



POLYTECHNIQUE
MONTREAL

RESEARCH INTERNSHIP PROGRAM

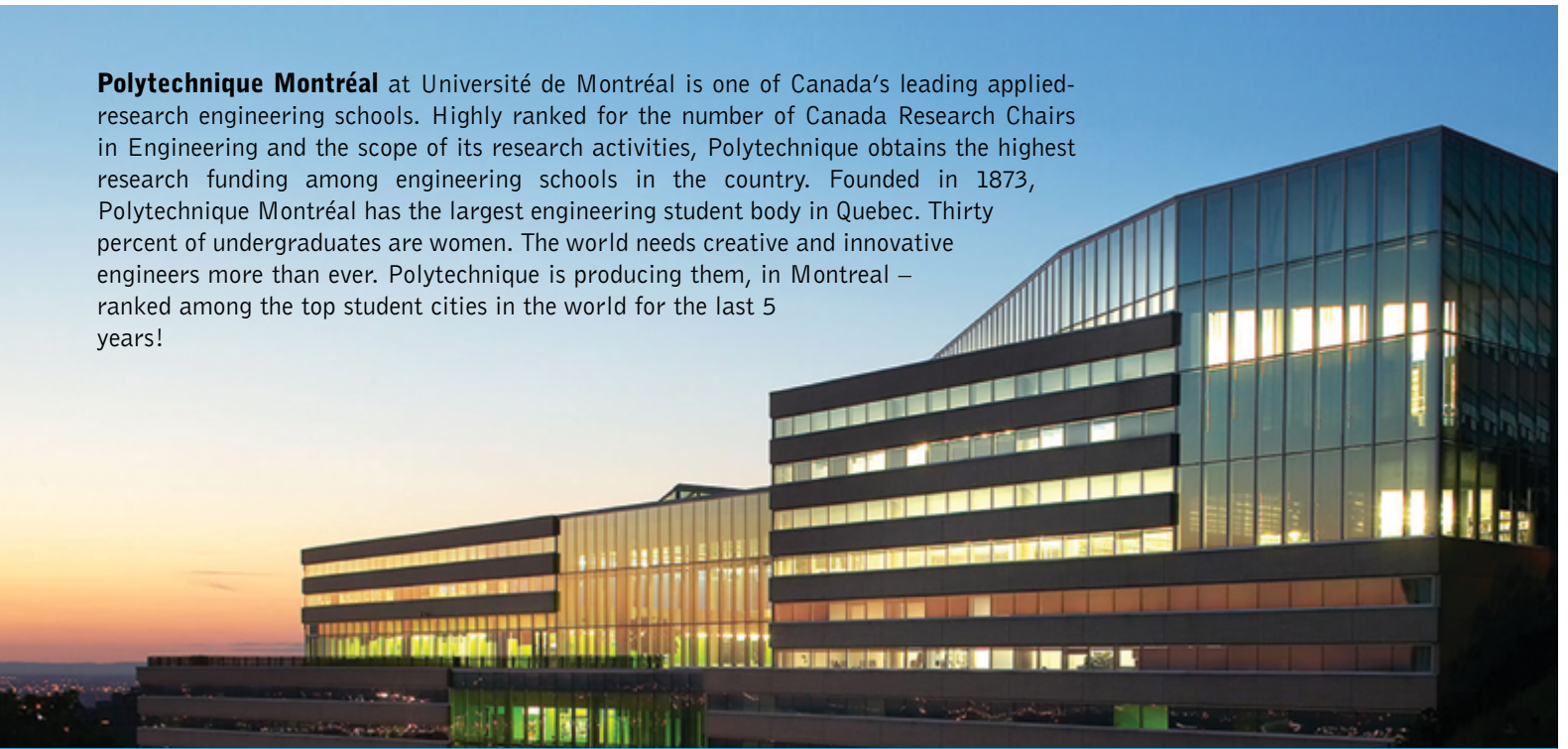
POLYTECHNIQUE
MONTREAL

TECHNOLOGICAL
UNIVERSITY



WINTER 2023

Polytechnique Montréal at Université de Montréal is one of Canada's leading applied-research engineering schools. Highly ranked for the number of Canada Research Chairs in Engineering and the scope of its research activities, Polytechnique obtains the highest research funding among engineering schools in the country. Founded in 1873, Polytechnique Montréal has the largest engineering student body in Quebec. Thirty percent of undergraduates are women. 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 carried out in the lab or *in situ*.

DURATION

The recommended duration of the internship is 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 university Program Coordinator before applying. Note that it is a full-time research internship (7 hours a day, 35 hours a week).

FINANCIAL ARRANGEMENT

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

Outstanding candidates may receive one of the 30 scholarships available! Maximum amount of the scholarship: 4,000 CAD for 4 months (prorated at 1,000 CAD/month).

ELIGIBILITY CRITERIA

- Enrolled in one of Polytechnique Montréal's partner universities
- Be officially nominated by your home university Program Coordinator
- 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
- Enrolled in a full-time program and will continue to be enrolled after your internship
- Minimum GPA of 2.75 out of 4 (or equivalent)
- Meet the required skills for the internship
- Be fluent in English or in French (no language test required)



REQUIRED DOCUMENTS FOR APPLICATION

- Online Application Form;
- 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);
- Letter of motivation including:
 - name of professor;
 - title of the project;
 - your interest in working in the selected project;
 - your skills in respect to the project.If you have selected 2 research projects, provide a letter of motivation for each project.
- Copy of your passport;
- Curriculum vitae (CV);
- 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)

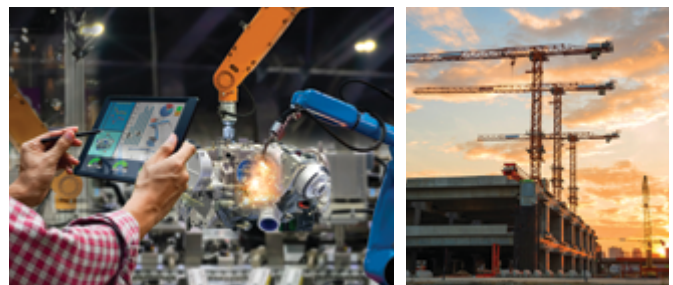
APPLICATION PROCEDURE

Click [**here**](#) to apply and send all required documents by August 22, 2022.

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

ANNOUNCEMENT

The results will be announced in September 2022 to all participating universities' Program Coordinators. Selected candidates will receive an official Invitation Letter necessary to undertake their immigration procedure according to their status. Note that we encourage the Short-term (120 days) work permit exemption for researchers.



AEROSPACE ENGINEERING

1	The CogniFly: the world's first sub-250g collision resilient artificial intelligence drone
2	Understanding the hydrodynamics of particle swarms through simulation
3	Development of numerical models to simulate granular flows
4	Additive manufacture of smart composites
5	Digital twin for hydroelectric generating unit
6	Drag reduction by elastic reconfiguration of a flat plate in a wind tunnel
7	Meso-scale numerical simulation of 3D fiberglass composite under vibration
8	Experimental validation of a structural damping system
9	Additive manufacturing of 3D printing of multi-material composite systems
10	Advanced additive manufacturing of multifunctional materials

BIOMEDICAL ENGINEERING

11	The Portiloop: a deep-learning tool for closed-loop brain stimulation
12	A.I.-control of neurostimulation interfaces
13	Neuroprosthesis to reverse hand/arm paralysis after spinal cord injury
14	Self healing electronic materials
15	Novel electroencephalography (EEG) devices
16	Conducting polymer biosensors using Kirigami patterns
17	On-skin electronics
18	Fabrication of ultra-flexible neural probe with silk shuttle
19	Acquisition, processing and visualization of biomedical signals for rehabilitation robots
20	Design of a control system for a pediatric exoskeleton robot
21	Design and prototyping of a semi-active ankle exoskeleton
22	Modeling, simulation and analysis of a gait exoskeleton in the Float system
23	Real-time quantification of muscle forces
24	Re-design of a robotic arm to assist patients with musculoskeletal disorders
25	Cellular electrochemistry on paper
26	Revealing microbial adhesion dynamics by single-molecule force spectroscopy
27	Smart materials for imaging cells in 3D
28	Development of a new single-molecule sensitive diagnostic device

CHEMICAL ENGINEERING

29	Supercritical-CO2 vs Microwave cannabis oil extraction
30	Integration of microplastics impacts in LCA
31	Printed and flexible organic transistors
32	Polymethylmethacrylate (PMMA) depolymerization in a stirred tank reactor
33	Capital cost estimation of chemical recycling plastic plants
34	Recycling Technologies for Polymer Automotive Components
35	Fischer-Tropsch pilot plant reactor control

36	Electrified catalytic partial oxidation (CPOX) of natural gas at high pressure
37	Fluidized bed conversion of lactose from cheese whey to lactic acid
38	Cheese whey waste to chemicals in a spinning disk reactor
39	Surface engineering of materials

CIVIL, GEOLOGICAL AND/OR MINING ENGINEERING

40	UHPFRC: From material development to structural applications
41	Next generation of drilling tools for subsurface investigation on the Moon and beyond
42	Automated mining on the Moon, Mars, and beyond
43	AI-based recognition tool to detect sites susceptible to permafrost carbon feedback
44	Laboratory experimental testing of partially saturated waste mining rockfill

COMPUTER AND SOFTWARE ENGINEERING

45	Collaborative Simultaneous Localization and Mapping
46	User experience (UX) design for AI-empowered systems
47	Supporting user experience (UX) design of open source software
48	Intelligent image mining for user interaction design
49	Intelligent text mining of open source discussions
50	Experimental setup and application in edge intelligence
51	AI0ps for digital twin applications
52	Software defect classification for defect detection

ELECTRICAL ENGINEERING

53	Implementation, optimization and explanation of binarized neural networks
54	Autonomous systems, control systems, robotics, navigation systems
55	Planning and operations methods for electric power systems with renewables
56	Novel optical fiber sensor development and applications
57	Novel photonic devices and integration by laser fabrication techniques

