



2019 Future Tech EXPO

HIGHLIGHT INNOVATIONS

DEC. 5 - 8
TWTC Hall 1

The background is a deep blue gradient. On the left side, there are numerous thin, white, wavy lines that create a sense of motion and depth. Scattered across the entire background are various semi-transparent geometric shapes, including rectangles, squares, and lines, in shades of light blue and white. Some of these shapes are slightly tilted or offset, giving the impression of a digital or futuristic environment.

Future Tech, Leading Your Life

26 featured highlights
from 88 technologies
in 2019 Future Tech Breakthrough Award.

AI & IOT Application 01 ●

Electronic & Optoelectronics 05 ●

Bio-tech & New Drugs 07 ●

Medical Devices 12 ●

Smart Machinery & Evolutionary Materials 16 ●

Semiconductor Moonshot Project 19 ●

Smart Agriculture 21 ●

Precision Sports 24 ●

Smart Disaster Prevention System 26 ●

About

The Ministry of Science and Technology is hosting the “2019 Future Tech” to exhibit advanced technologies, and to focus on the demands of industrial and socioeconomic fields, which is assembling the leading academic research projects with future industrial applicability and scientific breakthrough, and innovative technologies developed by institutions and science parks.

This exhibition is organized by the Ministry of Science and Technology, focusing on the key domains relevant to the country’ s social, household and industrial development, including Bio-tech & New Drugs, Smart Agriculture, Electronic & Optoelectronics, Semiconductors, Smart Machinery & Evolutionary Materials, and AI & IOT Application etc. Hundreds of revolutionized R&D project will be presented at the exhibition, with a selection of 26 highlights. This event will be hosted from December 5th (Thu) to December 8th (Sun) 2019 at Taipei World Trade Center Exhibition Hall 1. We look forward to building a beneficial industry-university-research platform for technology exchange and business matchmaking, as well as introducing innovative research strengths in Taiwan.

Free5gc : 5th Generation Mobile Core Network

National Chiao Tung University

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Technical introduction

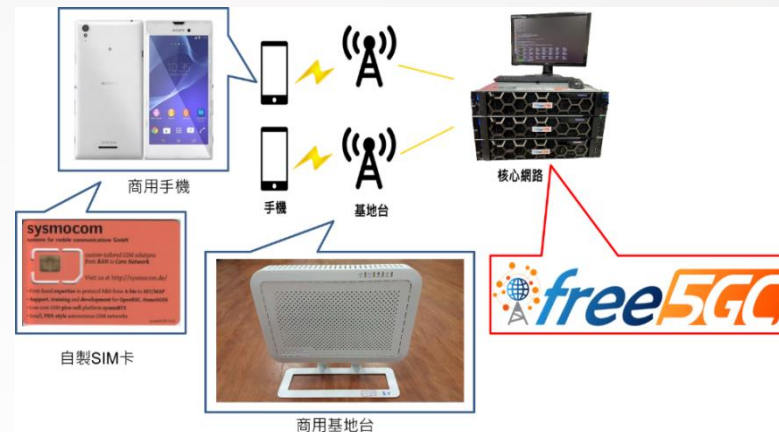
Although there are few open-source core network projects, none of them are conformed to 3GPP Release 15 (R15). The free5GC is the first one in the world based on 3GPP R15. The ultimate goal of free5GC is to implement a full commercial, operational core network including Operation, Administration and Management (OAM), orchestrator, and network slicing complied with 3GPP R15 and beyond.

Scientific breakthrough

The free5GC (<https://www.free5gc.org/>) is the first open-source 5th generation mobile core network based on the specifications defined by 3GPP.

Industrial applicability

This open-source project is the first 3GPP R15 5G core network in Taiwan and the world. It allows the base-station manufacturer to verify their systems and devices. Also, it will enable industries to develop future technologies such as AI, 8K HD video transmission, AR/VR, and V2X for mobile communications. The most important one is that it enables vertical industries to deploy and manage a private network away from mobile operators.



