catalyze the dehydration of fructose to HMF and the subsequent oxidation to the valuable platform chemicals, which makes these processes inefficient and expensive. Therefore, there is a gap in the development of sustainable heterogeneous catalytic processes for practical use.		
Tasks during the Internship: *(max. 50 words)*	(1) Reviewing the literature regarding agglomeration phenomena and heat transfer in the process. (2) Monitor the temperature distribution along the wall and near the nozzle to study heat transfer. (3) Analyze pressure signals across the bed to identify changes in the fluidization characteristics due to agglomeration. (4) Optimizing operating conditions.		
Required Skills for the Internship: *(max. 50 words)*	English proficiency, Problem-solving and analytical skills, Communication and presentation skills, Teamwork, Computer skills (Microsoft office, MATLAB)		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Gregory S. Patience Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☑ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Recycling Technologies for Polymer Automotive Components		
University Cycle :	☑ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Automotive polymers are currently not recycled in Canada. It is estimated 350 kt /year of plastics from end-of-life vehicles are landfilled. However, the use of plastics and plastic composites in vehicles is expected to increase, since they allow for significant weight reduction, and hence fuel consumption reduction, compared to conventional materials such as metals or glass. This project will develop economically viable and environmentally acceptable technologies for recycling polymer automotive components, with emphasis on PMMA (poly methyl methacrylate) and PC (polycarbonate), two transparent polymers envisioned for developing lightweight polymer glazings and other advanced components.		
Tasks during the Internship: *(max. 50 words)*	1- Literature review 2- Analysis of data 3- Visualization of data 4- Documentation and writing of reports		
Required Skills for the Internship: *(max. 50 words)*	1- Write and speak professionally and communicate and relate well to others 2- Problem solving: ability to analyze and evaluate a situation 3- Basic knowledge of chemical processes		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☑ Other, please specify: Polynov, 1st Croissant, Montreal, QC ☑ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Gregory S. Patience Title: Professor, Canada Research Chair Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☑ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Catalytic partial oxidation of natural gas at high pressure		
University Cycle :	☐ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Hydrogen (H2) is an alternative fuel to energy vector because of its net-zero emissions. One attractive option to produce H2 from hydrocarbon fuels is via Catalytic Partial Oxidation (CPOX). CPOX has rapid reforming kinetics. Also, they do not require water as in steam reforming and oxidative-steam reforming, so CPOX reactors are smaller and easier to incorporate in onboard fuel reforming systems, and applications where remote and distributed power is needed. The reactions in CPOX are complex with side reactions such as water-gas-shift, steam reforming and CO2 reforming. Problems that arise during CPOX are catalyst deactivation from high-temperature sintering, support deterioration, coke formation, and contamination for example from Sulphur which should be addressed.		
Tasks during the Internship: *(max. 50 words)*	the student will support a new PhD that started recently to design a new reactor to operate CPOX reaction at high pressure. He\She will support the PhD student to design, test and define the standard operating procedures of this new setup.		
Required Skills for the Internship: *(max. 50 words)*	English knowledge (French is a plus) Chemical Enginnering		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires		
Supervisor:	Name: Gregory Patience Title: Full Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☑ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☑ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Novel Catalyst Design and their activity in Fischer Tropsch Synthesis
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	The project is part of an industrial project (MRU-Micro Refinery Unit). MRU contains partial oxidation and Fischer Tropsch process connected to each other. The Fischer Tropsch process is used to convert syngas to hydrocarbons. The target here is to produce diesel and jet fuel and limit the waxing so it would not harm the pipes and reduce CH_4 and CO_2. We are working in high temperature and pressure. The main objective in the project will be synthesising novel catalysts for Fischer Tropsch synthesis, testing them, and analyzing the results. We aim to produce high temperature and attrition resistant catalysts.
Tasks during the Internship: *(max. 50 words)*	* Synthesize different catalysts based on the instructions * Operate the reactor in with full focus * Observe and analyze the results * Writing reports or part of articles
Required Skills for the Internship: *(max. 50 words)*	* Hard worker and punctual * Meticulous work * Practical, initiative approach * Ability to perform as instructed * Eagerness to learn different skills and knowledge
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Gregory S. Patience Title: Professor Department: Chemical Engineering Website: https://www.linkedin.com/in/gregory-patience-680b331/

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☑ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Extrusion catalytic depolymerization of PMMA		
University Cycle :	☑ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Industry produces 2.2 million tons of Polymethyl methacrylate (PMMA) per year for many applications. The increasing demand and consumption result in huge amounts of end-of-life waste. PMMA chemical recycling is a promising route since thermal depolymerization produces a high purity of MMA monomer. However, additives or fillers in waste PMMA lower the yield and purity of the produced MMA and restrain the continued operation of depolymerization due to the formation of coke or nondegradable residues. Here, we are producing a pure stream of methacrylic acid (MAA) by combining PMMA thermal depolymerization and in-situ MMA hydrolysis onto a reactive extrusion process.		
Tasks during the Internship: *(max. 50 words)*	The intern will get involved in the experimental operation of reactive extrusion using a twin-screw extruder, sample analysis using GC-MS and dynamic modelling of reactive extrusion. The half of time will be spent on experimental practice and the remaining time needs to focus on writing and modelling.		
Required Skills for the Internship: *(max. 50 words)*	The intern is supposed to have critical thinking and be good at collaboration and communication. Background or experience in polymer chemistry, rheology, and modelling (e.g. Solidworks, 3D max, Comsol, Ansys etc.) is a plus.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☑ Other, please specify: Anjou ☐ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Prof Gregory S. Patience Title: Full professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☑ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Coatings for Surface Organic Fouling and Sulfur Corrosion Materials Protection		
University Cycle :	☐ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Industrial Project: Heavy oil cracking present new challenges when compared to regular blend. A surface layer formation decreases the performance of materials, induce pressure instability, mismatch between sealing surfaces, which cost millions. Material selection is a critical factor in the design of a system. The protection of alloys with a thin film coating offers some economical and practical advantages. - Coating selection, deposition, and optimization in nickel-based super alloys; - Design of corrosion/fouling reactor unit to operate under real conditions of high pressure and temperature during crude oil hydrocracking; - Verify prospective material protection performance;		
Tasks during the Internship: *(max. 50 words)*	- Hands on: Reactor operation - Characterization of samples after degradation -Literature Review of kinetic degradation model -Develop scale (oxidation/sulfidation) formation kinetic model -Report Writing		
Required Skills for the Internship: *(max. 50 words)*	- Advanced English (must) French and Portuguese (asset) - Team Work, Collaborative, Analytical Skills, Logical Thinking, Detail Oriented (must) - Knowledge in thermodynamics and kinetics (desired) - Kinetic modeling software skills (asset)		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Gregory S. Patience Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☑ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Surface engineering of materials
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	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.
Tasks during the Internship: *(max. 50 words)*	Plan and execute experiments, analyze experimental results, construct/adapt chemical reactors, write progress reports, present results orally.
Required Skills for the Internship: *(max. 50 words)*	Reactor engineering (a must), photochemistry (or a desire to learn), nanomaterials (or willingness to learn), chemical analysis (basics)
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: TAVARES, Jason R. Title: Full professor Department: Chemical Engineering Website: jasontavares.ca

