INTERN RESEARCH TOPICS

Project Number	P1
Project title	AI for CyberSecurity and CyberSecurity for AI in Beyond 5G and 6G Networks
Description of the research	Directional wireless transmission technologies and quantum computing are introduced to satisfy broadband and low-latency demands in 5G/5G high-end applications such as holographic telepresence. There are, however, severe threats to user privacy and national security posed by wireless signal-based tracking or quantum attacks on public-key cryptosystems. In contrast, DDoS and adversarial attacks have been the main concerns of a connected and intelligent Internet. In order to protect cyberspace, our lab focuses on two research topics: (1) AI for Cybersecurity: Developing self-learning models for DDoS defense/wireless physical layer security/ quantum-resistant models. (2) Cybersecurity for AI: Protecting critical applications from adversarial attacks For related information, please refer to our lab's website at https://ccucyberseclab.github.io/
Mentor in CCU	Prof. Van-Linh Nguyen Dept. of Computer Science and Information Engineering National Chung Cheng University, Taiwan, ROC. (e-mail: nvlinh@cs.ccu.edu.tw)
Expected student level	■ Post-graduate student ■Third/forth-year undergraduate senior student
Category	■ Self-supported
Intern period	At least 8 weeks between 2023/2/1 and 2023/7/31

Project Number	P2
Project title	Day-ahead solar PV generation forecast based on cluster analysis and advanced deep learning neural network
Description of the research	Typically, day-ahead solar photovoltaic power generation forecast is performed based on historical data obtained from solar PV power plant. This project studies improved weather clustering procedures, which will provide more reliable evaluation and clustering results using cluster validation techniques. In addition, a model combining advanced neural network for optimizing the network model through automatic hyperparameter tuning. It is expected that improving cluster analysis and forecast model will effectively enhance the accuracy of the solar PV power generation forecast.
Mentor in CCU	Prof. Gary Chang Dept. of Electrical Engineering, National Chung Cheng University, Taiwan, ROC. (e-mail: ieegwc@ccu.edu.tw)
Expected student level	■ Third/forth-year undergraduate senior student
Category	■ Scholarship (without airfare reimbursement) ■ Self-supported
Intern period	At least 10 weeks between June 15 and Sept. 15

Project Number	P3
Project title	Improving voltage ride-through capability of grid-tied microgrid with harmonics mitigation
Description of the research	When the microgrid operates in grid-tied mode, the voltage ride-through (VRT) capability presents a challenge in its inverter controller design. This project proposes an effective method to support the VRT capability of an inverter-based grid-tied microgrid during grid fault. In addition, the inverter control is implemented by a combined method to mitigate its output current harmonics under normal or faulty grid conditions, even if the grid voltage is distorted. Simulations are to be performed using Matlab/Simulink and implemented in a real-time simulator with a hardware setup to validate the usefulness of the proposed method.
Mentor in CCU	Prof. Gary Chang Dept. of Electrical Engineering, National Chung Cheng University, Taiwan, ROC. (e-mail: ieegwc@ccu.edu.tw)
Expected student level	■ Post-graduate student ■ Third/forth-year undergraduate senior student
Category	■ Scholarship (without airfare reimbursement) ■ Self-supported
Intern period	At least 10 weeks between June 15 and Sept. 15

Project Number	P4
Project title	A Stochastic Approach for Assessment of PV Hosting Capacity in a Distribution Feeder with Combining Energy Storage System
Description of the research	Nowadays, as the penetration of renewable energy in the distribution system increases, the challenge to system operation rises. This project will focus on the hosting capacity estimate of a distribution feeder when a large number of PV units integrated into the system. This study uses the voltage deviation rate of each feeder bus as constraints to assess the solar photovoltaic hosting capacity (PVHC) of the feeder without violating operating voltage constraints. Then, the battery energy storage units are installed to check if the PVHC of the feeder can be improved. Through a good number of simulation scenarios, it is to assess the capability of energy storage systems in increasing the PV hosting capacity in the feeder.
Mentor in CCU	Prof. Gary Chang Dept. of Electrical Engineering, National Chung Cheng University, Taiwan, ROC. (e-mail: ieegwc@ccu.edu.tw)
Expected student level	■ Third/forth-year undergraduate senior student
Category	■ Scholarship (without airfare reimbursement) ■ Self-supported
Intern period	At least 10 weeks between June 15 and Sept. 15