Personalized Emotion Sensing for Spoken Dialog Interface

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Technical introduction

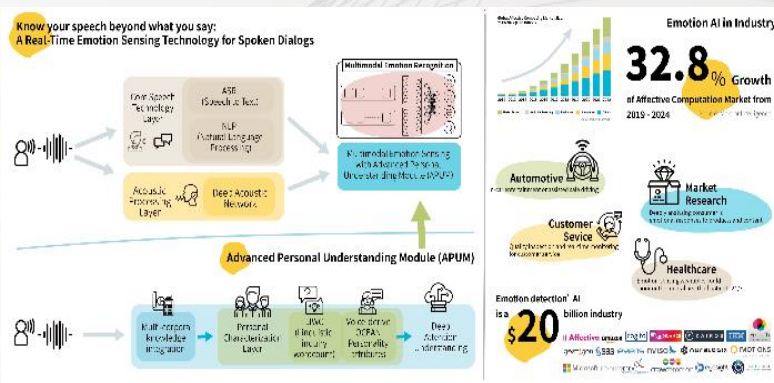
Recently, emotion-AI is becoming essential. Yet, the expression of emotion differs between individuals due to a variety of idiosyncratic human factors. Our solution integrates automatic speech recognition and text analysis, and learns an unsupervised individual space, formed our emotion recognition module. It is adaptable to the real application without needing labeled attributes of an individual.

Scientific breakthrough

When considering individuality in advancing emotion recognition, better modeling individual differences of human emotion expression is key. Our algorithm computes an unsupervised individual space and achieves the best accuracy in the emotion benchmark. The work is published in the flagship conferences on affective computing (ACII2019) and the world's largest speech technology (INTERSPEECH2019).

Industrial applicability

Gartner states that emotion AI is a 20 billion USD industry. Many applications can benefit from emotion AI, e.g., intelligence emotion-aware customer service can serve better, HR system identifies candidates efficiently, and business persuasion could also be improved. Numerous industries can create value by applying this emotion detection technique specifically through voice interaction service.



Real-Time Identification of Crop Losses Using UAV Imagery

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Technical introduction

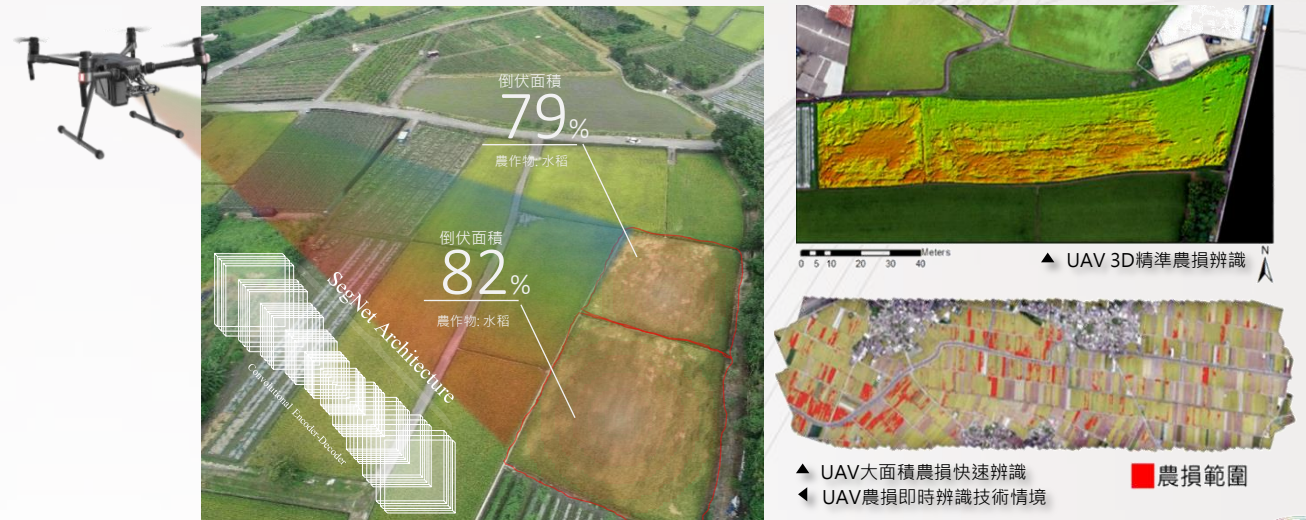
This technology integrates 1000+ times of UAV imaging experiences with labeled rice lodging images for training. A rice lodging recognition model using deep learning reaches 90% accuracy. The recognition model can be deployed in a microcomputer mounted on UAVs to implement edge computing. While taking aerial images, the inference can be completed and reveal lodging area and damage level in-time.