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☑ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☐ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Numerical modeling of open pit filling for mining closure		
University Cycle :	☑ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Open pit filling using mine wastes represents a friendly environmental alternative for mine closure. The final configuration of the remediation design will depend on the mechanical behavior of mine wastes used for pit filling, particularly drainage conditions and settlements. Moreover, delayed events of particle crushing of coarse waste rock can cause significant creep deformation, which could be promoted by high humidity due to raising water table after mining operation (i.e. decreasing suction). The aim of this internship is to simulate one-dimensional settlements of an open pit filling project implementing a suction-dependent and time-dependent constitutive model for crushable waste rock.		
Tasks during the Internship: *(max. 50 words)*	(i) Learn the conceptual framework of an existing constitutive model for crushable rockfills, capturing suction-dependent and time-dependent behavior. (ii) Code, implement and calibrate the model based on experimental data of mining waste rock. (iii) One-dimensional simulations of mine open pit filling.		
Required Skills for the Internship: *(max. 50 words)*	Solid mechanics. Geotechnical engineering. Constitutive modeling of geomaterials. Coding and numerical modeling.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Carlos Ovalle Title: Assistant Professor Department: Department of Civil, Geological and Mining Engineering Website: https://www.polymtl.ca/gmmg/en		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☑ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☐ Chemical ☐ Electrical ☐ Physics
Research Project Title : (max. 10 words)	Environmental safety of Slag Steel Filters Regarding Metals Leaching Behavior		
University Cycle :	☑ 1st cycle (Undergraduate) ☐2nd cycle (Master) ☐3rd cycle (Ph.D.)		
Background Information: (max. 100 words)	Steel slag filter is a practical and economic wastewater treatment method for phosphorous removal. This process shows high efficiency in P removal and reaches the target value of 1 mg/L at effluent requested in Quebec phosphorus-sensitive ecosystems. However, slag is a by-product of steel industry and contain high percentages of metals. Using steel slag filter has concerns about its environmental safety due to potential heavy metals leaching. Thus, heavy metal leaching by steel slag should be investigated before using it in slag filter applications.		
Tasks during the Internship: (max. 50 words)	The student will prepare synthetic wastewaters and run leaching tests in order to monitor the effluent composition throughout slag aging process. Besides, he/she will measure the adsorption capacity of phosphorus in various environmental conditions regarding pH, initial P concentration and time of process.		
Required Skills for the Internship: (max. 50 words)	The nominee should have basis laboratory skills and be ready to learn laboratory protocols such as pH measurement, preparation of synthetic wastewater, sampling, kinetic/isotherm investigation and regeneration tests. Basic knowledge in wastewater treatment or environmental engineering is recommended.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Dominique Claveau-Mallet Title: Professor Department: Civil, Geological and Mining Website: https://www.polymtl.ca/expertises/claveau-mallet-dominique		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☑ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Biological resin and Gravity-driven membrane filtration for drinking water treatment
University Cycle :	☑ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Natural organic matter is ubiquitous in surface water and causes numerous problems for human health. As a result, it should be eliminated from drinking water. The present research aims to combine the biological resins (BIEX) with the Gravity-driven membrane (GDM) filtration process. In BIEX, the backwash stage for a long period of time is omitted which allows to form Bio-film in the membranes' surface, resulting in additional resistance against natural organic matter. In GDM process, gravity acts as driving force which leads to elimination of pumps, making the process very simple and economic.
Tasks during the Internship: *(max. 50 words)*	Synthesis of ceramic membranes Characterization of membranes Application of ceramic membranes in drinking water treatment Application of BIEX resins and membranes during water treatment
Required Skills for the Internship: *(max. 50 words)*	Knowledge in water and wastewater treatment technologies knowledge in membranes filtration processes knowledge in the area of environmental engineering Capacity to work in laboratory environment and learn experimental protocols
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Dominique Claveau-Mallet Title: Assistant professor Department: Civil, Geological, Mining Website: https://www.polymtl.ca/expertises/en/claveau-mallet-dominiqu