ENGINEERING PHYSICS

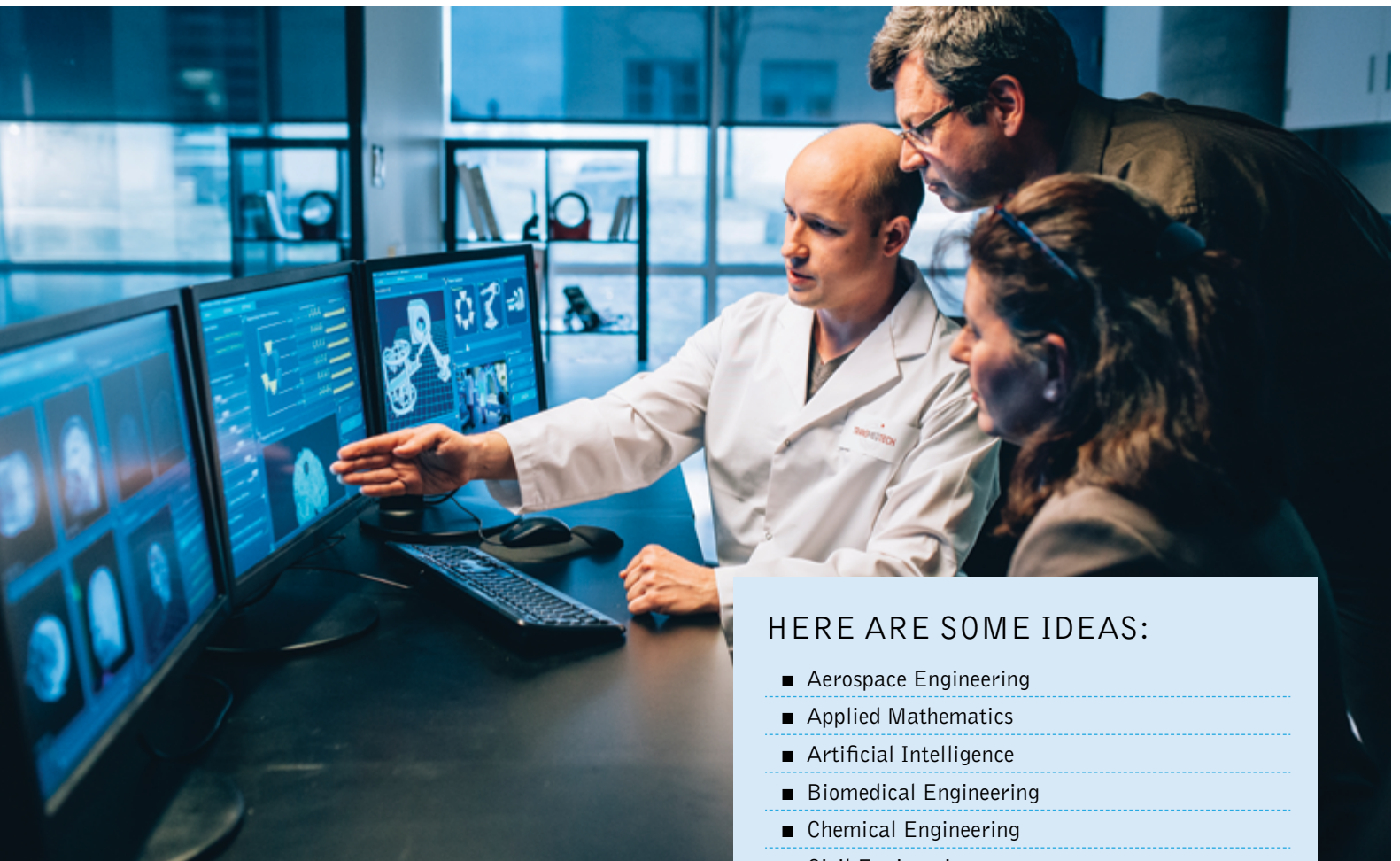
58	Foundations of stochastic electrodynamics
59	Determining Limits on General Photonic Devices
60	Optical nose on chip

MATHEMATICS AND INDUSTRIAL ENGINEERING

61	Effects of automated diagnostic algorithm on human trust and workload
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MECHANICAL ENGINEERING

62	Design and experiment with an underactuated walking robot
63	Design of a tracking device for mobile robots
64	Design of a twisting string actuation robotic gripper
65	Development of simulation tools for geothermal heat pump systems



ADDITIONAL AREAS OF EXPERTISE

YOU DIDN'T FIND WHAT YOU WERE LOOKING FOR?

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

HERE ARE SOME IDEAS:

- Aerospace Engineering
- 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

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

For any questions regarding your application, please contact: Polytechnique Montréal International • point@polymtl.ca

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Research Project Title : <i>(max. 10 words)</i>	The CogniFly: the world's first sub-250g collision resilient artificial intelligence drone
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The CogniFly Project focuses on the development of autonomous, collision resilient, flying robots, under 250g, powered by artificial intelligence. Everything is open source and available on our github repository (github.com/thecognifly/). We have many possible exciting projects related to embedded systems, artificial intelligence, robotics perception and localization, control systems, simulators and more!
Tasks during the Internship: <i>(max. 50 words)</i>	There are many cool tasks, that you will be able to show off on your CV later, related to The Cognifly Project and the main topics are: flight controller (iNAV) custom firmware, Python API, automatic battery swapping, parameter auto tuning, simulation (digital twin), wind effect on battery and control, SLAM / VIO, artificial intelligence using Coral Dev Mini.
Required Skills for the Internship: <i>(max. 50 words)</i>	The most important skill is the knowledge (programming / debugging) of Python and/or C/C++. Other specific skills will depend on the task chosen by the intern (e.g. automatic battery swapping needs 3D CAD).
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> 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://thecognifly.github.io/

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Research Project Title : <i>(max. 10 words)</i>	Understanding the hydrodynamics of particle swarms through simulation
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The flow of swarm of particles play a critical role in fluidized bed and spouted bed reactors , dryer and multiple other unit operations that are prevalent in the chemical process industry. The design of these unit operations remains a considerable challenge. This is in large part cause by the hydrodynamic interaction between the particles. Indeed, even if the macroscopic flow around the particles is uniform, the interaction between the fluid and the particle generate complex structures that greatly affect the efficiency of these process. The goal of this project is to further our understanding of these type of flows throughout direct numerical simulations (DNS) of particle-laden flows.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Carry out simulation of the hydrodynamics of freely moving particle using a high-performance open-source CFD code - Develop a methodology to post-process the simulation results in Python - Validate results with experiments
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - An interest in numerical simulation - Some knowledge on fluid dynamics or classical mechanics - Some Python or C++ programming experience - Basic knowledge about the Linux operating system
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Supervisor:	Name: Bruno Blais Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/blais-bruno

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Research Project Title : <i>(max. 10 words)</i>	Development of numerical models to simulate granular flows
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Metal additive manufacturing (AM) is growing fast, progressively moving from prototyping and R&D to part production. Most metal AM processes use metal powder as their base feedstock and several flowability challenges remain to be solved to facilitate this transition toward high-end applications. Poor understanding of powder flowability lead to severe problems for manufacturers which can lead to failure of the printed part due to the presence of porous zones or high residual stresses. This project aims at better characterising and predicting the flow behaviour of AM powders, and improving powder flow simulation.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Design and carry out Discrete Element Method (DEM) simulations; - Develop in C++ without our high-performance DEM code; - Develop tools to post-process DEM simulation results.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - An interest in numerical simulation - Some knowledge on fluid dynamics or classical mechanics - Some Python or C++ programming experience - Basic knowledge about the Linux operating system
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Research Project Title : <i>(max. 10 words)</i>	Additive manufacture of smart composites
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Additive manufacturing is evolving 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. Multi-material 3D printing can be used to locally strengthening structures, adding functionalities and other exciting properties. Multiple positions are available in multi-material 3D printing of smart materials.
Tasks during the Internship: <i>(max. 50 words)</i>	Projects can be a combination of the following : 1) Be trained to work in an laboratory environment; 2) Development of materials for FDM, Direct-write or SLA 3D printing processes; 3) Improve AM process and adapt them to smart materials; 4) fabricate and test the smart materials in laboratories and real world environments.
Required Skills for the Internship: <i>(max. 50 words)</i>	One or more of the following combinations of skills would be required : 1) 3D printing knowledge, mechanical design, CAD; 2) Python/C++/ Arduino programming; 3) Microprocessors programming, circuits developments; 4) Experience with building things.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
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Supervisor:	Name: Sampada Bodkhe Title: Assistant professor Department: Mechanical engineering. Website: https://www.polymtl.ca/expertises/en/bodkhe-sampada-0

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

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Research Project Title : <i>(max. 10 words)</i>	Drag reduction by elastic reconfiguration of a flat plate in a wind tunnel
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Plants rely on their flexibility to change form and reduce their drag when subjected to fluid flow. Flexibility allows plants to reduce their drag through reconfiguration, however it is well known that flexibility can also lead to a loss of stability and thus increased dynamical loads. Fluttering flags are a good example. In the proposed project, we will consider the limitation to reconfiguration brought by a dynamic loss of stability in constant uniform flow. To understand the trade-off that flexibility brings to real plants in terms of drag reduction and loss of stability, we will study an idealised system: a thin flat plate clamped at its centre and subjected to a normal flow in a wind tunnel.
Tasks during the Internship: <i>(max. 50 words)</i>	You will join a team to work on the modeling or the experimental side of the project according to your strength and interests. Your tasks will vary between deriving equations, coding models, running simulations or designing, sizing, manufacturing, assembling and testing an experimental setup and performing wind tunnel tests.
Required Skills for the Internship: <i>(max. 50 words)</i>	Skills are optional, motivation and will to learn are mandatory! Modeling: coding (python, matlab, C), fluid mechanics, vibration and dynamics, finite element analysis, computational fluid dynamics. Experimenting: CAD (Catia, Solidworks), designing, machining, instrumentation.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Research Project Title : <i>(max. 10 words)</i>	Meso-scale numerical simulation of 3D fiberglass composite under vibration
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Nomex/carbon sandwiches have become one of the aerospace standard materials due to their excellent mechanical properties. However, the combination of lightweight and high stiffness leads to poor vibration damping performances. Yet, it is essential to control and damp vibrations to guarantee the performances and integrity of a structure.</p> <p>As an alternative to Nomex, a 3D fiberglass fabric is currently being investigated as core replacement in sandwich composites. The aim of this internship is to develop a finite element (FE) model of this 3D fiberglass fabric at a meso-scale level in order to fully understand its behaviour under vibration.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	The tasks that the intern will carry out are as follows: reproduce the geometry of the 3D fiberglass structure ; mesh this geometry using finite elements ; perform numerical simulations using Ansys software ; compare the numerical results with the provided experimental data.
Required Skills for the Internship: <i>(max. 50 words)</i>	Knowledge of non-linear finite element simulation is required, with priority given to a candidate who has experience with Ansys. Knowledge of vibration analysis is an asset. The intern must be rigorous, disciplined, and capable of working autonomously. Good communication and initiative spirit are two other required skills
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
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Supervisor:	<p>Name: Annie Ross</p> <p>Title: Professor</p> <p>Department: Mechanical Engineering</p> <p>Website: https://www.polymtl.ca/expertises/ross-annie</p>