Scientific breakthrough

This technology employs image segmentation and edge computing to build agricultural disaster image database and implement the real-time inference on UAVs. This technology enables surveying personnel to instantly identify crop loss and damage distribution. This technology greatly simplifies the time-consuming and labor-intensive surveying and increases the efficiency of agriculture loss subsidy.

Industrial applicability

This technology accurately quantifies agricultural loss and saves manpower and time for loss subsidy. This technology can be beneficial to agricultural practitioners, such as UAV hardware and software developers, agricultural insurance companies, and pesticide fertilizer companies. The further research can be extended to large-scale rice field management and agriculture disaster detection.



5G Low Latency Massive Access Technology

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Technical introduction

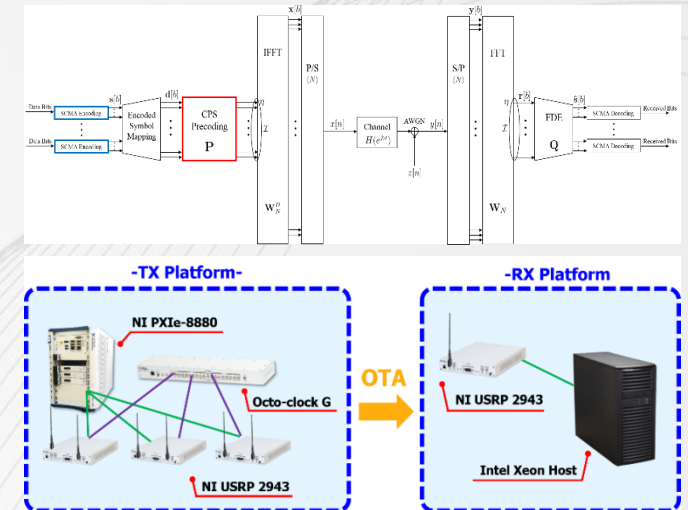
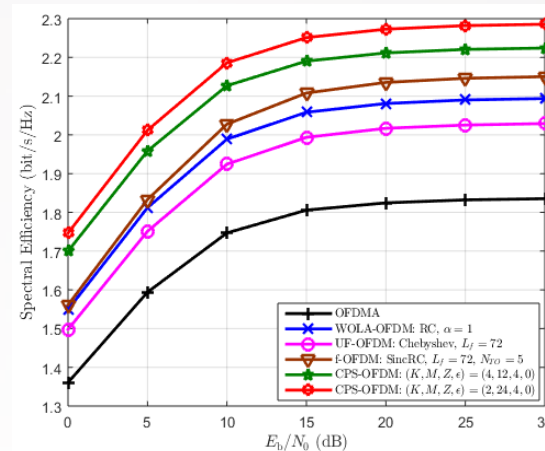
The CPS-OFDM technology by NTU enjoys the best spectral efficiency and design flexibility among the 5G candidate new waveform designs. CPS-OFDM is integrated and jointly optimized with the high performance SCMA by Univ of Surrey to achieve high communication efficiency, high reliability, low latency, for boosting the productivity of the factories of the future (FoF).