Project Number	P5
Project title	Object localization and recognition of autonomous vehicles via camera, lidar, and radar
Description of the research	Based on the sensed signals from cameras, lidars and radars from the open datasets, please design deep neural networks to figure out object localization and recognition of autonomous vehicles.
Mentor in CCU	Prof. Oscal Tzyh-Chiang Chen Dept. of Electrical Engineering National Chung Cheng University, Taiwan, ROC. (e-mail: oscal@ee.ccu.edu.tw)
Expected student level	■ Post-graduate student ■ Third/forth-year undergraduate senior student
Category	■ Self-supported
Intern period	At least 8 weeks between Jan. 1 and Jun. 30

Project Number	P6
Project title	6-DoF Visual Localization
Description of the research	Autonomous driving, mobile robotics and augmented reality attract lots of attention lately and many related techniques have dramatically developed, such as the estimation of the 3D structure and the camera pose, to offer accurate navigation and localization. Traditional navigation technology is susceptible to changes in the outdoor environment, including dim light, poor weather, or seasonal changes, resulting in a large content difference between the query image and the database image. Consequently, accurate image matching, place recognition, and localization under the varying environment is still a challenge. This research is to develop a deep learning based visual localization technique which is robust for various condition during the capture of the query image.
Mentor in CCU	Prof. Jui-Chiu Chiang Dept. of Electrical Engineering, National Chung Cheng University, Taiwan, ROC. (email: rachel@ccu.edu.tw)
Expected student level	■ Third/forth-year undergraduate senior student
Category	■ Scholarship ■ Self-supported
Intern period	At least 12 weeks between March 1 and Aug. 1

Project Number	P7
Project title	Computer vision applications based on deep learning techniques
Description of the research	This project is to do researches on computer vision based on the modern deep learning (machine learning) techniques. In this research, you will learn deep learning techniques such as CNN, RNN, LSTM, AE, VAE, etc. The possible applications and topics include: (1) 3D human skeleton extraction, skeleton-based action recognition, action prediction for elderly monitoring, (2) depth estimation from mono- binocular images, (3) 3D object (vehicle, pedestrian, cyclist) detection and positioning from fusion of RGB/LiDAR sensor data, (4) mapless robot navigation based on deep reinforce learning (DRL), (5) object (head/vehicle/human/object) pose estimation from single RGB image, (5) deep learning-based adverse drug reaction (ADR) prediction for clinic medicine use. The intern student is expected to have some preliminary knowledge on NN (neural network) or deep learning and skilled in Python programming. He/She will learn how to apply state-of-the-art deep learning techniques to solve the indicated problems. For more detail about my topics, please visit my Youtube vide at: https://youtu.be/tIwenpyFRhw
Mentor in CCU	Prof. Wen-Nung Lie Dept. of Electrical Engineering, National Chung Cheng University, Taiwan. (e-mail: ieewnl@ccu.edu.tw)
Expected student level	■ Post-graduate student ■ Third/forth-year undergraduate senior student
Category	■ Scholarship ■ Self-supported
Intern period	At least 16 weeks (4 months) between Jan.1 and Jun. 30, 2023