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Research Project Title : <i>(max. 10 words)</i>	Experimental validation of a structural damping system
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Structural vibrations are often undesirable. They originate and accelerate many mechanical issues, such as structural fatigue and damage, as well as causing acoustic noise. Therefore, it is essential to control and damp vibrations to guarantee the performances and integrity of a structure. It is a major challenge in numerous industries, such as automotive, aerospace, and transport.</p> <p>The aim of this internship is to validate, through experimental testing, the efficiency of multiple damping designs developed at the Laboratory for Acoustics and Vibration Analysis (LAVA) of Polytechnique Montréal.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	The tasks that the intern will carry out are as follows: fabricate test specimens ; conduct experimental characterization tests: mechanical ones (tensile, flexural...) using Instron testing machines, and vibratory (resonant frequencies, damping properties...) using a shaker ; analyze the acquired data to validate the design predictions ; write a concise internship report.
Required Skills for the Internship: <i>(max. 50 words)</i>	The intern must be rigorous, disciplined, and capable of working autonomously. Good communication skills and showing initiative are two other requirements. Prior experience in mechanical testing and vibrations is an asset.
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2023 Winter Research Internship Program

Main area of expertise :	<input checked="" type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input checked="" type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input checked="" type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Additive manufacturing of 3D printing of multi-material composite systems
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Additive manufacturing, or three-dimensional (3D) printing, of composites is a grouping of different shaping processes that allows the fabrication of structures through robotic deposition of material by means of a computer model. This technology is a very promising avenue for the implementation of many mechanical and aerospace systems. My research team focuses on the development of advanced composite materials offering multiple functionalities (where multiple properties are desired for a given application) for additive manufacturing (e.g., FDM, SLA, solvent assisted, extrusion-based). My research team innovates with multi-material and multi-functional printing of complex mechanical/aerospace systems.
Tasks during the Internship: <i>(max. 50 words)</i>	The intern will assist a senior graduate student (MS or PhD) with the realization of his or her research project. The main tasks are: design of composites, mixing of fillers, characterization of various material properties, tailoring of printing parameters, design of experiments, CAD design, robot programming, and 3D printing.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> • 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? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> 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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Research Project Title : <i>(max. 10 words)</i>	Advanced additive manufacturing of multifunctional materials
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Additive manufacturing (AM) or 3D printing refers to a family of processes of joining materials in order to fabricate objects layer by layer from a computer-aided-design (CAD) model. Our team at the Laboratory of multi-scale mechanics (LM2) develops new materials and printing processes mainly for aerospace applications. For this internship project, on the material side, the intern will mix the best nanoscopic or microscopic materials inside different types of polymers for improved electrical and mechanical properties while innovating in 3D printing methods using commercial and custom-made printers.
Tasks during the Internship: <i>(max. 50 words)</i>	The intern will work in collaboration with other graduate students from the research group. His/her tasks will be to assist the senior students with some of their experiments and data analysis (e.g., material characterization, tailoring of printing parameters, mechanical tests). He/she will participate in meetings.
Required Skills for the Internship: <i>(max. 50 words)</i>	Background in Mechanical or Chemical Engineering or Materials Science, Materials science (polymers, composites, nanocomposites), CAD (e.g., CATIA v. 5), Experimental material characterization (e.g., microscopy, mechanical testing), Basic programming skills (e.g., Matlab, LabView).
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Supervisor:	Name: Daniel Therriault Title: Professor Department: Mechanical Engineering Website: https://www.polymtl.ca/lm2/

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Research Project Title : <i>(max. 10 words)</i>	The Portiloop: a deep-learning tool for closed-loop brain stimulation
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Closed-loop brain stimulation refers to capturing neurophysiological measures such as electroencephalography (EEG), quickly identifying neural events of interest, and producing auditory, magnetic or electrical stimulation so as to interact with brain processes precisely. It is a promising new method for fundamental neuroscience and perhaps for clinical applications such as restoring degraded memory function; however, existing tools are expensive, cumbersome, and offer limited experimental flexibility. We designed the Portiloop, a deep learning-based, portable and low-cost closed-loop stimulation system able to target specific brain oscillations.
Tasks during the Internship: <i>(max. 50 words)</i>	You will help improve the design of the Portiloop PCB, build systems, collect EEG data, filter and analyze signals, and develop AI signal recognition using the Portiloop neural accelerator (Google Coral).
Required Skills for the Internship: <i>(max. 50 words)</i>	Signal processing and filtering is necessary, as well as a general understanding of electrical signals. Knowledge of PCB design, embedded systems, and Linux are also recommended.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> 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://thecognifly.github.io/

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Research Project Title : <i>(max. 10 words)</i>	A.I.-control of neurostimulation interfaces
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The sciNeurotech Lab develops A.I. technology enabling unprecedented control of neuromodulation delivery. Neuromodulation means stimulation therapies through electrical interfaces with the nervous system. These medical devices can help recovery mobility, communication and sensation after a neurotrauma or disease. We use Bayesian Optimization (BO) for personalized and efficient maximization of neurostimulation efficacy. You can think of it as a self-drive module for neurostimulation. A current limitations is that neural interfaces are inherently unstable: challenges include loss of electrodes, gains/loss of stimulation efficacy due to changes in the interface, network changes due to learning or plasticity.
Tasks during the Internship: <i>(max. 50 words)</i>	You will develop a theoretical novelty in A.I. optimization of neuromodulation, allowing our framework to handle non-stationarities typical of neural interfaces. You will code, validate in silico (and optionally in vivo) a new BO-based technique.
Required Skills for the Internship: <i>(max. 50 words)</i>	Very proficient coding for machine learning / A.I. Programming in Python and/or Matlab.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Marco Bonizzato Title: Assistant Professor Department: Electrical Engineering Website: https://www.linkedin.com/in/bonizzato/

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Research Project Title : <i>(max. 10 words)</i>	Neuroprosthesis to reverse hand/arm paralysis after spinal cord injury
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>The sciNeurotech Lab develops neuroprosthetic therapies. Neuroprostheses are electrical interfaces with the nervous system, which can let the user recovery mobility, communication and sensation after a neurotrauma or disease.</p> <p>We are currently developing an absolutely novel cortical neuromodulation intervention to improve reaching and grasping movements after spinal cord injury. We implant rats with cortical brain interfaces (similar to "Neuralink", but used to stimulate the brain networks) and we study the controllability of cortical stimulation on hand function. After a spinal cord injury, we are able to reverse motor deficits and recover hand/arm function.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	You will perform in vivo behavioral experiments in rats and collect kinematic data to study and optimize the control of movement that can be obtained by delivering cortical neuromodulation.
Required Skills for the Internship: <i>(max. 50 words)</i>	Behavioral animal research: patience, care, integrity. Kinematic analysis: handling Matlab or Python code. Ideal profile: competence in automation and control engineering.
Confidentiality and Intellectual Property *	Will the signature of a "Confidentiality Agreement" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Other, please specify: UdeM building (5min walk) <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Marco Bonizzato Title: Assistant Professor Department: Electrical Engineering Website: https://www.linkedin.com/in/bonizzato/

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Research Project Title : <i>(max. 10 words)</i>	Self Healing Electronic Materials
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The ability of certain materials to regenerate after damage has attracted a great deal of attention since the ancient times. For instance, self-healing concretes, able to resist earthquakes, aging, weather, and seawater have been known since the times of ancient Rome and are still the object of research. Self-healing conductors are still rare, and are nowadays attracting enormous interest for applications in electronic skin (E-skin) for health monitoring, wearable and stretchable sensors, actuators, transistors, energy harvesting, and storage devices, such as batteries and supercapacitors. In this project we will produce self healing electronic materials based on organic conducting polymers and study their self healing mechanism.
Tasks during the Internship: <i>(max. 50 words)</i>	The student will perform microfabrication, synthesis of self healing conducting polymers, electrical measurements, mechanical measurements.
Required Skills for the Internship: <i>(max. 50 words)</i>	Solid background in Engineering, Chemistry or Physics Fluency in English or French Basic knowledge of polymer chemistry and mechanical properties
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Supervisor:	Name: Fabio Cicoira Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/iontronics/en

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Research Project Title : <i>(max. 10 words)</i>	Novel electroencephalography (EEG) devices
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Electroencephalography (EEG) is a technic used to acquire biosignals from the brain using electrodes. However, the measurements may be contaminated by noise, called artifacts, resulting from the environment or the electrode leads. Recent progress in that field are proposing to use special transistors called organic electrochemical transistors (OECTs) for signal acquisition due to their amplification potential. Other research are proposing an algorithm to distinguish between the signal and artifacts. Thus, the present research is proposing the design and manufacturing of an improved EEG device using OECTs with an artifact rejection algorithm to improve diagnostic for health professionals.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	<p>Assisting in the literature review on OECTs, artifacts, algorithm, and their implication in EEG; Assisting in the design of the algorithm for artifact rejection on Python; Participate in the transistors measures collection and analysis (thickness, conductivity, etc.).</p>
Required Skills for the Internship: <i>(max. 50 words)</i>	<p>Knowledge of the Microsoft suite (Word, Excel, PowerPoint); Language requirements: English or French; Experience or knowledge of Python; A scientific background (human biology OR chemistry OR neurobiology OR electrochemistry OR psychology); Some experience in electrophysiology or EEG analysis is an asset.</p>
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
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Supervisor:	<p>Name: Fabio Cicoira</p> <p>Title: Full Professor</p> <p>Department: Chemical Engineering</p> <p>Website: https://www.polymtl.ca/iontronics/en</p>