Scientific breakthrough

By imposing the flexibility in frequency and time, the CPS-OFDM by NTU enjoys the best spectral efficiency and design flexibility among the 5G candidate new waveform designs. The CPS-OFDM jointly optimized with the high performance SCMA by Univ of Surrey can achieve high communication efficiency, high reliability, low latency, for boosting the productivity of the factories of the future (FoF).

Industrial applicability

The CPS-OFDM by NTU has the best performance among the 5G candidate waveform designs, and has potential to be included in 5G standards. The high performance SCMA by U of Surrey is based on Huawei's SCMA, which is likely to be included in the 5G standards. Joint CPS-OFDM and SCMA can achieve high communication efficiency, reliability, low latency, which are features desired by 5G products.



On-Chip Integrated Quantum Polarization-Entangled Photonic Source

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Technical introduction

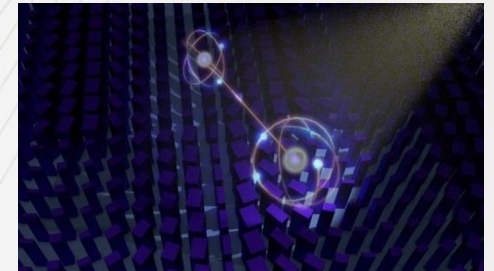
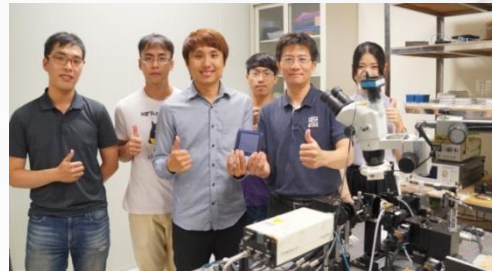
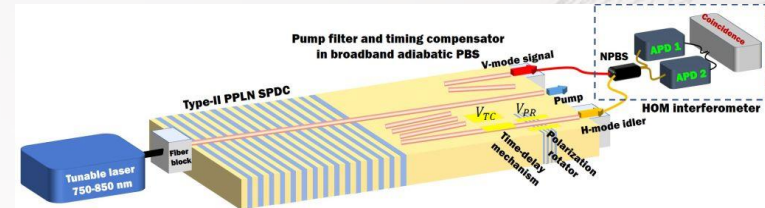
We developed a unique integrated quantum polarization entangled light source, in addition to generating a quantum polarization entangled photon pair, the integrated quantum chip also utilizes a special adiabatic optical light transfer array to integrate the on-chip polarization-dependent spectral splitting via the quantum tunneling effect. The integrated quantum light source provides a stable polarization entangled source for the more quantum applications.

Scientific breakthrough

The integrated quantum polarization-entangled light source was experimentally verified by Australian National University for the ultra-micro quantum polarization state tomography experiments. Combined with a metasurface, the experimental structure is directly integrated into the nm scale metasurface with the cm-long integrated chip, which is greatly reduced experimental scale. This study was published in Science.

Industrial applicability

Due to its superior computing speed and true parallel processing capability, Quantum Computer greatly improve the crisis and risk prediction accuracy of energy, finance, climate, etc., assist in the construction of absolute safety communication and engage in other astronomical, high-energy physics and military science and technology require large-scale complex computing events, leading the world are actively and heavily invested.



Innovative Wireless Positioning and Tracking System

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Technical introduction

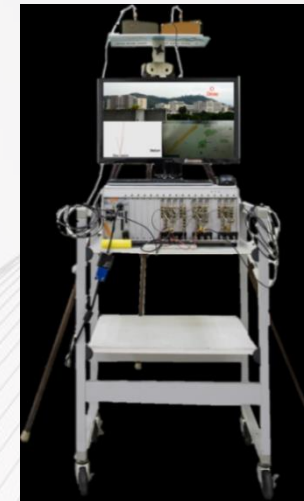
- iShield: The competitive portable solution devoting to tracking and disabling errant drones used in indoor environment for location-based service and in outdoor scenario for drone detection.
- iPosition: The wireless positioning system can be applied to find the geolocations of multiple targets efficiently and precisely.
- iFollow: The auto-following system with the AI-powered wireless communication technology is designed for drone and vehicle

Scientific breakthrough

Based on the development of advanced ICs and systems, the world's first wireless positioning and sensing technologies with high entry barrier are proposed to the indoor environment for location-based service and to the outdoor scenario for anti-drone application. The existing products, such as DJI and Yuneec, can only use expensive GPS device and image recognition processor, which are not attractive for customers.