Project Number	P8
Project title	Impulse radar Imaging System and Components
Description of the research	Three investigation topics over Ultra-Wideband Impulse Radar imaging system: One is backprojection imaging algorithm used to reconstruct the radar image. The second one is the studies of the transmitting and receiving circuits and Vivaldi antenna array. The third topic is RF components design such as PA and LNA, by CMOS process or III-V technology.
Mentor in CCU	Associate Prof. Janne-Wha Wu Dept. of, Electrical Engineering National Chung Cheng University, Taiwan, ROC. (e-mail: jwwu@ccu.edu.tw)
Expected student level	■ Post-graduate student ■ Third/forth-year undergraduate senior student
Category	■ Scholarship ■ Self-supported
Intern period	At least 8 weeks between Jan. 1 and Oct. 31

Project Number	P9
Project title	Advantaged Technologies about Renewable Energy Integration
Description of the research	The research topic covers the control of wind or solar power generation with control theory, forecasting technologies with artificial intelligence, and fault diagnosis in PV systems. Candidates must read international papers and fundamentals on code programming. In addition, it is preferred that the candidates would like consider to study CCU for master or PhD degrees.
Mentor in CCU	**Prof. Yuan-Kang Wu** Dept. of, Electrical Engineering National Chung Cheng University, Taiwan, ROC. (e-mail: allenwu@ccu.edu.tw)
Expected student level	■ Post-graduate student ■ Third/forth-year undergraduate senior student
Category	■ Scholarship
Intern period	At least 3 months between March 1 and May 31 (A longer period is preferred.)

Project Number	P10
Project title	Silicon photonics and optical biosesnors
Description of the research	The topic is to develope (a) new types of silicon-based, CMOS compatible photodetectors, which have many advantages over conventional III-V based counterparts for mid-infrared applications, (b) new disposable optical biosensors for cost-effective and rapid biomedical detection for precise medicine. This internship program is open for talents who are interested in advanced optoelectronic-sensing technologies. Focus will be placed on designing, simulating, and analyzing new Si-based group-IV photodetectors and optical biosensors. For related information, please refer to the website of our lab at https://ccuphotonics307.wixsite.com/ccuphotonics307
Mentor in CCU	Prof. Guo-En Chang Dept. of Mechanical Engineering National Chung Cheng University, Taiwan, ROC. e-mail: imegec@ccu.edu.tw
Expected student level	■ Post-graduate student ■ Third/forth-year undergraduate senior student
Category	■ Scholarship ■ Self-supported
Intern period	At least 8 weeks between Jan. 1 and Jun.30

Project Number	**P11**
Project title	Numerical modeling and Experiments of a helium atmospheric pressure plasma jet operated in air with shielding gas
Description of the research	Atmospheric-pressure plasma jets have been developed extensively for applications such as plasma medicine and plasma agriculture due to the generation of abundant reactive species being critical for manipulating reaction pathways in different fields. However, it is still challenging to develop a proper plasma source with controlled parameters by experimental measurements because of fast discharge dynamics and complex plasma chemistry. Alternatively, numerical simulations can be used to capture discharge dynamics with detailed chemistry revealed. In this project, a two-dimensional axisymmetric plasma fluid model will be integrated with a two-dimensional axisymmetric gas flow model to predict the dynamic behavior of a helium atmospheric pressure plasma jet. The simulated results will be compared with photos taken by an intensified CCD camera to validate the model. It is a topic involving thermofluid science, which is suitable for students in mechanical engineering.
Mentor in CCU	Prof. Kun-Mo Lin Dept. of, Mechanical Engineering National Chung Cheng University, Taiwan, ROC. (e-mail: imekml@ccu.edu.tw; kmlin.tw@gmail.com)
Expected student level	■ Post-graduate student ■ Third/forth-year undergraduate senior student
Category	■ Scholarship ■ Self-supported
Intern period	At least 10 weeks between Jan. 1 and Dec. 31, 2023