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Research Project Title : <i>(max. 10 words)</i>	Conducting Polymer Biosensors using Kirigami Patterns
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Organic conducting polymers are very attractive candidates for biomedical applications such as electrodes or biosensors. The main objectives of this internship is to fabricate novel electrodes based on conducting polymers, to monitor body signals, using auxetic patterns. Auxetics are structures with a negative Poisson's ratio. When stretched, they will expand instead of getting thinner like conventional materials. They have been shown to increase durability of a material. Many parts of the body are composed of negative Poisson's ratio tissues. Using conductive polymers, auxetic patterns might prove useful for durable biomedical applications. The fabrication of auxetic sensors will be completed using 3D printed molds, laser cutting and drop-casting on flexible and stretchable substrates.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Literature review on auxetic materials - Fabrication of molds (3D printing), Precision cutting of samples (laser cutting), inkjet printing - Preparing and testing samples (strain, durability, electrotensile testings)
Required Skills for the Internship: <i>(max. 50 words)</i>	Motivation to work in a multidisciplinary field. Background in chemistry, chemical, mechanical and biomedical engineering. Active learner with good communication skills and team player. Familiarity with one 3D CAD software (autodesk Inventor, Fusion 360, Catia, etc.) would be an asset.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Supervisor:	Name: Fabio Cicoira Title: Full Professor Department: Chemical Engineering Website: http://www.polymtl.ca/iontronics/en

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Research Project Title : <i>(max. 10 words)</i>	On-skin electronics
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Epidermal patch electronics are widely explored for applications in human healthcare, such as monitoring of vital signs, body temperature and blood pressure, as well as for detection of analytes in bodily fluids . Monitoring of vital signs, via techniques such as electrocardiography (ECG), electromyography (EMG), and electroencephalography (EEG), is of utmost importance for wear- able electronics and point of care diagnostics.</p> <p>In this research, conductive polymers are used to fabricate epidermal electrodes which are self-healable and capable of recording ECG, EMG, and EEG signals.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Getting familiar with the subject by studying the related work - Participating in meetings to report progress or any potential issues - Perform fabrication and characterization experiments
Required Skills for the Internship: <i>(max. 50 words)</i>	<p>Solid background in Chemical or Biomedical Engineering Fluency in English or French Excellent communication skills Basic knowledge of biomedical instrumentation</p>
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
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Supervisor:	<p>Name: Fabio Cicoira</p> <p>Title: Professor</p> <p>Department: Chemical Engineering</p> <p>Website: https://www.polymtl.ca/iontronics/en/people</p>

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Research Project Title : <i>(max. 10 words)</i>	Fabrication of ultra-flexible neural probe with silk shuttle
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Neural probes are important for investigating the mechanisms of the brain. Flexible neural probes reduce the inflammatory response of the brain, thus allowing for chronic monitoring of neural signal in neuroscience research or in clinical use. We intend to fabricate flexible neural probes using photolithography methods and characterize the electrical and mechanical properties and the biological response to the probes in vivo, to assess if these probes demonstrate an advantage compared to current rigid neural probes.
Tasks during the Internship: <i>(max. 50 words)</i>	-Work in the cleanroom for photolithography and micro-deposition: Mask aligner; Metal evaporator; Oxygen Reactive Ion Etching system; -Work with analytical tools: Potentiostat; Scanning Electron Microscopy; Profilometer -Other minor lab works
Required Skills for the Internship: <i>(max. 50 words)</i>	Background in chemical and biomedical engineering. Knowledge Python, Matlab
Confidentiality and Intellectual Property *	Will the signature of a “ Confidentiality Agreement ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “ Assignment of Intellectual Property ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Research Project Title : <i>(max. 10 words)</i>	Acquisition, processing and visualization of biomedical signals for rehabilitation robots
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	POLAR (Polytechnique's Lab for Assistive and Rehabilitation technologies) has several ongoing projects related to utilizing robots for the purpose of rehabilitating patients with different neuromuscular disorders. In order to improve the design of these robots and and to validate their effect during the rehabilitation program, various types of biomedical data should be collected via sensors and analyzed to reveal information about the subject's behavior and robot's operation.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Study of the literature and familiarization with the laboratory equipment - Familiarization and participation in data collection using robotic systems. - Signal processing and data analysis - Data visualization, conclusion, writing of the research report
Required Skills for the Internship: <i>(max. 50 words)</i>	Knowledge in: Programming with MATLAB/SIMULINK and Python (basic knowledge) Signal analysis and processing Use of data acquisition systems and biomedical sensors (EMG, motion capture, etc)
Confidentiality and Intellectual Property *	Will the signature of a "Confidentiality Agreement" be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Other, please specify: Technopole in Pediatric Rehabilitation <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Abolfazl Mohebbi Title: Professor Department: Mechanical and Biomedical Engineering Website: www.polarlab.ca

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Research Project Title : <i>(max. 10 words)</i>	Design of a control system for a pediatric exoskeleton robot
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Polytechnique lab for assistive and rehabilitation technologies (POLAR) is working on designing a lower-limb exoskeleton robot for pediatric cerebral palsy patients. To incorporate this robot into rehabilitation programs and everyday assistance scenarios, proper impedance-based control systems as well as position/torque servo control systems should be designed and embedded into an on-board processing unit. This control system will regulate the physical interactions between the user and the exoskeleton. The on-board system will be also used to communicate data with the user interface of a software/mobile application to monitor the activity of the patient and their progress.
Tasks during the Internship: <i>(max. 50 words)</i>	literature study of the interactive control models for exoskeleton robots Modeling position/torque and impedance control systems using MATLAB/Simulink Implementation of the control model into a real-time system Validation tests.
Required Skills for the Internship: <i>(max. 50 words)</i>	Programming with MATLAB/SIMULINK and C++ (basic knowledge is required) Knowledge in Control Systems Design Experience with embedded processors (Arduino, Raspberry PI, etc)
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Research Project Title : <i>(max. 10 words)</i>	Design and prototyping of a semi-active ankle exoskeleton
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The rehabilitation procedure for a wide range of patients with neuromotor impairments requires customization of exercise intensity. In recent years, exoskeletons have been used to help patients in their rehabilitation programs. They are usually motorized (active) to induce additional forces and movements to assist users or to change the intensity of walking exercises. The primary application of this device will be focused on rehabilitation procedures. However, this device can be used for the assistance of the elderly and patients with neuromuscular disorders, as well as for sports and recreational purposes.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Develop a semi-active exoskeleton whose joint is not motorized, but its impedance is controlled by a motorized spring. - Develop a spring with variable stiffness using an electric motor and their editor. Prototype an ankle exoskeleton using 3D printers.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Expertise in Mechanisms design and mechanical components. - Expertise with 3D modeling - Knowledge in prototyping with 3D printers
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Other, please specify: Technopole in Pediatric Rehabilitation <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Abolfazl Mohebbi Title: Professor Department: Mechanical and Biomedical Engineering Website: www.polarlab.ca

** 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

2023 Winter Research Internship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input checked="" type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input checked="" type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input checked="" type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Modeling, Simulation and Analysis of a gait exoskeleton in the Float system
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	For millions of children with neuromuscular disorders, debilitating weakness makes everyday tasks nearly impossible, such as gait. And no satisfying commercial exoskeleton 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 exoskeleton, available to children who need it, thanks to 3D-printing. The objective of this project is to model and simulate the dynamics of this innovative exoskeleton of the lower limb, based on our expertise and infrastructure on multibody modeling, and measurements from the motion analysis system Float (https://reha-stim.com/fr/the-float/).
Tasks during the Internship: <i>(max. 50 words)</i>	Get familiarized with multibody dynamics (www.edx.org/course/modeling-and-simulation-of-multibody-systems-part-i) and with our motion capture systems including the FLOAT, following our training plan; perform measurements and multibody modeling; Technical Report, user's guide, and transfer.
Required Skills for the Internship: <i>(max. 50 words)</i>	Knowledge in mechanics / kinematics and dynamics. Ability to focus to follow training plans with devices. Taste for multidisciplinary project in an engineering team in a clinical environment.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Other, please specify: Technopole in pediatric rehabilitation <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Maxime Raison Title: Full professor Department: Mechanical engineering Website: https://www.polymtl.ca/recap/en/

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PROJECT DESCRIPTION

2023 Winter Research Internship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input checked="" type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input checked="" type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input checked="" type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Real-time Quantification of Muscle Forces
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	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 data from electromyography (EMG) and inertial motion units (IMU). 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: <i>(max. 50 words)</i>	Get familiarized with our musculoskeletal modeling in MATLAB and Python; Contribute to the development of a novel tool for real-time quantification of muscle forces based on musculoskeletal (probably in Python); Extend the musculoskeletal modeling; Technical Report, user's guide, and transfer.
Required Skills for the Internship: <i>(max. 50 words)</i>	Basic knowledge of coding in MATLAB and Python, but C++ is a plus; Basic knowledge about musculoskeletal modeling (biomechanics); Knowledge of filtering and optimization is a must; Taste for multidisciplinary project in an engineering team in a clinical environment.
Confidentiality and Intellectual Property *	Will the signature of a "Confidentiality Agreement" be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Other, please specify: Technopole in pediatric rehabilitation <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Maxime Raison Title: Full professor Department: Mechanical engineering Website: https://www.polymtl.ca/recap/en/