Industrial applicability

- iShield: The developed wireless positioning and sensing technologies can be used in the indoor environment for location-based service and in the outdoor scenario for drone detection.
- iPosition: The tracking and positioning techniques are developed.



Finding Cures – New Platform and Techniques for The Development and Testing of New Drugs for Ataxia

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Technical introduction

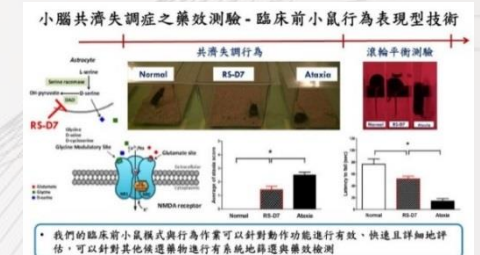
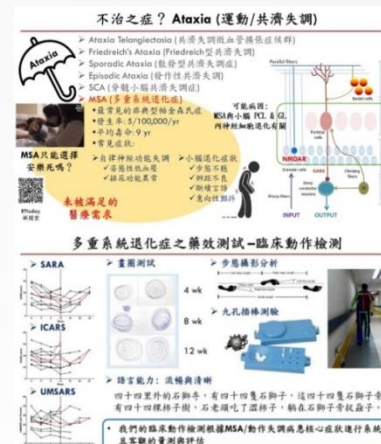
Our inter-institutional research team developed RS-D7, a novel NMDAR modulator/DAO inhibitor as a drug candidate for the treatment of ataxia/MSA. Based upon the core symptoms, we designed and applied preclinical mouse behavioral phenotyping techniques and clinical motor assessments to demonstrate the effectiveness of RS-D7 and our functional assays. RS-D7 offers multi-symptomatic relief.

Scientific breakthrough

Ataxia is an urgent unmet medical need. Our research team aims at developing novel NMDAR modulators and exploring new indications for RS-D7. Comparing with TAK-831 from Takeda, we successfully applied preclinical mouse behavioral phenotyping techniques and clinical motor assessments to demonstrate the therapeutic effects of RS-D7 on the alleviation of ataxia-related motor deficits in mice and clinical study.

Industrial applicability

1. We received several awards, e.g., Mentoring Program of Novartis Venture Fund, National Innovator Award and Future Tech Exhibition of MOST.
2. Ataxia is an urgent unmet medical need. The future is wide open for investment in orphan drug.
3. IP protection is nearly completed.
4. Our preclinical behavioral phenotyping and clinical motor assessments can be directly applied for drug testing.
5. RS-D7 offers multi-symptomatic relief.



Mobile Application for Anti-Doping & Gastroenteritis Defender

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Technical introduction

1. 'Mobile Application for Anti-Doping' containing more than 40,000 pharmaceuticals which allows athletes to check whether the pharmaceuticals are prohibited in- or out-of-competition simply via typing in the product names.
2. 'Gastroenteritis Defender' utilizes nanotechnology to enhance andrographolide oral bioavailability and could effectively prevent gastrointestinal inflammatory disorders.

Scientific breakthrough

1. 'Mobile Application for Anti-Doping' is the first mobile application in Taiwan developed for anti-doping purpose. Also, the only application includes data from Chinese herbal products in the world.
2. 'Gastroenteritis Defender' is the first andrographolide nano-formulation product which could enhance the oral bioavailability of andrographolide and prevent gastrointestinal inflammatory disorders.