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☑ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☐ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Evaluation of pathogenic content in bioaerosols from wastewater treatment plants		
University Cycle :	☑ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)		
Background Information: *(max. 100 words)*	Aerosols are generated throughout the different steps of wastewater treatment plants and can be dispersed within indoor facilities or in the facility surroundings. These aerosols may contain a wide diversity of bacteria and host organisms and are documented as an emerging source of Legionella and other opportunistic pathogen, as well as antibiotic resistant bacteria. To limit the risk associated for the surrounding neighborhood, it is important to understand the characteristics of the aerosols produced according to the design and operating parameters of the facilities. The project is in collaboration with municipalities and the industry.		
Tasks during the Internship: *(max. 50 words)*	Environmental sampling of water and air at participating sites; Physico-chemical analyses (i.e. total and volatile suspended solids, chemical oxygen demand); Microbial analyses (molecular detection methods of targeted pathogens, total culturable bacteria); Data analysis. The intern will work with a graduate student.		
Required Skills for the Internship: *(max. 50 words)*	Rigor, autonomy, teamwork, eagerness to learn, laboratory experience, environmental microbiology. Knowledge of molecular biology (DNA extraction, PCR) and R programming language is an asset. This internship is part of a large research program and there is a possibility to pursue as a Master student if there is interest.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Emilie Bédard Title: Assistant Professor Department: Civil, Mining and Geological Engineering Website: https://www.polymtl.ca/expertises/bedard-emilie-0		

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2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☑ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Screening of wastewater treatment plants as a source of legionellosis cases
University Cycle :	☐ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Municipal and industrial wastewater treatment plants (WWTP) are an emerging and confirmed source of Legionella. The need for aeration within these processes leads to the formation of aerosols, in which the presence of Legionella spp. and other opportunistic pathogens has been reported. In parallel, over 95% of Legionella cases are sporadic and of unknown source. It is important to assess if WWTP are underestimated sources of sporadic cases. A survey of WWTP will be conducted to evaluate their proximity to reported cases, the presence of Legionella in wastewater from these WWTP and the similarity between environmental and clinical strains.
Tasks during the Internship: *(max. 50 words)*	Selection of sampling sites based on data analysis of municipal and industrial wastewater treatment plants and processes used in Quebec (factors will include type of process, risk of aerosol generation, proximity of population); Detailed characterization of 20 selected sites; Planification of sampling campaign.
Required Skills for the Internship: *(max. 50 words)*	The required skills include : teamwork, rigor, autonomy, understanding of wastewater treatment processes, data organization and analysis, eagerness to learn, knowledge of environmental microbiology. The ability to read French is an asset. Possibility to pursue as a PhD student if there is interest.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so
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2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☑ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	UHPFRC : From material development to structural applications.
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	In the last decade ultra-high performances fiber reinforced concretes (UHPFRC) have been developped. 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 CO_2 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).
Tasks during the Internship: *(max. 50 words)*	• Produce UHPFRC mixes or structural applications at the laboratory • Measure UHPFRC properties at fresh and hardened states with standard lab. tests or measure the structural behavior of applications with specific tests • Analysis of results and production of a technical report
Required Skills for the Internship: *(max. 50 words)*	• Excellent leadership and be autonomous to manage technical activities • Good knowledge of concrete production and properties, lab experience is an asset • Good dexterity and be familiar with manual works to carry out lab activities • Excellent knowledge of Excel and Word software in order to analyze results
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Jean-Philippe Charron Title: Full Professor in Civil Engineering Department: Civil, Geological and Mining Engineering Website: https://www.polymtl.ca/expertises/en/charron-jean-philippe

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☑ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☐ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Effect of mineralogy on cement stabilized tailings hydrogeochemical behaviour		
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)		
Background Information: *(max. 100 words)*	One of the most critical issues faced by the mining industry is the management and safe disposal of the important quantities of tailings and waste rocks produced during extraction. These materials often contain sulfides which can oxidize upon contact with oxygen (air) and water, and produce acidic effluent with high concentrations of sulfates and heavy metals (also known as acid mine drainage or AMD). This project aims to evaluate the performance of an innovative reclamation approach consisting in mixing tailings with cement to form an oxygen barrier and prevent oxygen diffusion to the reactive tailings. This project is a collaboration with several mining companies and LafargeHolcim.		
Tasks during the Internship: *(max. 50 words)*	Sample preparation (mixing and compacting different types of tailings with different types of cements). Characterization of hydrogeological (hydraulic conductivity, water retention curve, oxygen diffusion coefficient) and geochemical properties of cement stabilized tailings. Support to Master's and PhD students.		
Required Skills for the Internship: *(max. 50 words)*	Basic knowledge in geotechnical engineering, geochemistry and/or hydrogeology. Previous experience in the laboratory could be useful but is not mandatory.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Thomas Pabst Title: Professor, Scientific Director of RIME Department: Civil, Geological and Mining Engineering Website: irme.ca/en/		

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2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☑ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☐ Chemical ☐ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Stability of acid generating mine wastes disposed of in open pits		
University Cycle :	☑ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	The mining industry produces large quantities of solid wastes (mainly tailings and waste rocks) which are usually disposed of in tailings impoundments and waste rock piles on the surface. These storage facilities can be unstable and their exposition to the atmosphere could lead to the generation of acid mine drainage (AMD). Among recently developped integrated mine waste management approaches, the backfilling of open pits is therefore a promising avenue which could contribute to physically isolate mine wastes and prevent environmental contamination. The objective of this project is to evaluate the possibility to dispose of pre-oxidized mine wastes in open pits. This project is a collaboration with several mining companies.		
Tasks during the Internship: *(max. 50 words)*	Laboratory experiments: geochemical and hydrogeological characterization of mine wastes, kinetic tests in column experiments. Numerical simulations using a reactive 2D/3D transport code. If the sanitary situation requires so, the project could focus on numerical simulations and be carried out remotely only.		
Required Skills for the Internship: *(max. 50 words)*	Basic knowledge in geochemistry and hydrogeology. Previous experiences in the laboratory and/or with numerical simulations code could be useful but are not mandatory.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Thomas Pabst Title: Professor, Scientific Director of RIME Department: Civil, Geological and Mining Engineering Website: irme.ca/en/		