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Research Project Title : <i>(max. 10 words)</i>	Re-design of a Robotic Arm To Assist Patients with Musculoskeletal Disorders
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Robotics arms assisting patients with musculoskeletal disorders, such as JACO(TM) developed by the Canadian company Kinova, are emerging. Our research laboratory developed a very competitive assistive robotic arm, with 3D printing and Dynamixel motors, which can be commanded by either Matlab on a computer, or Arduino when embedded. This robot can not only assist beneficiaries, but even play ping pong.
Tasks during the Internship: <i>(max. 50 words)</i>	Adapt the robot to lower its cost: adapt the CAD files (Fusion 360) to integrate the 12A or 18A Dynamixel motor 6-packs (bulks); adapt the CAD files to integrate anti-gravitational mechanisms from already existing 3D printed mechanisms in our lab (but from other devices); assemble, test; Technical Report, user's guide, and transfer.
Required Skills for the Internship: <i>(max. 50 words)</i>	Knowledge of coding in Fusion 360 (Autodesk); Knowledge about design; Knowledge about command; Basic knowledge about Matlab and Arduino; Knowledge of robotics processing is a must; Taste for multidisciplinary project in an engineering team in a clinical environment.
Confidentiality and Intellectual Property *	Will the signature of a "Confidentiality Agreement" be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Other, please specify: Technopole in pediatric rehabilitation <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Maxime Raison Title: Full professor Department: Mechanical engineering Website: https://www.polymtl.ca/recap/en/

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Research Project Title : <i>(max. 10 words)</i>	Cellular Electrochemistry on Paper
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Electrochemical sensors can be built on paper using printing techniques. Chemical modifications can improve their sensitivity and selectivity, to build high-performance sensors in light, easy-to-use paper devices. The use of paper is a sustainable option over the use of plastics. Cells can also be grown on paper.</p> <p>The project will combine these 2 aspects by culturing endothelial cells (EC) on paper chips fitted with electrochemical sensors. The target molecule will be nitric oxide (NO), a ubiquitous molecule involved in tissue growth and cancer. The project can be adapted to fit 1st, 2nd and 3rd cycle requirements.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> -Design and characterize electrochemical sensors on paper. -Grow EC on these paper chips and confirm their viability. -Measure on-chip the chemical response of EC to angiogenic factors, focusing on NO. -Compare the cell results to the standard of the field (fluorescent assays)
Required Skills for the Internship: <i>(max. 50 words)</i>	<p>Required: Experience in laboratory work, interest in biology and/ or microdevices</p> <p>Desirable: Knowledge in basic biology, experience in cell culture</p>
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	<p>Name: Raphael Trouillon</p> <p>Title: Professeur Adjoint (Assistant Professor)</p> <p>Department: Electrical Engineering</p> <p>Website: https://www.polymtl.ca/expertises/trouillon-raphael</p>

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Research Project Title : <i>(max. 10 words)</i>	Revealing microbial adhesion dynamics by single-molecule force spectroscopy
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Bacteria have a significant impact on practically every facet of human activity. This is due in part to their astonishing ability to colonize nearly every type of biotic and abiotic surface and their potential to form biofilms.</p> <p>In order to prevent biofilm formation, we seek to understand the initial adhesion event that occurs between a single cell and a surface. Force sensing is thought to play a role in the process, but the detailed mechanism remains poorly understood.</p> <p>Together with collaborators, the Weiss Lab is developing the ultrasensitive tools needed to test this and other hypotheses related to cell-to-surface interactions.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	<p>In this project you will:</p> <ol style="list-style-type: none"> 1. Build an "optical tweezers" setup for applying forces to nano-microscale objects. 2. Deploy the system to stimulate cell interactions with surfaces.
Required Skills for the Internship: <i>(max. 50 words)</i>	The Weiss Lab is a diverse and interdisciplinary research. The ideal applicant has previous coursework experience using Matlab, Python, or equivalent; knowledge in one or more of: optics, microfluidics, electricity and magnetism, or circuits; and is committed to communication, teamwork and solving challenging problems.
Confidentiality and Intellectual Property *	<p>Will the signature of a "Confidentiality Agreement" be required?</p> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
	<p>Will the signature of an "Assignment of Intellectual Property" be required?</p> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	<p>Name: Lucien Weiss</p> <p>Title: Assistant Professor</p> <p>Department: Engineering Physics</p> <p>Website: WeissLab.ca</p>

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Research Project Title : <i>(max. 10 words)</i>	Smart materials for imaging cells in 3D
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Traditionally, cell imaging uses a microscope to capture images of cells that have been adhered on a surface. For cells that do not easily attach, such as blood cells, this poses a major challenge.</p> <p>The Weiss lab develops custom instruments and analysis tools that solve this problem by imaging suspended cells as they move through a microfluidic device. Together with collaborators, we are applying our techniques to optimize the delivery and treatment of new genetic therapies.</p> <p>In this project, we will balance two key parameters, imaging speed and image quality, by "capturing" cells as they pass through our device.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	<p>This project has two parts:</p> <ol style="list-style-type: none"> 1. Characterize the biocompatibility of controllable materials 2. Design and construct a hardware add-on to our microscope for rapidly exploring a sample.
Required Skills for the Internship: <i>(max. 50 words)</i>	The Weiss Lab is a diverse and interdisciplinary research. The ideal applicant has previous coursework experience using Matlab, Python, or equivalent; knowledge in one or more of: optics, microfluidics, electricity and magnetism, or circuits; and is committed to communication, teamwork and solving challenging problems.
Confidentiality and Intellectual Property *	<p>Will the signature of a "Confidentiality Agreement" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an "Assignment of Intellectual Property" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	<p>Name: Lucien Weiss</p> <p>Title: Assistant Professor</p> <p>Department: Engineering Physics</p> <p>Website: WeissLab.ca</p>

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Research Project Title : <i>(max. 10 words)</i>	Development of a new single-molecule sensitive diagnostic device
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Traditionally, most molecular detection devices work by binding targets to a surface. To make them more sensitive, this binding is often designed to be irreversible, making them intrinsically single use.</p> <p>We are developing an alternative approach that catches and then releases bound targets, achieving specificity by measuring the characteristic attachment times. This relies on being able to observe individual binding events, made possible by the single-molecule-sensitive microscopes being developed in the Weiss Lab.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	<p>In this project you will design and build a proof-of-principle experiment using DNA hybridization.</p> <p>Next, you will deploy the device for label-free cell-typing experiments.</p>
Required Skills for the Internship: <i>(max. 50 words)</i>	The Weiss Lab is a diverse and interdisciplinary research. The ideal applicant has previous coursework experience using Matlab, Python, or equivalent; knowledge in one or more of: optics, microfluidics, electricity and magnetism, or circuits; and is committed to communication, teamwork and solving challenging problems.
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	<p>Name: Lucien Weiss</p> <p>Title: Assistant Professor</p> <p>Department: Engineering Physics</p> <p>Website: WeissLab.ca</p>

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Research Project Title : <i>(max. 10 words)</i>	Supercritical-CO2 vs Microwave cannabis oil extraction
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Cannabis oil research has evolved to serve the medical industry to treat pathologies such as sclerosis, cancer and HIV using cannabinoids like cannabidiol and tetrahydrocannabinol to ease neuropathic pain and boost the immune system. Microwave-assisted and supercritical CO2 extraction of cannabis oils produce 20% more CBD oil than the traditional extraction methods. The project aims to compare these techniques, regarding accelerating the processing time and reducing the quantity of solvent used or even replacing them with natural solvents tolerated in the medical industry. Both technologies are sustainable alternatives, as they minimize the use of chemicals.
Tasks during the Internship: <i>(max. 50 words)</i>	<ol style="list-style-type: none"> 1. Operating a lab-scale supercritical-CO2 reactor, microwave and ultrasound. 2. Preparing samples, and analyzing extracts using HPLC/GC-MS. 3. Literature review on cannabis oil extraction techniques. 4. Collect and analyze patents.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ol style="list-style-type: none"> 1. Write and speak professionally and communicate efficiently. 2. Knowledge, or strong Interest for medicinal cannabis. 3. Basic knowledge of chemical engineering and chemistry. 4. Knowledge of chemistry lab equipment and analytical chemistry. 5. Design of experiment (Statistica, JMP..) is an asset, but not mandatory.
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Other, please specify: sometimes Saint-laurent or Hawkesbury <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	<p>Name: Daria Camilla Boffito</p> <p>Title: Professor</p> <p>Department: Chemical Engineering</p> <p>Website: https://www.polymtl.ca/expertises/en/boffito-daria-c</p>

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Research Project Title : <i>(max. 10 words)</i>	Integration of microplastics impacts in LCA
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	A team at CIRAIG is working on the model development for the integration of plastic litter impacts in LCA. This include the modeling of the fate mechanisms (sedimentation, fragmentation, degradation), the exposure of humans and ecosystems, as well as the potential damages. All projects are well integrated into a coherent framework (Woods et al, 2021) which was developed by MarILCA (www.marilca.org).
Tasks during the Internship: <i>(max. 50 words)</i>	The intern will conduct research tasks in support of the different ongoing projects for Marine impacts in LCA, including literature search, data analysis, calculations, validation of models.
Required Skills for the Internship: <i>(max. 50 words)</i>	Ability to read and analyze scientific literature Scientific Rigor Analytical skills Curiosity and confidence in exploring new fields / Independence in working
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Other, please specify: 3333 Queen-Mary (CIRAIG's office) <input checked="" type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Anne-Marie Boulay Title: Assistant Professor Department: Chemical Engineering Website: www.ciraig.org ; www.marilca.org

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Research Project Title : <i>(max. 10 words)</i>	Printed and flexible organic transistors
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Organic electrochemical transistors (OECTs) gained a significant attention for bio-sensing applications due to their low operating voltage and their ability to work in aqueous media. Poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT: PSS) is a p-type ambient stable material, extensively used as an active channel material for OECTs. Most OECTs reported to date have planar configuration with large channel length, limiting the performance of devices. Vertical configuration enables downscaling the channel length to few micrometers. This project will mainly focuses on preparation of flexible OECTs with vertical configuration using printing techniques.
Tasks during the Internship: <i>(max. 50 words)</i>	Fabrication and assembly of transistors. Electrical characterization of transistors and data analysis.
Required Skills for the Internship: <i>(max. 50 words)</i>	Good teamwork ability. Knowledge of transistor working principle. Basic knowledge of chemistry
Confidentiality and Intellectual Property *	Will the signature of a “ Confidentiality Agreement ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “ Assignment of Intellectual Property ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> 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 : <i>(max. 10 words)</i>	Polymethylmethacrylate (PMMA) depolymerization in a stirred tank reactor
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Poly(methyl methacrylate) (PMMA), known as acrylic as well as 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 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. To reach a wider market, and reduce the economical risk we hydrolyse PMMA to methacrylic acid (MAA) with steam, in a stirred-tank reactor.
Tasks during the Internship: <i>(max. 50 words)</i>	TGA analysis on PMMA composites (Corian, Cristalite), Operate a 5l stirred-tank reactor, analyse liquid hydrolysis oil in GC (gas chromatography) or HPLC. Heat and mass balance
Required Skills for the Internship: <i>(max. 50 words)</i>	Hands-on attitude, with some laboratory experience (an asset but not mandatory). Knowledge of basic liquid analytic techniques, or willing to learn. Knowledge of stirred-tank reactors, or willing to learn. Knowledge or interest of chemical recycling of plastics
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Gregory Patience Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott

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PROJECT DESCRIPTION

2023 Winter Research Internship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input checked="" type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Capital cost estimation of chemical recycling plastic plants
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	For any plastic recycling process to make it to the large scale, it has to be economically viable. At the early-stage, the most suitable Capex estimation methods are the power law, the factorial, the functional unit, and the thermodynamic estimation. Unfortunately, most of those are tailored for the OIL/Gas and petrochemical industry. Especially with few plants at commercial scale, usual techniques are not adequate. So far, we created a database of over 150 plastic recycling plants, divided into Pyrolysis, Gasification, Solvolysis. The goal is to propose a new estimation model, and validate it with the database we build.
Tasks during the Internship: <i>(max. 50 words)</i>	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. Statistical analysis of the database to look for main factors determining the capital cost of a plant.
Required Skills for the Internship: <i>(max. 50 words)</i>	Fundamentals of process economics, Heat and mass balance calculations. Knowledge, or strong Interest for chemical recycling of plastics. Excel, coding (Matlab, Phyton) is an asset, but not mandatory.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Gregory Patience Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott

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Research Project Title : <i>(max. 10 words)</i>	Recycling Technologies for Polymer Automotive Components
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	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: <i>(max. 50 words)</i>	1- Performing pyrolysis of PMMA and PC in a fluidized bed reactor, 2- Performing pyrolysis of PMMA and PC in a twin screw extruder 3- Analysis of data, visualization of data 4- Documentation and writing of reports
Required Skills for the Internship: <i>(max. 50 words)</i>	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? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Other, please specify: Polynov (Anjou) <input type="checkbox"/> 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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Research Project Title : <i>(max. 10 words)</i>	Fischer-Tropsch pilot plant reactor control
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Gas-to-liquids technology converts associated gas (methane rich) to green diesel. The Fischer-Tropsch step (2nd step) operates at 300 °C and 20 bar and is highly exothermic and cause an exotherm of several hundred Celcius on start-up. Controlling the operating conditions is require to prevent reaction runaway. Cooling coils in our 200 ID pilot plant regulates the temperature with a PID controller.</p> <p>The main goal is to study the controllability and heat exchange of the reactor to the coolant during the start-up and standard operating conditions.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	<ol style="list-style-type: none"> 1. Operating the micro-refinery / Fischer-Tropsch pilot setup. 2. Writing process hazard review of for the Fischer-Tropsch reactor. 3. Simulation by ASPEN/ Hysys software.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ol style="list-style-type: none"> 1- Intermediate / advance skill to write and speak in English to communicate well. 2- Problem solving : ability to analyze and evaluate a situation. 3- Basic knowledge of chemical engineering in particular thermo and heat transfer. <p>2- Familiar with ASPEN PLUS/ HYSYS</p>
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input checked="" type="checkbox"/> Other, please specify: Montreal <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	<p>Name: Gregory S. Patience</p> <p>Title: Professor, Canada Research Chair</p> <p>Department: Chemical Engineering</p> <p>Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott</p>

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Research Project Title : <i>(max. 10 words)</i>	Electrified catalytic partial oxidation (CPOX) of natural gas at high pressure
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	This project will design an electrified partial oxidation reactor to convert wasted natural gas to CO and H ₂ at 1000 oC and 20 bar. This is the first step to produce green diesel. Electrification of conventionally fired chemical reactors has not yet been applied in CPOX reactors. In the electrically heated reactor, heating is based on the Joule effect (the heating that occurs when an electric current flows through a resistance). In our hypothesis, the intimate contact between the electric heating source and the reaction site drives the reaction close to thermal equilibrium and improves selectivity and yield.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Operate the CPOX reactor (How to load the catalyst, start-up of the reactor, send gases, etc.) -Synthesize the catalyst -Do literature review We will also give a brief training on the experimental tasks.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Fluency in English (French is a plus) - knowledge of safety in lab - Ability to do research - Basics in chemical engineering and reactor design
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> 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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Research Project Title : <i>(max. 10 words)</i>	Fluidized bed conversion of lactose from cheese whey to lactic acid
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The dairy industry generates a significant amount of liquid waste-cheese whey that contains 5% lactose in water. Lactose, being a waste from the dairy industry, represents great potential since it can be converted to sugar, furans, or ingredients with high added value. Lactic acid (LA), produce from glucose or galactose, is an important molecule in the synthesis of a wide range of chemicals. Currently, LA has emerged as a renewable building-block chemical in a new generation of materials including biodegradable plastics. This project is entitled Milk waste to milk bottles.
Tasks during the Internship: <i>(max. 50 words)</i>	Catalyst synthesis and characterization. Operate a fluidized bed reactor. Liquid and gas chromatography analysis. Perform and interpret design of experiments.
Required Skills for the Internship: <i>(max. 50 words)</i>	Knowledge or great interest in reaction mechanisms Problem solving: ability to analyze and comment on a problem Knowledge or interest in interpreting and disseminating data (writing reports) Knowledge of chemistry lab equipment
Confidentiality and Intellectual Property *	Will the signature of a “ Confidentiality Agreement ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “ Assignment of Intellectual Property ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Gregory Patience Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott

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Research Project Title : <i>(max. 10 words)</i>	Cheese whey waste to chemicals in a spinning disk reactor
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	In 2010, Quebec alone produced close to 2 million tonnes of cheese whey (CW). CW is mostly water (0.93 g/g) and lactose (0.05 g/g), with some protein, lipids, and minerals. Due to its high water content and low value, CW is exported (or discarded as waste). However, its organic loading represents an opportunity to produce biofuels and high-value specialty chemicals. The objective is to convert lactose, a major constituent of the CW that can be hydrolyzed and hydroxylated by an acid catalyst, into an high value lactic acid and hydromethylfurfural (HMF) used to produce hydrocarbon fuel.
Tasks during the Internship: <i>(max. 50 words)</i>	Literature review and synthesis of the best catalysts for the conversion of lactose to lactic acid and HMF, design and operate a spinning disk reactor, HPLC and GC MS analysis.
Required Skills for the Internship: <i>(max. 50 words)</i>	Hands-on attitude, catalysis synthesis and reactor design knowledge with some laboratory experience. Knowledge or willingness to learn advanced analytic techniques (HPLC, GC MS). Interest in waste valorisation. Eager to learn, curiosity, initiative, communication.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Gregory Patience Title: Professor Department: Chemical Engineering Website: https://www.polymtl.ca/expertises/en/patience-gregory-scott

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Research Project Title : <i>(max. 10 words)</i>	Surface engineering of materials
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Often, we need the surface of a material to serve a different function from what its native properties allow. 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: <i>(max. 50 words)</i>	Plan and execute experiments, analyze experimental results, construct/adapt chemical reactors, write progress reports, present results orally.
Required Skills for the Internship: <i>(max. 50 words)</i>	Chemical reactions or polymers (at least one is 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? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Jason Robert TAVARES Title: Full Professor Department: Chemical Engineering Website: jasantavares.ca

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PROJECT DESCRIPTION

2023 Winter Research Internship Scholarship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input checked="" type="checkbox"/> Civil, Geological, Mining <input type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	UHPFRC : From material development to structural applications.
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	In the last decade ultra-high performances fiber reinforced concretes (UHPFRC) have been developed. They present very high mechanical properties, and very low porosity and permeability. One UHPFRC have been developed at Polytechnique Montreal. The goal of the internship will be either : to modify the UHPFRC mix in order to reduce its CO2 emissions and increase its mechanical properties by using special mineral admixture, or to develop and test in laboratory structural applications designed with the UHPFRC. The types of activities to be carried out will be adapted according to the academic background of the candidate (1st, 2nd or 3rd cycles).
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> • 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: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> • Excellent leadership and be autonomous to manage technical activities • Good knowledge of concrete production and properties, lab experience is an asset • Good dexterity and be familiar with manual works to carry out lab activities • Excellent knowledge of Excel and Word software in order to analyze results
Confidentiality and Intellectual Property *	Will the signature of a “ Confidentiality Agreement ” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “ Assignment of Intellectual Property ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> 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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Research Project Title : <i>(max. 10 words)</i>	Next generation of drilling tools for subsurface investigation on the Moon and beyond
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The proposed research aims to develop a novel drilling mechanism for subsurface investigation on the Moon, Mars, and beyond in low or microgravity conditions. The proposed mechanism will be based on the features and mechanical response of smart materials on extra-terrestrial bodies. The project aims to study the regolith-tool interaction in low stress conditions.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Literature review - Develop the basic principles of concept - Develop the technology concept and formulate application
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Granular mechanics - Damage mechanics - Computational mechanics - Vibration
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Pooneh Maghoul Title: Associate Professor Department: Civil, Geological and Mining Engineering Website: https://www.siglab.ca/

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Research Project Title : <i>(max. 10 words)</i>	Automated mining on the Moon, Mars, and beyond
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The proposed research aims to develop AI/ML platforms for prospecting of resources on the Moon, Mars, and beyond through a multiscale data-driven approach. The existing and publicly available data and geologic features will be used for data training purposes. The platform will be used for automated space mining on extraterrestrial bodies.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Literature review - Develop the basic principles of concept - Develop the technology concept and formulate application - Proof of Concept
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Artificial Intelligence - Machine Learning - Multispectral Imaging - Pattern recognition
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Pooneh Maghoul Title: Associate Professor Department: Civil, Geological and Mining Engineering Website: https://www.siglab.ca/

