McGill

DEPARTMENT OF
ELECTRICAL AND COMPUTER ENGINEERING

# Area of Research and Applicant Profile Form

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|---|---|---|---|---|
| Name: Shuo Liu | | | | |
| Email address: shuoliu2020@163.com | | | Tel No.: +86-13954608969 | |
| Degree sought: | ✔ | M.Eng. | ☐ | Ph.D. |

**FUNDING**

| | | |
|---|---|---|
| Would you like to be considered for financial support? | ☐ | Yes |
| | ✔ | No |
| If financial support is not available, would you like to be considered for admission without financial support? | ✔ | Yes |
| | ☐ | No |

**AREA OF RESEARCH**

Listed below are the ten areas of research in the Department of Electrical and Computer Engineering. In accordance with your on-line application form, again indicate your 1st and 2nd choice of research group. If you wish, you may indicate which sub-areas of your two choices interest you most. If you check none of the sub-areas, we will assume that you are equally interested in all sub-areas. For details and lists of professors associated with each research area, visit www.mcgill.ca/ece/research.

| | **BIO-ELECTRICAL ENGINEERING** | | |
|---|---|---|---|
| ☐ | CMOS sensor microsystems | ☐ | Brain/Body machine interfaces |
| ☐ | MEMS and microfluidics | ☐ | Systems neurosciences |
| Preferred supervisor(s): | | | |

| | **COMPUTATIONAL ELECTROMAGNETICS** |
|---|---|
| ☐ | Computational methods in microwave |
| ☐ | Computational methods in power-frequency electromagnetic |
| ☐ | Intelligent design methods |
| Preferred supervisor(s): | |

| | **INTEGRATED CIRCUITS AND SYSTEMS** |
|---|---|
| ☐ | Analog, digital, mixed-signal, microwave/RF integrated circuits; integrated microsystems and MEMS |
| ☐ | Computer Aided Design for analog and digital microsystems |
| ☐ | Embedded systems, reconfigurable computing and FPGAs/signal processing hardware |
| ☐ | Mixed signal testing and design for testability/manufacturability (DFT/DFM) |
| ☐ | Signal integrity, electromagnetic compatibility packaging and antennas in integrated systems |
| Preferred supervisor(s): | |

| 1 | **INTELLIGENT SYSTEMS** | | |
|---|---|---|---|
| ✔ | Computer vision | ✔ | Medical image processing |
| ✔ | Human computer interaction | ✔ | Robotics |
| Preferred supervisor(s): Professor Jeremy Cooperstock, Tal Arbel, and Frank Ferrie | | | |

| | **NANO-ELECTRONIC DEVICES AND MATERIALS** | | |
|---|---|---|---|
| | Nanoscale optoelectronics | | Carbon electronics |
| | Semiconductors and devices | | Organic nano material and devices |
| | Integrated and flexible piezoelectric/ultrasonic devices | | |
| Preferred supervisor(s): | | | |

| | **PHOTONIC SYSTEMS** | | |
|---|---|---|---|
| | Nonlinear optics | | Photonic sensing and monitoring |
| | Photonic integrated circuits, nano-photonics, opto-electronics and fiber components | | |
| | Fiber optics communications, transmission systems and networks | | |
| | Optical data/computer devices and communications | | |
| Preferred supervisor(s): | | | |

| | **POWER ENGINEERING** | | |
|---|---|---|---|
| | High power electronics | | Distributed generation |
| | Power system operations and planning | | |
| Preferred supervisor(s): | | | |

| 2 | **SOFTWARE ENGINEERING** | | |
|---|---|---|---|
| | Cyber-physical systems | | Internet-scale software |
| ✔ | Mining software repositories | | Model-driven engineering |
| | Release engineering | | Requirements engineering |
| Preferred supervisor(s): Professor Shane McIntosh. | | | |

| | **SYSTEMS AND CONTROL** | | |
|---|---|---|---|
| | Robust control systems | | Stochastic and adaptive systems |
| | Discrete-event, hybrid and hierarchical control | | |
| | Industrial, manufacturing, aerospace and robotic control | | |
| | Nonlinear systems, nonholonomic control and optimal control | | |
| Preferred supervisor(s): | | | |

| | **TELECOMMUNICATIONS AND SIGNAL PROCESSING** | | |
|---|---|---|---|
| | Communication systems | | Digital signal processing |
| | Network engineering | | |
| Preferred supervisor(s): | | | |

**APPLICANT PROFILE**

In the following, describe your personal profile in the space allocated. This information will be used to assess your application for admission and to consider recommendations for funding and awards. Provide enough information to help the committee appreciate your achievements.

**Research Experience and Interests:** *Comment on why you would like to pursue graduate studies, with a clear identified objective. Further clarify if you have a particular research interest, possibly in the context of past experience and accomplishments. List publications: authors, title, journal, number, year, pages & URL.*

The first time I used computer was during an information competition in high school when I tried to program in Pascal under my computer teacher ' s guidance. As I grow up, I discovered my interests in computer engineering, thus I chose Software Engineering as my undergraduate major. Gradually, I realized that I still needed to accumulate more knowledge and skills in graduate program to give further play to my capability and creativity in this promising field. With a prestige faculty and a wide platform, McGill provides me with the opportunity to study in-depth specialization about this subject to achieve my dream, thus I would like to pursue my graduate studies in ECE, McGill.