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2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☑ Chemical ☑ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Effect of climate change on the performance of mine drainage treatment systems
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	One of the most critical issues for the mining industry remains the management and safe disposal of the important quantities of tailings and waste rocks produced during extraction. These materials often contain sulfides which can oxidize upon contact with oxygen and water, producing acidic effluent (also known as acid mine drainage, or AMD) with high concentrations of sulfates and heavy metals. Treatment systems are efficient to reduce contamination but their efficiency is highly dependant on climatic conditions. The objective of this project is therefore to evaluate the resilience of mine water treatment systems to climate change and in particular the increase of the frequency and intensity of extreme precipitation events.
Tasks during the Internship: *(max. 50 words)*	Compilation and statistical analysis of water quality data from real mine effluents and drainage treatment systems. Laboratory experiments (if the sanitary situation allows travel). Numerical simulations using a reactive transport code (e.g. PHREEQC, Min3P) and parametric analysis using climate projections. Report writing and presentation.
Required Skills for the Internship: *(max. 50 words)*	Basic knowledge in geochemistry and hydrogeology. Previous experiences in the laboratory and/or with numerical simulations code could be useful but are not mandatory.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Thomas Pabst Title: Professor, Scientific Director of RIME Department: Civil, Geological and Mining Engineering Website: irme.ca/en/

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace	☐ Biomedical	☐ Chemical
	☐ Civil, Geological, Mining	☑ Computer/Software	☐ Electrical
	☐ Mathematics/Industrial	☐ Mechanical	☐ Physics

Research Project Title : *(max. 10 words)*	The Cognifly project

University Cycle :	☐ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)

Background Information: *(max. 100 words)*	The Cognifly is a light weight drone collision reselient that we have developed in the lab for various purposes: research, precision agriculture, exploration, and many others. The drone has the ability to do fairly complicated AI tasks despite its small size, and combined with its agility and collision reselience, it makes for a very versatile drone.

Tasks during the Internship: *(max. 50 words)*	1) Customizing the flight controller firmware to allow for more control modalities and for using indoor positioning system information. 2) Developing the drone: testing different motor variants, configurations and battery types to extend the drone's life time.

Required Skills for the Internship: *(max. 50 words)*	Good software engineering skills, as well as good command of coding in c, c++, python, in addition to familiarity with customizing open source software.

Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No

Location:	☐ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so

Supervisor:	Name: Giovanni Beltrame Title: Professor Department: Computer and Software Engineering Website: mistlab.ca

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Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Semantics-based Collaborative Simultaneous Localization and Mapping
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	SLAM (Simultaneous Localization and Mapping) Łłis a core problem of robotics to enable autonomy in GPS-denied environment (indoors, caves, etc.). Collaborative SLAM is the application of SLAM to multi-robot systems, so that the robots can collaborate to build a common 3D understanding of the environment. In this project, we plan to leverages the recent advances in deep learning and computer vision to enhance the 3D maps by adding semantic information (e.g. object detection, semantics labels, etc.)
Tasks during the Internship: *(max. 50 words)*	- Work on 3D object detection and instance segmentation - Integrate the semantic data into the Collaborative SLAM pipeline - Test the system against state-of-the-art benchmarks
Required Skills for the Internship: *(max. 50 words)*	Strong C++ or Python programming skills Prior experience in deep learning, robotics or computer vision.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Giovanni Beltrame Title: Professor Department: Computer and Software Engineering Website: https://mistlab.ca/

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2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☑ Electrical ☐ Mathematics/Industrial ☑ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	The Cognifly battery swap station
University Cycle :	☐ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	The Cognifly is a light weight drone collision reselient that we have developed in the lab for various purposes: research, precision agriculture, exploration, and many others. Long time autonomy is a paramount feature for these types of missions. For that end, the battery swap station will serve this need. We intend to exploite specific design features in the Cognifly that makes the battery easily extractable to desing a simple, small size battery swap station.
Tasks during the Internship: *(max. 50 words)*	1) Designing a battery swap station for the Cognifly 2) Developing the drone: potentially testing different battery bay designs 3) Implementing a prototype of the battery swap station 4) Testing the station in actual flight conditions
Required Skills for the Internship: *(max. 50 words)*	Good command of CAD software (preferably open source), good fabrication and prototyping skills, ability to use stepper and servo motors, some experience in mechanical deisgn (designing mechanisms, structures, etc).
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Giovanni Beltrame Title: Professor Department: Computer and Software Engineering Website: mistlab.ca

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2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Augmenting user experience (UX) design of open source software
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	With the increasing maturity and popularity of open source software (OSS), ongoing efforts to increase the user experience (UX) of the software developed under the open source model are growing in importance. While user participation in the design process is vital for achieving successful UX, it is often pushed aside as OSS teams adapt to asynchronous, remote working and focus on code and functionality. In this project, we aim to explore techniques and tools to facilitate asynchronous user involvement and UX design in large-scale OSS projects in order to help OSS teams augment the UX of their software products.
Tasks during the Internship: *(max. 50 words)*	Interns will be integrated in a group of PhD and master's students. We will follow a user-centered approach, involving OSS practitioners and end users, to design, develop, and evaluate a set of tools for supporting asynchronous UX design in large-scale OSS projects.
Required Skills for the Internship: *(max. 50 words)*	- Motivated learner, critical thinker, and team contributor - Passionate for UX and usability - Knowledge and/or interests in open source software process and tools - Experience in user-centered interaction design and/or front-end development
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Jinghui Cheng Title: Assistant Professor Department: Computer and Software Engineering Website: http://jhcheng.me

