PhD studentship (Full-time)

Institution	Xi'an Jiaotong-Liverpool University, China
School	School of Advanced Technology
Supervisors	Principal supervisor: Professor Ka Lok Man (XJTLU) Co-supervisor: Dr. Yutao Yue (JITRI) Co-supervisor: Professor Eng Gee Lim (XJTLU)
Application Deadline	Open until the position is filled
Funding Availability	Funded PhD project (world-wide students)
Project Title	Wide-band antenna design based on machine learning 基于机器学习的天线设计
Contact	Please email ka.man@xjtlu.edu.cn (XJTLU principal supervisor's email address) or yueyutao@idpt.org (JITRI supervisor's email) with a subject line of the PhD project title

Requirements:

The candidate should have a first class or upper second class honours degree, or a master's degree (or equivalent qualification) in Computer Science/Electrical Engineering/Electronic Engineering/Computer Engineering.

Evidence of good spoken and written English is essential. The candidate should have an IELTS score of 6.5 or above, if the first language is not English. This position is open to all qualified candidates irrespective of nationality.

Degree:

The student will be awarded a PhD degree from the University of Liverpool (UK) upon successful completion of the program.

Funding:

This PhD project is a collaborative research project between XJTLU (http://www.xjtlu.edu.cn) in Suzhou and JITRI (Jiangsu Industrial Technology Research Institute) Institute of Deep Perception in Wuxi. The student will be registered as an XJLTU PhD student but is expected to carry out the major part of his or her research at the Institute in Wuxi.

The PhD studentship is available for three years subject to satisfactory progress by the student. The award covers tuition fees for three years (currently equivalent to RMB 80,000 per annum). In addition, during the period of undertaking main research at institute in Wuxi , the PhD candidate will be provided with monthly living allowance at a standard of 3000-7000RMB by JITRI Institute of Deep Perception.

Project Description:

With the rapid development of modern wireless communication and radar technologies, as one of the most important components of the radio frequency front end, the structure and design of antennas and arrays are becoming more and more complex, which brings increasing computational burdens. Traditional antenna design methods usually rely on the work experience and theoretical knowledge of antenna designers. The design process is not only complicated but also time-consuming, and it is also difficult to achieve optimal design. In recent years, antenna optimization design has been paid attention and researched. In the past two decades, machine learning (ML) methods have been extensively studied and introduced into the field of antenna design to learn corresponding knowledge from actual antenna or simulation data to accelerate the antenna design process. As a proxy model-based optimization method, Machine-Learning-Assisted-Optimization (MLAO) uses ML to learn model features that are originally computationally expensive, thereby establishing a cheap proxy model to predict potentially better sample points The model responds at the location, thereby accelerating the optimization design process. Based on the parameter optimization in the antenna design process, this project collects and studies a variety of MLAO methods for different application scenarios and special design tasks, reduces manual labor in antenna design, shortens design time, and improves antenna optimization design efficiency.

This project intends to adopt the following research methods:

(1) Artificial Neural Network (ANN)

As one of the most well-known ML methods, ANN has been dated in the electromagnetic and microwave fields as early as the 1990s, and has been applied in many fields including radar, antenna, circuit, measurement, and reverse. At the end of the 20th century, ANN was first dated in the field of antenna design, modeling a microstrip patch antenna, mapping the dielectric constant of its dielectric substrate, antenna parameters, and resonant frequency of the antenna's main mode to the length of the antenna. ML models with more layers including Deep Neural Network (DNN) are used in the field of antenna design to solve problems including parameter and topology optimization. In the initial stage of the genetic algorithm optimization design of the antenna, full-wave numerical simulation is used to provide training samples for the neural network algorithm; because the genetic algorithm optimized design antenna direction and results are mainly determined by a small number of individuals with high fitness values, the neural network algorithm prediction replaces the full-wave numerical value After simulation, full-wave numerical simulation is used to verify individuals with

high moderate values, and even to ensure the correctness of the optimized design, while updating the neural network algorithm training sample library to improve the accuracy of prediction.

(2) Support Vector Machine (Support Vector Machine, SVM)

Compared with ANN, the application of SVM in the antenna field benefits from its better generalization characteristics in actual optimization tasks. The amount of calculation of full-wave simulation in the antenna design task determines that the number of samples in the training set generated is limited, which brings about the possibility of overfitting in some ANN applications. SVM is used to model the reflection array unit and establish the relationship between its parameters and the real and imaginary parts of its reflection coefficient, thereby assisting the optimization design of the reflection array.