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Research Project Title : <i>(max. 10 words)</i>	AI-based recognition tool to detect sites susceptible to permafrost carbon feedback
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Permafrost underlies 40–50 percent of Canada and its extent is as wide as Canada’s North. Many of these regions are rich in carbon and consequently a dangerous source of carbon-cycle positive feedbacks and accelerating growth in greenhouse gas emissions. To date, no country has a strategy to deal with permafrost carbon feedback. Forestation can be a viable solution to address permafrost carbon feedback. This project aims to develop an AI-based pattern recognition tool to investigate the change in vegetation landscape in Canada’s North through satellite imaging technology. The tool will feed a physics-based multiphase tool to study soil-root-climate interaction of permafrost sites in Canada’s North affected by climate change.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Literature review - Develop the basic principles of concept - Develop the technology concept and formulate application - Proof of Concept
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Artificial Intelligence - Machine Learning - Multispectral Imaging - Pattern recognition
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Pooneh Maghoul Title: Associate Professor Department: Civil, Geological and Mining Engineering Website: https://www.siglab.ca/

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

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2023 Winter Research Internship Scholarship Program

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Research Project Title : <i>(max. 10 words)</i>	Collaborative Simultaneous Localization and Mapping
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>SLAM (Simultaneous Localization and Mapping) is a core problem of robotics to enable autonomy in GPS-denied environment (indoors, caves, etc.).</p> <p>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.</p> <p>In this project, we plan to leverage 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.)</p>
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Work on 3D object detection and instance segmentation - Integrate the semantic data into a Collaborative SLAM pipeline - Test the system against state-of-the-art benchmarks
Required Skills for the Internship: <i>(max. 50 words)</i>	<p>Strong C++ or Python programming skills</p> <p>Prior experience in deep learning, robotics or computer vision.</p>
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required?</p> <p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required?</p> <p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	<p>Name: Giovanni Beltrame</p> <p>Title: Professor</p> <p>Department: Computer and Software Engineering</p> <p>Website: https://mistlab.ca/</p>

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PROJECT DESCRIPTION

2023 Winter Research Internship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	User experience (UX) design for AI-empowered systems
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	User experience (UX) design of the increasingly powerful AI-empowered systems have profound social and economic impacts on modern society. The special characteristics of the AI technologies have posed new design challenges. Particularly, designers face a new conundrum of planning the UX of a system that can independently change its behavior according to the data it receives over time, while being essentially a black box. This research program aims to devise novel methods and tools to address such challenges and support the collaborative and creative UX design process of AI-empowered systems.
Tasks during the Internship: <i>(max. 50 words)</i>	Interns will be integrated in a group of PhD and master's students. The specific direction and tasks can be flexible based on the intern's expertise and interest. Overall, we will pinpoint the designers' challenges through human-centered studies, explore UX design patterns that can help address these challenges, and investigate methods to support the UX design of AI-empowered systems.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Motivated learner, critical thinker, and team contributor - Experience or interests in human-computer interaction and/or user-centered interaction design - Passionate for UX and design
Confidentiality and Intellectual Property *	Will the signature of a "Confidentiality Agreement" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> 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

2023 Winter Research Internship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Supporting user experience (UX) design of open source software
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	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: <i>(max. 50 words)</i>	Interns will be integrated in a group of PhD and master's students. The specific direction and tasks can be flexible based on the intern's expertise and interest. Overall, 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: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - 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? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> 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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2023 Winter Research Internship Program

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Research Project Title : <i>(max. 10 words)</i>	Intelligent image mining for user interaction design
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	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: <i>(max. 50 words)</i>	Interns will be integrated in a group of PhD and master's students. The specific direction and tasks can be flexible based on the intern's expertise and interest. Overall, we will explore methods for identifying interactive elements in the design artifacts (images of UI design), identification and detection of UX design patterns, and the design of tools that leverage these methods.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - 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? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> 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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2023 Winter Research Internship Program

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Research Project Title : <i>(max. 10 words)</i>	Intelligent text mining of open source discussions
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	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: <i>(max. 50 words)</i>	Interns will be integrated in a group of PhD and master's students. The specific direction and tasks can be flexible based on the intern's expertise and interest. Overall, we will explore natural language processing (NLP)-based text mining techniques to detect and extract various information and knowledge in the OSS discussions.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - 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? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> 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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2023 Winter Research Internship Program

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Research Project Title : <i>(max. 10 words)</i>	Experimental setup and application in Edge Intelligence
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>The internship will contribute to the research group activities in the areas of edge intelligence (Edge AI).</p> <ul style="list-style-type: none"> - setting up an experimental environment for mobile edge intelligence. - developing an edge AI application in the area of IoT and autonomous systems.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - use commercial-off-the-shelf hardware, to setup an experimental platform for mobile edge intelligence. - develop an Edge AI application with federated learning.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Very good development skills. - Good knowledge in machine learning - Basic knowledge in networking technologies
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p>
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	<p>Name: Soumaya Cherkaoui</p> <p>Title: Full Professor</p> <p>Department: Computer and Software Engineering</p> <p>Website: https://www.polymtl.ca/expertises/en/cherkaoui-soumaya</p>

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PROJECT DESCRIPTION

2023 Winter Research Internship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	AIOps for Digital Twin Applications
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>Modern systems are demanding updated development and deployment processes and cultures regarding their large size and complexity. Monitoring, analyzing, and evaluating the real-time data generated by these systems are highly recommended practices for maintaining and testing modern systems. As software systems become larger and more complex, storing and analyzing log data will become a big-data problem in the operating environment. The AIOps approach proposes using machine learning approaches to solve big-data problems. Therefore, AIOps can be leveraged in the digital twin applications, i.e., the operation environment of software systems, to provide faster and more proactive monitoring and analyzing resolutions.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	<p>Studying AI approaches in IT operation analysis, Applying AIOps to the fast-growing log data, Developing and evaluating a method for improving log data analysis in digital twin application using machine learning</p>
Required Skills for the Internship: <i>(max. 50 words)</i>	<p>Ability to handle large datasets and perform high-level data analysis, experience in programming and developing Internet scale applications, Familiar with machine learning approaches, IT operations, Logging, Experienced in doing research, Analytical thinker and critical problem solver, Ability to manage time, Ability to work in a team, Academic writing ability</p>
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	<p>Name: Mohammad Hamdaqa</p> <p>Title: Assistant Professor</p> <p>Department: Department of Computer Engineering and Software Engineering</p> <p>Website: https://www.polymtl.ca/expertises/en/hamdaqa-mohammad</p>

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2023 Winter Research Internship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Software defect classification for defect detection
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Software defects are often communicated through human intensive intensive reporting systems such as bug trackers (e.g., Jira). These bug trackers often allow a high level of flexibility for the users to determine how to label their reported software defects. The labour intensive nature of these tasks, coupled with the flexibility of the classification often means that defects have many different labels, which render them difficult to distinguish. In this project, we propose to identify appropriate high level labels for software defects in order to build an automated classifier for future software defects.
Tasks during the Internship: <i>(max. 50 words)</i>	Leverage known techniques such as topic modelling (e.g., LDA) to determine appropriate high level labels for software bugs; Leverage existing software classifiers (e.g., SVM or neural nets) to attempt a prototype software defect classification and; Manually investigate the results of the topic modelling and classifications.
Required Skills for the Internship: <i>(max. 50 words)</i>	Basic knowledge of software bug trackers. Familiarity with a scripting programming language (e.g., Python or R). Basic understanding of software classifiers.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Maxime Lamothe Title: Assistant Professor Department: Computer Engineering and Software Engineering Website: https://lamothemax.github.io/

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PROJECT DESCRIPTION

2023 Winter Research Internship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input checked="" type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Implementation, optimization and explanation of binarized neural networks
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	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, optimization and explanation of AI algorithms. 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: <i>(max. 50 words)</i>	Write code for Artificial Intelligence (AI) mostly in Python (Pytorch) Test / optimize / explain algorithms for AI Write report/paper
Required Skills for the Internship: <i>(max. 50 words)</i>	Some background in AI (neural networks) Python, ideally some background with PyTorch C/C++ Maybe Verilog/VHDL for FPGA design
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> 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

2023 Winter Research Internship Scholarship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input checked="" type="checkbox"/> Electrical <input checked="" type="checkbox"/> Mathematics/Industrial <input checked="" type="checkbox"/> Mechanical <input type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Autonomous systems, control systems, robotics, navigation systems
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Internships are possible that are related to my group's activities on - control under information constraints, security and privacy in cyber-physical systems - multi-agent and networked control systems, robotic networks - application of mean-field games to multi-agent systems - decision-making under uncertainty, reinforcement learning - 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: <i>(max. 50 words)</i>	Tasks during the internship: - Develop algorithms to control multi-agent or multi-robot systems - Implement the algorithms in simulation or possibly on real-world robots - Study the properties of these algorithms theoretically or empirically - Write an internship report summarizing the main findings
Required Skills for the Internship: <i>(max. 50 words)</i>	Training in at least one area among: control theory, robotics, signal processing, machine learning for 3D perception, applied mathematics, human-machine interaction, etc.
Confidentiality and Intellectual Property *	Will the signature of a "Confidentiality Agreement" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Jérôme Le Ny Title: Associate professor Department: Electrical Engineering Website: http://www.professeurs.polymtl.ca/jerome.le-ny/

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PROJECT DESCRIPTION

2023 Winter Research Internship Program

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Research Project Title : <i>(max. 10 words)</i>	Planning and Operations Methods for Electric Power Systems with Renewables
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	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: <i>(max. 50 words)</i>	The candidate will be tasked with mathematical modelling of power system problems, designing specialized methods to tackle efficiently our problems, and/or conducting numerical experiments to evaluate the performance of our approaches.
Required Skills for the Internship: <i>(max. 50 words)</i>	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? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “ Assignment of Intellectual Property ” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> 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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Main area of expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input type="checkbox"/> Computer/Software <input checked="" type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input checked="" type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Novel optical fiber sensor development and applications
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Optical fiber sensors are more and more widely used in both industrial and biomedical applications. Immune to electromagnetic interference and ultra-precise, these new types of sensors can do distributive measurement, that is they can measure all along the optical fiber giving spatial information. The projects proposed here involve the development of new applications of incoherent fiber Bragg grating sensors such as robotic or biomedical shape sensing or for magnetic sensing intended for fusion reactors (Tokamaks). New types of sensors leading to lab-in-a-fiber is also a possibility of development. These projects involve designing, building and testing the both the interrogation system as well as the sensor itself.
Tasks during the Internship: <i>(max. 50 words)</i>	The candidate will be tasked with numerical modelling as well as experimental work in the laboratory involving laser operation, optical fiber manipulation, electrical and optical system design. The candidate will be required to mount an experiment, analyse results and compare with expected model.
Required Skills for the Internship: <i>(max. 50 words)</i>	The applicant must have a good scientific curiosity as well as a good initiative to solve problems. The candidate should be experience in Matlab or Python and be comfortable in numerical simulation. Good background knowledge in optics/photonics and optical fibers is required.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Sébastien Loranger Title: Assistant Professor Department: Electrical Engineering Website: https://www.polymtl.ca/expertises/en/loranger-sebastien-0