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : (max. 10 words)	Intelligent image mining for user interaction design
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)
Background Information: (max. 100 words)	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.
Tasks during the Internship: (max. 50 words)	Interns will be integrated in a group of PhD and master's students. 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.
Required Skills for the Internship: (max. 50 words)	- Motivated learner, critical thinker, and team contributor - Experience in machine learning and/or computer vision techniques - Programming skill in python - Knowledge and/or interests in user-centered interaction design
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Jinghui Cheng Title: Assistant Professor Department: Computer and Software Engineering Website: http://jhcheng.me

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2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Intelligent text mining of open source discussions
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Open source software (OSS) development teams often use various platforms to manage bug reports, feature requests, code reviews, questions and answers, and other affairs or cases during the development process. Many of these platforms and tools for OSS development allow users to add comments and form conversations. Over time, these comments accumulate into discussion threads embedded with rich information and knowledge about the health of the OSS project, the perception of the community, the characteristics of the contributors, and the effective ways of communication in OSS contexts. However, discovering and retrieving these information and knowledge from the discussion threads is a challenging task.
Tasks during the Internship: *(max. 50 words)*	Interns will be integrated in a group of PhD and master's students. We will explore natural language processing (NLP)-based text mining techniques to detect and extract various information and knowledge in the OSS discussions, including discourse features, argumentation schema, and appropriate/inappropriate language use.
Required Skills for the Internship: *(max. 50 words)*	- Motivated learner, critical thinker, and team contributor - Experience in machine learning and/or natural language processing - Programming skill in python - Knowledge and/or interests in human-centered perspectives towards software development
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Jinghui Cheng Title: Assistant Professor Department: Computer and Software Engineering Website: http://jhcheng.me

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Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	API Usability of Machine Learning Libraries
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	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.
Tasks during the Internship: *(max. 50 words)*	Interns will be integrated in a group of PhD and master's students. 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.
Required Skills for the Internship: *(max. 50 words)*	- Motivated learner, critical thinker, and team contributor - Programming skill in python - Knowledge about one or more machine learning library - Knowledge and/or interests about user-centered approaches and usability
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Jinghui Cheng Title: Assistant Professor Department: Computer and Software Engineering Website: http://jhcheng.me

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Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☑ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Planning and Operations for Electric Power Systems with Renewables
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	The integration of renewables to electric power systems is inducing important changes to the way they are planned and operated, in particular due to the intermittency of the renewable sources of generation. A key element for their integration while ensuring the grid resiliency and stability is the design of more flexible systems. An increase in flexibility can be achieved both on the demand and generation side. In my research group, we develop models and dedicated numerical methods for modern, more flexible grids. Interested candidates are encouraged to contact me to discuss specific projects tailored to their background.
Tasks during the Internship: *(max. 50 words)*	The candidate will be tasked with mathematical modelling of power system problems, designed specialized methods to tackle efficiently our problems, and/or conducting numerical experiments to evaluate the performance of our approaches.
Required Skills for the Internship: *(max. 50 words)*	The applicant must have programming experience (Python, MATLAB, etc.). Background knowledge in optimization, control theory, machine learning, or power systems is also required.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Antoine Lesage-Landry Title: Assistant Professor Department: Electrical Engineering Website: https://www.polymtl.ca/expertises/en/lesage-landry-antoine

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2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☑ Electrical ☑ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Simulating 5G Applications in very large smart cities
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	This project deals with continuing the large-scale simulator development for 5G applications and their evaluation of their Quality of Experience. The project invoves telecom, Machine learning, statistics and optimization methods. There is also front-end development. Several students of different levels can work in this project.
Tasks during the Internship: *(max. 50 words)*	Software development, data gathering, production of tests, literature review, report and paper writing.
Required Skills for the Internship: *(max. 50 words)*	Very good grades, excellent technical judgment, interested in mathematical modelling. Python programming.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Brunilde Sansò Title: Professor Department: Electrical Engineering Website: https://www.trafficm2modelling.com

** 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.*

PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☑ Electrical ☑ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Problems in Green networking
University Cycle :	☑ 1st cycle (Undergraduate)　☑ 2nd cycle (Master)　☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	This project deals with optimization and simulation methods to design networks that can work only with solar energy. There is also front-end development. Several students of different levels can work in this project.
Tasks during the Internship: *(max. 50 words)*	Software development, data gathering, production of tests, literature review, report and paper writing.
Required Skills for the Internship: *(max. 50 words)*	Very good grades, excellent technical judgment, interested in mathematical modelling. Python programming.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name:　Brunilde Sansò Title:　Professor Department:　Electrical Engineering Website:　https://www.trafficm2modelling.com

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☑ Electrical ☑ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Ultra reliable telecommunication networks
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	As climate change brings new types of failures, the telecommunication infrastructure must be able to sustain those failures. This project deals with the modelling, imulation and optimization implementation of comprehensive systems to increase network reliability and availability while insuring network sustaininbility. Several students of different levels can work in this project.
Tasks during the Internship: *(max. 50 words)*	Software development, data gathering, production of tests, literature review, report and paper writing.
Required Skills for the Internship: *(max. 50 words)*	Very good grades, excellent technical judgment, interested in mathematical modelling. Python programming.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Brunilde Sansò Title: Professor Department: Electrical Engineering Website: https://www.polymtl.ca/expertises/en/sanso-brunilde

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☑ Electrical ☑ Mathematics/Industrial ☐ Mechanical ☑ Physics
Research Project Title : *(max. 10 words)*	Algorithms for IP/optical network defragmentation
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	A fundamental problem that arises in the design of optical networks is how to defragment the connections. This project deals with network defragmentation in a multi-layer setting. The project includes mathematical modelling, data mining, algorithmic implementation as well as network controller implementation. Several students of different levels are needed in this project.
Tasks during the Internship: *(max. 50 words)*	Software development, data gathering, production of tests, literature review, report and paper writing.
Required Skills for the Internship: *(max. 50 words)*	Very good grades, excellent technical judgment, interested in mathematical modelling. Python programming.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Brunilde Sansò Title: Professor Department: Electrical Engineering Website: https://www.polymtl.ca/expertises/en/sanso-brunilde

