# Motivation Letter

**Name: Jiajun Hu**
**Application MSc program: Electrical Engineering: Signal & System**

Currently I am a final year undergraduate in the University of Nottingham, China Campus. My major is Electrical and Electronic Engineering (with Honors). Our campus of the University of Nottingham carries a complete British education, where English is the official instruction and working language.

With my study continuing and project experience grows, my interest and motivation in Electrical Engineering becoming stronger. At present my passion for career is to be an expert in electrical engineering. I want to engage in the design and construction of autonomous systems, like robotics, pattern recognition and modern computing system. My undergraduate study equipped with fundamental knowledge and skills about them, but I think a more advancing degree is of vital significance to explore the further, and the deeper world in EEE field. So, I decide to apply for Delft's graduate program

During my undergraduate, in my year 2 project, I finished an Auto-navigate vehicle by myself. This project guided me in the deeper field of Micro-programmable Controller Unit (MCU). To finish this project, I started to study the external sensors and electronic devices using Arduino and Raspberry Pi. This integrated hands-on task strengthened my programming and circuit analysis skills in the embedded system. Furthermore, to develop the auto-navigation function, I studied simple image processing by reading the official manual of OpenCV.

This teamwork-based project had also inspired me to join the "Robomaster Team" in our university, as a member of a software group working on Visual Computing tasks in an international robot competition held by DJI company.

In my year 3 application projects, my teammates and I accomplished an AC-DC forward converter implementation and its control strategy using our own designed PCB with specific chips and electronic components. Then we developed an STM32L based speed detection radar module, whose computing and receiver module is driven by a Verilog programmed FPGA to perform signal detection and analysis. This year, I interacted more with the electrical signal in circuits and aim to design a control strategy to amend and compensate the exceeded electrical excitations and signals, in the form of currents and voltages.

The projects in y2 and y3, enabled me to know how a real electrical system is operated, and the way to put my courses materials into the real applications. At the same time, I was capable of building hands-on computing projects and manipulate excitation signals in a certain system.

**(what I have done in past time, which guided me into signal & system area)**

Besides these projects, I have also learned several significant courses regarded to signal and system, including "Signal Transform" which taught me to analyze signal using Fourier Transform, Laplace Transform and Z-Transform, "Energy Conditioning and Control" which provided valid and complete control theory and concepts of evaluating and amending an electrical system performance. T

I have also chosen the "Advanced Engineering Mathematics" and “signal processing & sensing

system" in my final year study course list, to explore the processing of a digital signal using computer aided tools. However, to achieve higher goals and implement advanced projects requires a higher-level education and knowledge. At the same time, sharing and studying with those talented and motivated engineering students is always an exciting experience.

**(How my courses relations to signal & system)**

In my last summer, I chosen a research topic "Noise Cancellation" and join a research group led by Dr. Shunbai to deal with Audio Signals as a beginning step of my BSc thesis work. In this project, we are aiming to develop an embedded system which can achieve active noise cancellation.

I mainly focus on the FPGA based algorithm acceleration using C/C++ and Xilinx High-Level-Synthesis. Due to the parallel digital circuit architecture on FPGA, with the optimized solution provided by High-Level-Synthesis, a PC-based algorithm can be implemented on FPGA with much higher processing speed.

My major task is to develop an adaptive algorithm to cancel or minimize the effect of background noise when people are speaking. The whole processing scheme contains two major parts. The first part is pre-processing, using conventional FFT and digital filter to block some high frequency noise and reconstruct the signal without losing the speech information. This part is firstly achieved on PC using Python, then will be refactorized by C/C++ for hardware implementation. Theis process is about to take roughly 85 hours (estimated 15 hours per week) starting from learning the fundamental audio speech processing knowledge to successfully implemented. By the end of my first semester, the accelerated performance should be verified.

The second part is using Convolutional Neural Network (CNN) combined with statistic digital signal processing methods to achieve the self-adaptive noise estimation and cancellation. The machine learning algorithm is firstly tested on PC and then, similar to pre-processing steps, transplant to FPGA using C/C++ under fully optimized configurated solution. I will spend about 120 hours in learning machine learning algorithms with its application in signal processing domain. By the beginning of my final semester, I shall prepare the well tested model on PC and then discuss the FPGA configuration and thesis framework with my supervisor. The whole BSs project is estimated to take 6 months since early October 2020 to be finished at middle April 2021, with four deliverable tasks including preprocessing performance, machine learning model performance, acceleration verification and final algorithm transplant, and a 8500 words limited summarized thesis.

**(my BSc thesis work)**

At this stage, I want to pursue further research and study in the Multi-media signal system, and Robotics. In modern days, multimedia is a key transceiver requires fast and accurate processing solution, delivering require high accuracy data for fast localization and mapping.

Robotics is an emerging interdisciplinary area, requiring system modelling and signal processing. These newly rising hot topics produce countless innovation in modern industry.

Engaging in these two areas can provide me with comprehensive professional techniques and meets me expectation to become an expert in signal processing with the chance to bring some improvements and changes in industry intelligentization

After graduation, I prefer to join large companies for the first several years, like Philips or Tesla, to gain some practical experience. In such a large company, I can engage in the frontline of

industry. More specifically, I would like to get a detailed know about my interested topics by participating in a real research-development process. So that, I can figure out the shortcomings of my knowledge and prepare for further study and self-improvement such as PhD and another master's degree.

I am also interested in PhD studies. Comparing to the fundamental research, I prefer applicational research. The unique PDEng programs in the Netherlands enables me to be involved in a real industry product development process, gaining precious experience for the path to a real industry expert.

**(My further career expectation.)**

Delft University of Technology is one of the most famous and attractive institutions of science and technology in the world, providing a wide range of advanced study options. On the other hand, TU Delft possesses the most talented and motivated staff, which would fire my thoughts and motivation in my later study period in order to peruse a higher capability and knowledge in Electrical Engineering. That would be a great preparation for my future PhD study or my career.

More specifically for Signal & System track, the most attractive part is the diverse courses option provided by TU Delft. In such a program, I am capable of designing my own study plan varying from stat-of-art interdisciplinary computer science technical courses including deep learning, pattern recognition, to higher advanced mathematical modelling skills such as convex optimization, information theory and adaptive control system. It also offers conventional signal processing courses in biomedical and audio system.

Study in such a fantastic program can give me strict academic training then provide me with solid and comprehensive professional skill.

In terms of international life, Netherlands is a country with fabulous sightseeing and the most diverse culture in the world, and it is also one of the countries where western capitalism and industrialization have risen and accomplished ahead. Studying and living in Netherlands can enlarge my sight of views then provide me with a different lifestyle and more opportunities in the future career path.

**(why I choose this master program)**

All in all, it is my interest and career path to put my effort into signal & system track and the great reputation and comprehensive support of Delft could provide me with an excellent preparation and education for my future career development.