In my undergraduate study, I developed my interests in many areas. During my research experiences in Inplus Lab, I mainly focused on application and contract layer of Blockchain Systems. I have completed two publications and had several publications under review. Application of Blockchain in IoT Data Trust and Information Available Technology (published in 2019 ISCID) is a survey focusing on analyzing the mapping relationship of Blockchain technology for the hierarchical architecture of IoT. Perishable Digital Goods Trading Mechanism for Blockchain-based Vehicular Network (published in 2019 ISPA) proposes a perishability-oriented pricing mechanism to support trading in IoV. Blockchain-Based Digital Goods Trading Mechanism in Internet of Vehicles (under IEEE Cloud review) proposes a two-layer Stackelberg Game for data trading in Blockchain-based IoV scenario. BCShare: A Decentralized Social Data Storage and Sharing on Blockchains (under IEEE TSC review) employs IPFS and certificateless cryptography to address the control of user data from giant companies. My research in Inplus Lab not only helps to improve my mastery of Blockchain technology, but also to further my understanding of Trustworthy Systems, Cryptography, and Distributed Systems.

In addition, I am also interested in researching Computer Vision and Reinforce Learning. During my research in CUMTB, my colleagues and I dynamically captured and tracked targets timely by using Back Propagation Neural Network and Partial Swarm Optimization. As a result, we completed a publication Optimal Analysis of Target Dynamic Tracking Strategy Based on Computer Vision (published in 2019 EITCE). I believe this work is of great value to researching the concentration of Multi-Sensor Target Tracking in System Control in your department. I also had internship experiences relevant to Reinforce Learning in CASIA. I built a StarCraft Learning Environment and applied Multi-Agent Deep Deterministic Policy Gradient to train the soldiers with my colleagues and improved the average winning rate of soldiers from 26% to 43%. This internship inspired me to explore more aspects that will be taught in the concentration of Intelligent Systems in your department.

In the short term, upon obtaining my master degree, I expect to complete my project plan with excellent performance to broaden my horizon and consolidate the knowledge I have gained. In the next 3 to 5 years, I aspire to become a reliable researcher by pursuing a doctor degree. In the long run, I hope to work as a professor to educate future students and to promote promising technologies to better our lives.

**Research Area and Preferred Supervisor:** *For the specified research area(s) of interest, briefly but clearly comment on your choice. Further, if you have specified a supervisor(s), state why he or she would be your preferred mentor.*

If admitted, I am inclined to work on Intelligent Systems, including Medical Image Analysis by Professor Tal Arbel and Artificial Perception by Frank Ferrie. I am experienced in Deep Learning as I have taken Artificial Neural Networks course (scored 99, ranked 1st), where I employed several neural networks, such as VGGNet, ResNet, DenseNet, to process images. In its final, I participated in a Kaggle Competition relevant to cactus identification and achieved a 99.97% accuracy.

In addition, I am also willing to devote myself to Software Engineering to mine software repositories under the instruction of Professor Shane McIntosh because of my Data Mining experiences. I predicted NBA players ' salary in my Introduction to Data Mining (scored 99, ranked 1st). Other than that, in 2019 MCM/ICM (Problem C), our group analyzed the growth pattern of drug reported quantity and found some important demographic features highly related to drug abuse. These all have clearly demonstrated my competence for research in this area.

**Academic Profile:** *Describe your academic profile, highlighting particular achievements and relevant scholarships or awards.*

As an undergraduate student, I managed to accumulate a fair amount of technical knowledge and improve my programming skills. In the first two years of my study, my coursework (100- and 200-level courses) mainly focused on the basics of mathematics and programming. I studied elementary methods to consolidate mathematical basics, and solved many rudimentary puzzles in different languages to hone my programming skills. My scores were ranked top in Probabiity and Statistics, Data Structures and Algorithms, Computer Programming (C++), Java and Object-oriented Design (Java), and etc. As I ' ve laid solid groundwork for the fundamentals, I managed to achieve high in more professional engineering courses afterwards. I got the best scores in Principles of Animation and Design of Network-Based Games, Practice of Artificial Neural Networks (Python), Software Engineering Training: Integrated Projects, and etc. In return, I was awarded Academic Innovation Scholarship, SYSU (top 3%) and Second Prize Scholarship, SYSU (top 15%) in my junior year. Hence, I believe I am qualified for pursuing further studies in your department.

**Additional Information:** *Describe any other relevant information, including, for example, teaching experience, leadership positions, special circumstances, etc.*

Except for my professional performance, my team spirits and academic ethic are also laudable.

In social activities, I learned to be a leader and a responsible man. During my college life, I developed time management skills in my tenure as the vice president of the Table Tennis Association. To be more precise, I managed to balance well between course assignment and club activities, such as arranging Intercollegiate Table Tennis Competition agenda. Besides, as a group leader of Guangdong Science Center Volunteer, I led a team to help visitors. Under my instruction, our group had clear definitions of responsibilities, rewards and punishments, so that the ability of each member could be fully utilized. Aforementioned experiences make me a trustworthy leader and a good partner to work with.

In addition, I always respect the academic rules. I have never submitted my papers to two or more conferences, and there are always new ideas in my papers, which makes me a reliable researcher in work.