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☑ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : (max. 10 words)	Communication System Design for Deep Space Networks: The Role of Metasurfaces
University Cycle :	☐ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: (max. 100 words)	Communication activities in deep space are expected to be supported by relays. Understanding their critical role to support sustainable space networks, relay nodes are needed for reliable and efficient communication for Earth connectivity. Furthermore, to alleviate the high path loss that is observed due to the distances of thousands of kilometers, relay nodes can be equipped with programmable metasurfaces, frequently referred to reflective intelligent surfaces (RIS), to aid the improve the communication reliability. The goals of this internship is to understand the related design requirements investigation the possible performance improvement that can be obtained through the use of RIS units.
Tasks during the Internship: (max. 50 words)	1. Reading, understanding and summarizing the existing related literature 2. Simulation studies regarding the communication channels (RF or FSO) 3. Investigation of the use of RIS units for performance improvement 4. Quantification of the performance through simulation studies
Required Skills for the Internship: (max. 50 words)	Probability theory Basic communication system theory Basic programming skills
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Gunes Karabulut Kurt Title: Associate Professor Department: Electrical Engineering Website: https://www.polymtl.ca/expertises/karabulut-kurt-gunes

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Civil, Geological, Mining ☐ Mathematics/Industrial	☐ Biomedical ☐ Computer/Software ☐ Mechanical	☐ Chemical ☑ Electrical ☐ Physics
Research Project Title : *(max. 10 words)*	Secure Satellite Communication Systems: Design of Physical Layer Security Solutions			
University Cycle :	☐ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)			
Background Information: *(max. 100 words)*	Emerging low-Earth orbit satellite mega-constellations have a high potential to address global connectivity problems both in rural areas and densely populated metropolitan centers. The communication security between the inter-satellite links (ISLs) is an issue that is yet to be addressed by the literature in a comprehensive manner. The goals of this internship include understanding system constraints of the ISLs and the corresponding signal models, and design and development of new secure ISL communication strategies through techniques including beamforming, power control, and artificial noise, possibly supported via machine learning applications.			
Tasks during the Internship: *(max. 50 words)*	1. Reading, understanding and summarizing the existing related literature 2. Simulation studies regarding satellite networks 3. Design of new secure ISL communication approaches 4. Performance evaluation through simulation studies			
Required Skills for the Internship: *(max. 50 words)*	Probability theory Basic communication system theory Basic programming skills			
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No			
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so			
Supervisor:	Name: Gunes Karabulut Kurt Title: Associate Professor Department: Electrical Engineering Website: https://www.polymtl.ca/expertises/karabulut-kurt-gunes			

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace	☐ Biomedical	☐ Chemical
	☐ Civil, Geological, Mining	☑ Computer/Software	☑ Electrical
	☐ Mathematics/Industrial	☐ Mechanical	☐ Physics
Research Project Title : *(max. 10 words)*	Binarized neural networks : implementation, optimization and explanation		
University Cycle :	☑ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	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. https://scholar.google.com/citations?user=yVubPz4AAAAJ&hl=en&oi=sra		
Tasks during the Internship: *(max. 50 words)*	Write code for Artificial Intelligence (AI) mostly in Python (Pytorch) Test / optimize algorithms for AI Write report/paper		
Required Skills for the Internship: *(max. 50 words)*	Some background in AI (neural networks) Python, ideally some background with PyTorch C/C++		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Jean Pierre David Title: Professor Department: Electrical Engineering Website: https://www.polymtl.ca/expertises/david-jean-pierre		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace	☐ Biomedical	☐ Chemical
	☐ Civil, Geological, Mining	☑ Computer/Software	☑ Electrical
	☑ Mathematics/Industrial	☐ Mechanical	☐ Physics
Research Project Title : *(max. 10 words)*	Autonomous systems, control systems, robotics, navigation systems		
University Cycle :	☐ 1st cycle (Undergraduate)	☑ 2nd cycle (Master)	☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Internships are possible that are related to my group's activities on - decision-making under uncertainty, reinforcement learning - multi-agent and networked control systems, robotic networks - application of mean-field games to multi-agent systems - control under information constraints, security and privacy in cyber-physical systems - safe control of autonomous systems with machine learning in the loop - navigation systems, machine perception for info. acquisition - intelligent bi-directional human-robot interfaces Interested applicants can contact me to discuss in more details. For more information, see http://www.professeurs.polymtl.ca/jerome.le-ny/		
Tasks during the Internship: *(max. 50 words)*	Tasks can range from theoretical studies to experimental robotics. TBD based on the profile of the candidate.		
Required Skills for the Internship: *(max. 50 words)*	Training in at least one area among: control theory, robotics, signal processing, machine learning for 3D perception, applied mathematics, human-machine intereraction, etc.		
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No		
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so		
Supervisor:	Name: Le Ny, Jerome Title: Associate professor Department: Electrical Engineering Website: http://www.professeurs.polymtl.ca/jerome.le-ny/		

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☐ Mechanical ☑ Physics
Research Project Title : *(max. 10 words)*	Optical nose on chip
University Cycle :	☐ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	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: polymtl.ca/carrefour-actualite/en/innovatio/optical-nose-analyzing-gas-mixtures
Tasks during the Internship: *(max. 50 words)*	Assembly of the optical nose. Taking optical measurements on different gas compositions.
Required Skills for the Internship: *(max. 50 words)*	Optical experiments, gas handling, polymer synthesis, electronic control, data acquisition
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Yves-Alain Peter Title: Professor Department: Engineering Physics Website: www.polymtl.ca/pomp/en