(3) Gaussian Process Regression (GPR)

In recent years, GPR has received extensive attention in electromagnetic engineering, including antenna optimization design. Compared with the first two ML methods, GPR can not only provide the predicted value of the potential design point, but also its uncertainty, thus providing the possibility for Bayesian optimization. For the common training set with small sample points, the MLAO method based on GPR can more effectively explore the unknown area in the design space, so that it is more likely to get the global optimal design point. By establishing a Gaussian process model to show the non-linear mapping relationship between input variables and design index values, the Gaussian process model is used to replace the true fitness function to evaluate the pros and cons of the individual, and then the Gaussian process model is used to predict the optimal particle of the individual. The optimal particle is substituted into the real fitness function (calling HFSS simulation), and the obtained result is compared with the predicted value of the previous Gaussian process model. When the error is less than the standard, the optimized knowledge base is updated with the predicted value of the Gaussian process model, continuously Improve the predictive ability of the Gaussian process model, so that the optimal value is obtained in this loop, until the design index is met or the maximum number of iterations is reached, the algorithm stops.

For more information about doctoral scholarship and PhD programme at Xi'an Jiaotong-Liverpool University (XJTLU): Please visit

http://www.xjtlu.edu.cn/en/study-with-us/admissions/entry-requirements

http://www.xjtlu.edu.cn/en/admissions/phd/feesscholarships.html

Supervisor Profile:

Principal Supervisor:

Ka Lok Man is currently a Professor in the School of Advanced Technology at Xi'an Jiaotong-Liverpool University (XJTLU) in Suzhou, China and an Adjunct Professor in the Faculty of Engineering and Science, Swinburne University of Technology Sarawak,

Malaysia. He is an Honorary Recognized Professor at Big Data Excellence Centre, Kazimieras Simonavicius University, Lithuania. He is also a Visiting Professor at imec-DistriNet, KU, Leuven, Belgium and at the Faculty of Informatics, Vytautas Magnus University, Lithuania. He has about 20 years of international teaching experience, several years of industrial experience in integrated circuit design and has been involving in many industry-oriented research projects in Microelectronics and Computer Science, many of them in cooperation with STMicroelectronics, Synopsys and LG. He has a good publication record and to date has more than 500 published academic articles. Also, he has received more than 50 international research awards and fellowships. Ka Lok Man has become a well-established international researcher within a number of related areas, including formal methods, process algebras, hybrid systems, cyber physical systems, recommendation systems, data analytics, low power integrated circuits, wireless sensor networks & communication, IoT, photovoltaic & battery management systems and signal processing. Currently, he is supervising/co-supervising about 20 PhD students, 3 MSc students, a number of UG students and research assistants in the areas of solar energy, wireless sensor networks, communication, middleware, IoT, signal processing, data mining, machine learning, deep learning, cloud computing and image/video identification.

JITRI co-supervisor:

Yutao Yue received his B.S. degree of applied physics from University of Science and Technology of China in 2004, Ph.D. degree of computational physics from Purdue University in 2010. He then served as senior scientist of Kuang-Chi Institute, team leader of Guangdong "Zhujiang Plan" Introduced Innovation Scientific Research Team, and associate professor of Southern University of Science and Technology of China, etc. He has authored 17 papers and over 300 patents, and advised 13 postdoc researchers. He also serves as the "Industrial Professor" of Jiangsu Province, advisory panel member of SAIIA, technical review expert of Guangdong, Jiangsu, Shenzhen, and Wuxi. He is now the founder and director of Institute of Deep Perception Technology (IDPT), Jiangsu Industrial Technology Research Institute (JITRI). His research interests include modeling and optimization, computational electromagnetics, radar perception, artificial intelligence theories.

How to Apply:

Interested applicants are advised to email ka.man@xjtlu.edu.cn (XJTLU principal supervisor's email address) or yueyutao@idpt.org (JITRI supervisor's email) the following documents for initial review and assessment (please put the project title in the subject line).

- CV
- Two reference letters with company/university letterhead
- Personal statement outlining your interest in the position
- Proof of English language proficiency (an IELTS score of 6.5 or above)

- Verified school transcripts in both Chinese and English (for international students, only the English version is required)
- Verified certificates of education qualifications in both Chinese and English (for international students, only the English version is required)
- PDF copy of Master Degree dissertation (or an equivalent writing sample) and examiners reports available