Project Number	P12
Project title	Interdisciplinary opto-mechanical integration
Description of the research	Our research is mainly about interdisciplinary integration, such as integration of semiconductor solar photovoltaic components and single-cell biochips, to achieve self-powered biochips, the integration of various micro-nano process technologies such as laser interference lithography, anodized aluminum, nano Imprinting technology on solar cells, light-emitting diode components and the development of novel optical analysis techniques on two-dimensional materials, in the study of cross-domain integration, the study of basic physical mechanisms is very important, such as electronic hole pairs. The relationship between transmission and the polarity of cancer cells, the mechanism of the surface microstructure of the surface for the generation of surface plasma waves, and the interaction between the atomic layer and the atomic layer in two-dimensional materials. Our research is also about the application of hyperspectral imaging on medical images, and the automated optical inspection. These basic mechanisms involve physics, chemistry, materials, optics and other related fields. And there are still many unclear issues on the subject of these studies. If you can further solve these mysteries, you can make a considerable contribution to both basic science and engineering.
Mentor in CCU	Prof. Hsiang-Chen Wang Dept. of Mechanical Engineering, National Chung Cheng University, Taiwan, ROC. (email: hcwang@ccu.edu.tw)
Expected student level	■ Post-graduate student
Category	■ Scholarship ■ Self-supported
Intern period	At least 8 weeks, between 8 and 25 weeks

Project Number	P13
Project title	Study on the topics of biochemical engineering and biomedical sciences
Description of the research	This project aims to recruit undergraduate and postgraduate students from the universities in South and Southeast Asian countries to CCU laboratories for technical training and short-team research. Topics of research cover biochemical engineering (applied microbiology, enzyme engineering, protein expression and large-scale production), systems biology, metabolic network simulation, cancer epigenomics, and neurodegenerative diseases. Each student can choose one of those topics and work on a laboratory in either the Department of Chemical Engineering or the Department of Biomedical Sciences.
Mentor in CCU	Prof. Wen-Chien Lee Dept. of, Chemical Engineering National Chung Cheng University, Taiwan, ROC. (email: chmwcl@ccu.edu.tw)
Expected student level	■ Post-graduate student ■ Third/forth-year undergraduate senior student
Category	■ Scholarship
Intern period	At least 7 weeks between Jan. 1 and Jun.30

Project Number	P14
Project title	Formation of nanomaterials for lithium ion battery, lithium sulfur battery, metal-air battery and supercapacitor
Description of the research	The research will focus on the synthesis of nanomaterials such as carbon nanotubes, oxide nanomaterials and single atom catalysts for novel applications in the field of the energy storage including metal ion battery, metal air battery, and supercapacitors.
Mentor in CCU	Prof. Yuan-Yao Li Dept. of Chemical Engineering, National Chung Cheng University, Taiwan, ROC. (e-mail: chmyyl@ccu.edu.tw)
Expected student level	■ Post-graduate student ■ Third/forth-year undergraduate senior student
Category	■ Self-supported
Intern period	At least 8 weeks between Jan. 1 and Dec. 31

Project Number	P15
Project title	Implementing evaluation scenarios in B5G/6G communication of IMT-2030
Description of the research	This project is to build topologies and derive environmental channel conditions in several generally accepted scenarios which contain focused B5G/6G challenges in the IMT-2030, such as a hybrid network consisting of disparate networks including fixed, mobile cellular, high-altitude platforms, satellites and others yet to be defined. The B5G/6G will also bring previously fictional technology capabilities within the reach of users: three-dimensional holographs providing fully-immersive virtual and augmented reality and an extraordinary user communications experience. The outcome of this project can be used in realization, visualization, demonstration, evaluation, and calibration of future B5G/6G communication systems in IMT-2030. For related information, please refer to the website of our lab at https://sites.google.com/view/ccuantlab/english
Mentor in CCU	Prof. Jen-Yi Pan Dept. of Communications Engineering, National Chung Cheng University, Taiwan, ROC. (e-mail: jypan@ccu.edu.tw)
Expected student level	■ Post-graduate student ■ Third/forth-year undergraduate senior student
Category	■ Self-supported
Intern period	At least 8 weeks between January 1 and June 30

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