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☑ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☐ Electrical ☑ Mathematics/Industrial ☐ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Automated Fault Diagnostic Algorithm in Process Control on Human Performance
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Major failure in process control affects multiple systems and trigger alarm floods. They are troublesome for operators trying the determine the failure's source because the quantity of alarms is too numerous to manage. Recent research has developed algorithms able to identify automatically the failure's cause and propose diagnosis to the operator, however, limited studies have been done on the interactions between the human and the automated diagnostic of failure in process control. The objective of this study is to investigate how the automated fault diagnostic affects the operator's decision-making, trust in the machine, and performance during high-workload scenarios.
Tasks during the Internship: *(max. 50 words)*	To this end, a simulated process control environment (simulating an automated diagnostic algorithm) was developed to enable interactions between operators and alarm diagnostics. The main task during the internship will be to support the main researchers in: 1) performing user testing using the simulator, 2) gathering data and, 3) analysing results.
Required Skills for the Internship: *(max. 50 words)*	Interpersonal skills, autonomy, great communication skills, works wells in a team, organized and meticulous, and have interest in the domain! Having experience with MATLAB, data analysis and human factors is a plus.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Philippe Doyon-Poulin Title: Professor Department: Industrial Engineering Website: https://www.polymtl.ca/expertises/en/doyon-poulin-philippe

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☑ Aerospace	☐ Biomedical	☑ Chemical
	☐ Civil, Geological, Mining	☐ Computer/Software	☐ Electrical
	☐ Mathematics/Industrial	☑ Mechanical	☐ Physics

Research Project Title : *(max. 10 words)*	Additive manufacturing of 3D printing of multi-material composite systems

University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)

Background Information: *(max. 100 words)*	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, solvant assisted, extrusion-based). My research team innovates with freeform, multi-material and multi-functional printing of complex mechanical/aerospace systems.
Tasks during the Internship: *(max. 50 words)*	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.
Required Skills for the Internship: *(max. 50 words)*	• Strong Mechanical/Aerospace Engineering or Material Sciences background • Interest for applied research, 3D printing technologies, CAD, robot programming • Interest for material characterization (e.g., optical microscopy, SEM, mechanical) • Good team worker with good communication skills
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Daniel Therriault Title: Professor Department: Mechanical Engineering Website: www.polymtl.ca/lm2/en

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☑ Aerospace ☐ Biomedical ☑ Chemical ☑ Civil, Geological, Mining ☑ Computer/Software ☐ Electrical ☑ Mathematics/Industrial ☑ Mechanical ☑ Physics
Research Project Title : *(max. 10 words)*	Exploration of deep learning algorithms in computational fluid dynamics
University Cycle :	☑ 1st cycle (Undergraduate) ☑ 2nd cycle (Master) ☑ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Over the past decade, artificial intelligence (AI) has been remarkably successful in many scientific and technological applications. However, it has only recently emerged as a new approach to computational fluid dynamics (CFD). Unlike classical CFD methods that solve the Navier-Stokes equations using computationally intensive Eulerian or Lagrangian discretisation approaches, deep learning-based AIs are trained to learn fluid dynamics and provide high-fidelity predictions in near-real time using dedicated libraries and data sets generated by classical CFD methods. Physics-informed neural networks and graph networks are two of the most promising deep learning algorithms, used in Eulerian and Lagrangian contexts respectively.
Tasks during the Internship: *(max. 50 words)*	1) review the AI approaches used in CFD; 3) generate an appropriate training dataset using an existing CFD code; 4) train an existing AI algorithm from the generated dataset; 5) test the ability for generalisation of the algorithm; 6) write a concise report on the results obtained.
Required Skills for the Internship: *(max. 50 words)*	1) Knowledge of fluid mechanics and some CFD tools; 2) Good computer and programming skills (e.g. knowldge of BASH scripting, Matlab/Python, C++/Fortran and/or parallel computing is an asset); 3) Knowledge or strong interest in deep learning and AI.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☑ Yes ☐ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☑ Yes ☐ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: David Vidal Title: Assistant Professor Department: Mechanical Engineering Website: https://www.polymtl.ca/expertises/vidal-david

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☑ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Design and Experiment with an Underactuated Walking Robot
University Cycle :	☑ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	This project consists in designing a new and improved prototype of an underactuated robotic leg that has been created in the Robotics Lab of Polytechnique Montreal. The previous version of this prototype can be seen in action at: https://youtu.be/w9Pv8jG_RRg This leg is able to mechanically modify its own kinematic structure in order to overcome unknown obstacles or uneven grounds. We are looking for a intern to design, 3D print, assemble and experiment a new, stronger, and better balanced prototype. Once a satisfactory design is produced, we will duplicate it to obtain a walking biped and try out different gait algorithms.
Tasks during the Internship: *(max. 50 words)*	- Inspection of the existing prototype, brainstorm better design ideas. - Design, 3D print and assemble the new design - Experiments and gather data - Assemble two legs to produced a bipedal robot and experiment.
Required Skills for the Internship: *(max. 50 words)*	- Excellent CAD skills and mechanical good practice - Familiarity with electronic basics (wiring, connections, basic programming skills) - Knowledge of design for 3D printing and ease with 3D printed part assembly
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Lionel Birglen Title: Professor Department: Department of Mechanical Engineering Website: www.polymtl.ca/labrobot/en/