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Research Project Title : <i>(max. 10 words)</i>	Novel photonic devices and integration by laser fabrication techniques
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Laser fabrication techniques for microstructures, such as cutting/ablation, ultra-fast induced refractive index change and 3D printing have significantly improved in the last decade and have unlocked a new horizon of photonic crystals and integrated photonic devices. For instance, writing waveguide and microstructures in flexible and biocompatible substrate now allows for tunable photonic devices with biomedical applications. High resolution 3D printing can now enable advanced photonic crystals in the THz range. Combining all those instances enables new photonic/THz integration options which can be applied to telecommunications and sensors. The projects here involve exploring, designing and testing new devices along those lines.
Tasks during the Internship: <i>(max. 50 words)</i>	The candidate will be tasked with numerical modelling as well as experimental work in the laboratory involving laser operation, optical fiber manipulation, 3D modelling and printing, electrical and optical system design. The candidate will be required to mount an experiment, analyse results and compare with expected model.
Required Skills for the Internship: <i>(max. 50 words)</i>	The applicant must have a good scientific curiosity as well as a good initiative to solve problems. The candidate should be experience in Matlab or Python and be comfortable in numerical simulation. Good background knowledge in optics/photronics or RF/THz waves and waveguides/optical fibers is required.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Sébastien Loranger Title: Assistant Professor Department: Electrical Engineering Website: https://www.polymtl.ca/expertises/en/loranger-sebastien-0

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PROJECT DESCRIPTION

2023 Winter Research Internship Program

Main area of expertise :	<input type="checkbox"/> Aerospace <input type="checkbox"/> Biomedical <input type="checkbox"/> Chemical <input type="checkbox"/> Civil, Geological, Mining <input checked="" type="checkbox"/> Computer/Software <input type="checkbox"/> Electrical <input type="checkbox"/> Mathematics/Industrial <input type="checkbox"/> Mechanical <input checked="" type="checkbox"/> Physics
Research Project Title : <i>(max. 10 words)</i>	Foundations of Stochastic Electrodynamics
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	The current theory of fluctuational electrodynamics rests on two rather strong, often unstated, assumptions: that each physical body in question is local thermal equilibrium; and that the thermally driven currents are statistically independent. Strictly, neither statement is true in the majority of applications in which the theory is used, namely modeling near-field radiative thermal power and force transfer. In this project, we will begin to undertake a first principles analysis of both (a) the physical phenomena that characterize different current correlation, and (b) the kinds of correlations that are possible when local thermal equilibrium is not assumed.
Tasks during the Internship: <i>(max. 50 words)</i>	Comprehensive review of the formulations and assumptions of modern stochastic electrodynamics. Simulation of observable physical phenomena under the assumption of altered correlation functions. Comparison of simulation results with existing experimental studies.
Required Skills for the Internship: <i>(max. 50 words)</i>	Familiarity with Maxwell's equations in linear media. Proficiency in at least one of MatLab, Mathematica, Python, Julia, C++ or C. Ideally some experience working with two-point correlation functions.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Sean Molesky Title: Assistant Professor Department: Engineering Physics Website: https://polymtl.ca/expertises/en/molesky-sean

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Research Project Title : <i>(max. 10 words)</i>	Determining Limits on General Photonic Devices
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Over the course of the last three years, we have developed a method for determining bounds on the maximal level of performance that can be achieved by any photonic device subject to simple restrictions on the maximum volume it may occupy and bulk material properties. We are now looking to turn this theory into a freely available numerical design analysis tool, and, in this context, we must come to an understanding of the algorithms best suited to our particular problem.
Tasks during the Internship: <i>(max. 50 words)</i>	Exploration of efficient methods for optimizing special classes of differentiable convex functions. Adaptation of an existing code-base for integration with commercial solvers. Study of techniques for determining whether or not a matrix is positive-definite.
Required Skills for the Internship: <i>(max. 50 words)</i>	Basic familiarity with electromagnetics, scattering theory, and optimization theory. Proficiency in at least one of Python, Julia, C++ or C. Ideally experience with GPU coding.
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Sean Molesky Title: Assistant Professor Department: Engineering Physics Website: https://polymtl.ca/expertises/en/molesky-sean

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Research Project Title : <i>(max. 10 words)</i>	Optical nose on chip
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	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: <i>(max. 50 words)</i>	Assembly of the optical nose. Taking optical measurements on different gas compositions.
Required Skills for the Internship: <i>(max. 50 words)</i>	optical experiments, gas handling, polymer synthesis, electronic control, data acquisition
Confidentiality and Intellectual Property *	Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> 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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Research Project Title : <i>(max. 10 words)</i>	Effects of Automated Diagnostic Algorithm on Human Trust and Workload
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	During a major failure in complex systems, a failure can affect multiple related systems and trigger an alarm flood. These alarm floods can be troublesome for operators trying to determine the source of the fault because the quantity of alarms is too numerous to manage. Recent research has developed algorithms able to identify automatically the cause of alarm floods 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 diagnostics of faults affects the operator's decision-making, trust in the machine, and performance during high-workload scenarios.
Tasks during the Internship: <i>(max. 50 words)</i>	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 with participants using the simulator, 2) gathering data, 3) analysing results, and 4) article writing.
Required Skills for the Internship: <i>(max. 50 words)</i>	Interpersonal skills, autonomous, great communication skills, works well 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? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
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Supervisor:	Name: Philippe Doyon-Poulin Title: Professor Department: Industrial Engineering Website: https://www.polymtl.ca/expertises/en/doyon-poulin-philippe

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Research Project Title : <i>(max. 10 words)</i>	Design and Experiment with an Underactuated Walking Robot
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	<p>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 first version of this prototype can be seen in action at: https://youtu.be/w9Pv8jG_RRg</p> <p>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.</p>
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - 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: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Excellent CAD skills and mechanical good practice - Knowledge of design for 3D printing and ease with 3D printed part assembly - Familiarity with electronic basics (wiring, connections, basic programming skills)
Confidentiality and Intellectual Property *	<p>Will the signature of a “Confidentiality Agreement” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	<p>Name: Lionel Birglen</p> <p>Title: Professor</p> <p>Department: Department of Mechanical Engineering</p> <p>Website: www.polymtl.ca/labrobot/en/</p>

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Research Project Title : <i>(max. 10 words)</i>	Design of a Tracking Device for Mobile Robots
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	This project stems from a need to record and analyze the motion of mobile machines and walking robots developed in the Robotics Lab of Polytechnique Montreal. In order to properly assess the performance of these machines when traversing different 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: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - 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: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - 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? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Supervisor:	Name: Lionel Birglen Title: Professor Department: Department of Mechanical Engineering Website: www.polymtl.ca/labrobot/en/

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Research Project Title : <i>(max. 10 words)</i>	Design of a Twisting String Actuation Robotic Gripper
University Cycle :	<input checked="" type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	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 will first design a single finger system based on the existing prototype. Then, passive return actuation will be added followed by an actuator of proper power. Finally, a power amplifier and controller will be selected to control the finger and how to drive at least two fingers will be studied.
Tasks during the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - Design of the mechanical subsystems - Selection of appropriate actuator and driver. - Fabrication and experiments.
Required Skills for the Internship: <i>(max. 50 words)</i>	<ul style="list-style-type: none"> - 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? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an “Assignment of Intellectual Property” be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique’s Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> 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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Research Project Title : <i>(max. 10 words)</i>	Development of simulation tools for geothermal heat pump systems
University Cycle :	<input type="checkbox"/> 1 st cycle (Undergraduate) <input checked="" type="checkbox"/> 2 nd cycle (Master) <input checked="" type="checkbox"/> 3 rd cycle (Ph.D.)
Background Information: <i>(max. 100 words)</i>	Design and simulation of geothermal systems rely on accurate predictions of soil and fluid temperature variations due to the operation of the heat pump over the system's life-span. Typically, temperatures are calculated from the spatial and temporal superposition of analytical thermal response functions, considering the heat extraction and rejection history of the system since the start of operation. The temporal superposition method is critical to the accuracy of temperature predictions and the computational efficiency of the simulation. The objective of this project is to implement and assess the accuracy and efficiency of higher order temporal superposition techniques.
Tasks during the Internship: <i>(max. 50 words)</i>	<ol style="list-style-type: none"> 1. Identify and implement higher order temporal superposition techniques for the simulation of geothermal systems 2. Assess the accuracy and computational efficiency of the implemented methods, and recommend parameters for practical simulations
Required Skills for the Internship: <i>(max. 50 words)</i>	<ol style="list-style-type: none"> 1. Knowledge of Object-Oriented Programming (Python) 2. Experience or relevant courses in : Heat transfer, Numerical methods in engineering, Partial differential equations
Confidentiality and Intellectual Property *	Will the signature of a "Confidentiality Agreement" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Will the signature of an "Assignment of Intellectual Property" be required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Location:	<input checked="" type="checkbox"/> Polytechnique's Building (Main, Lassonde, Bombardier, Aisenstadt) <input type="checkbox"/> Other, please specify: <input checked="" type="checkbox"/> This project can be offered remotely if the sanitary situation requires so
Supervisor:	Name: Massimo Cimmino Title: Assistant Professor Department: Mechanical Engineering Website: https://www.polymtl.ca/expertises/en/cimmino-massimo

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