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☑ Chemical ☐ Civil, Geological, Mining ☑ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☑ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Design of a Tracking Device for Mobile Robots
University Cycle :	☑ 1st cycle (Undergraduate) ☐2nd cycle (Master) ☐3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	This project stems for a need to record and analyze the motion of mobile machines developed in the Robotics Lab of Polytechnique Montreal. To properly assess the performance of these machines when traversing terrains, we need to track their motion (both in terms of position and orientation) with respect to time with a relatively good accuracy. The aim of this project is to design such a tracking system balancing accuracy with cost. Data fusion from multiple sources, e.g. IMU and cameras, will also probably need to be considered. A prototype needs to be developed and experimented with by the intern.
Tasks during the Internship: *(max. 50 words)*	- Literature review of existing solutions - Analysis and comparison of these solutions - Production of a design recommendation - Data acquisition and processing with the selected sensor(s) - Production of a technical specification of the developed system
Required Skills for the Internship: *(max. 50 words)*	- Excellent programming and interfacing skills - Basic electronics skills - Experience with image and data processing suggested - "Hands-on" attitude
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Lionel Birglen Title: Professor Department: Department of Mechanical Engineering Website: www.polymtl.ca/labrobot/en/

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☑ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Modeling and Mechanical Characterization of a Linkage for Robotic Walking
University Cycle :	☑ 1st cycle (Undergraduate) ☐2nd cycle (Master) ☐3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	Based on a previous design of robotic underactuated leg produced by the Robotics Lab of Polytechnique Montreal (https://youtu.be/w9Pv8jG_RRg), we are looking for a thorough mechanical characterization of this prototype. In particular, because of the large number of joints used, significant backlash and friction were observed. The aim of this internship is to quantify the friction and/or clearance in the joints as well as link flexibility if needed in order to implement all these phenomena in the theoretical model. This model will be compared to the experimental data and used both for guidance of future improvements and model-based control.
Tasks during the Internship: *(max. 50 words)*	- Design of experimental procedures to quantify friction, backlash, and flexibilty - Build a virtual model including all the previously identified parameters - Experimentation with the model to identify critical and most impactful parameters - Recommend changes in the prototype.
Required Skills for the Internship: *(max. 50 words)*	- Excellent mechanical skills, previous experience with practical systems an asset - Experience with a dynamic simulation software (CAD package or MSc Adams) strongly encouraged
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Lionel Birglen Title: Professor Department: Department of Mechanical Engineering Website: www.polymtl.ca/labrobot/en/

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PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☐ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☐ Electrical ☐ Mathematics/Industrial ☑ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Design of a Twisting String Actuation Robotic Gripper
University Cycle :	☑ 1ˢᵗ cycle (Undergraduate) ☐ 2ⁿᵈ cycle (Master) ☐ 3ʳᵈ cycle (Ph.D.)
Background Information: *(max. 100 words)*	A twisting string actuation (TSA) transmission uses wire(s) to transmit power from a motor to a load. When the motor rotates the wires are twisting themselves and provide a pulling force on the load. The aim of the project is to improve on a very basic TSA gripper previously designed in our lab and produce a complete robotic two-finger (or more!) gripper embedding the TSA transmission. To this aim, the intern needs to improve our single finger system and then, add passive return actuation and a servomotor system. Finally, how to mechanically drive at least two fingers will be studied.
Tasks during the Internship: *(max. 50 words)*	- Design of the mechanical subsystems - Selection of appropriate actuator and driver. - Fabrication and experiments.
Required Skills for the Internship: *(max. 50 words)*	- Excellent CAD skills - Good knowledge of DC, servo and BLDC motors as well as their control - Familiarity with design for 3D printing - Basic knowledge of electronics and embedded programming an asset.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☑ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Lionel Birglen Title: Professor Department: Department of Mechanical Engineering Website: www.polymtl.ca/labrobot/en/

* 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.

PROJECT DESCRIPTION
2022 Winter Research Internship Scholarship Program

Main area of expertise :	☑ Aerospace ☐ Biomedical ☐ Chemical ☐ Civil, Geological, Mining ☐ Computer/Software ☑ Electrical ☑ Mathematics/Industrial ☑ Mechanical ☐ Physics
Research Project Title : *(max. 10 words)*	Design and construction of a continuous fiber 3D print-head
University Cycle :	☑ 1st cycle (Undergraduate) ☐ 2nd cycle (Master) ☐ 3rd cycle (Ph.D.)
Background Information: *(max. 100 words)*	3D printing is increasingly moving from being a prototyping technique towards being one of the mainstream fabrication solutions. With continuous advancements in the materials and structures being produced via 3D printing, one of the major advantages of this technique is in the possibility of fabricating entire structures or systems on a single platform. Researchers have been creating multimaterial platforms for creating electronic devices, biomedical solutions, even organs on chips. Continuous fiber integration into polymeric structures results in locally strengthening structures, one of the major applications of 3D printing. This thesis aims to create and upgrade such continuous fiber printing head.
Tasks during the Internship: *(max. 50 words)*	1) Upgrade and intial design of a 3D print-head attachment. 2) Add mechanism like automated cutting tool to increase the efficiency of the tool head. 3) 3D print the non-moving parts of the print-head attachment. 4) Programming of the stepper motors and synchronizing the print-head attachment with the print-head of the 3D printer.
Required Skills for the Internship: *(max. 50 words)*	- Enthusiastic towards creating things and have hands-on experience, independently driven, well versed with design softwares like CATIA and AutoCAD. Have experience with programming micro-controllers, stepper motors. Experience with 3D printing and programming languages like Python, MATLAB is recommended.
Confidentiality and Intellectual Property *	Will the signature of a **"Confidentiality Agreement"** be required? ☐ Yes ☑ No Will the signature of an **"Assignment of Intellectual Property"** be required? ☐ Yes ☑ No
Location:	☑ Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) ☐ Other, please specify: ☐ This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Sampada Bodkhe Title: Assistant Professor Department: Mechanical Engineering Website: https://www.polymtl.ca/expertises/bodkhe-sampada-0

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