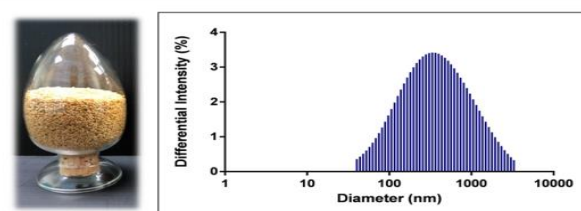
Industrial applicability

1. 'Mobile Application for Anti-Doping' has been promoted by many lectures and used for medical practices, for instance, before physicians' prescribing and during pharmacists' counselling.
2. 'Gastroenteritis Defender' could be further commercialized in different types. The technology has industrial applicability and could drive the sports industry demand for sports nutrition supplements.

1. Mobile Application for Anti-Doping



2. Gastroenteritis Defender



Modular Polymeric Nanoshells for Precision Antiviral and Anticancer Vaccination

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Technical introduction

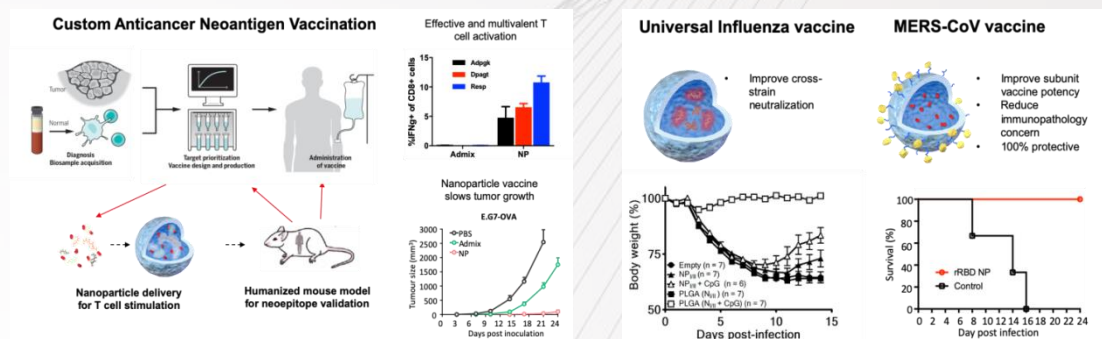
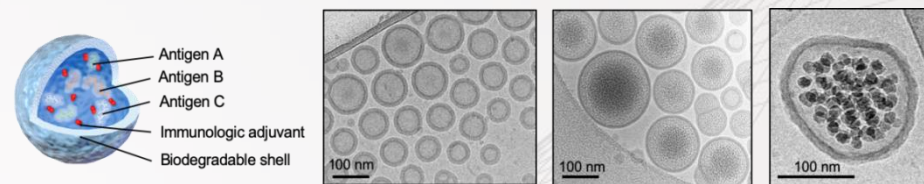
Effectively inducing cytotoxic T cell expansion has been a critical challenge in vaccine development. To address this challenge, an entirely biodegradable polymeric nanoshell was invented to couple antigens and adjuvants for safe and potent immune potentiation. The invention has been adopted for precision anticancer vaccine, broadly reactive influenza vaccine, and an effective vaccine MERS-CoV.

Scientific breakthrough

The biodegradable polymeric nanoshell fundamentally addresses the critical challenge in nano-encapsulation of water soluble and combinatorial compounds. The T cell stimulating capacity stemming from the nanoshell-based vaccines is unparalleled by any viral vector or non viral vector-based vaccine platforms. The platform is highly versatile for developing novel antiviral and anticancer nanoformulations.

Industrial applicability

The nanoshell-based vaccine is highly adaptable for vaccine preparation, enabling facile preparation of safe and effective vaccine formulations. It also addresses a fundamental challenge in the development of customizable anticancer vaccine, thereby paving ways to effective anticancer treatments. The polymeric nanoshells are also amendable to other nanomedicine development for drug and biologics delivery.



Composition for Treating Lung Fibrosis and Emphysema and Therapeutic Method Using the Same

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Technical introduction

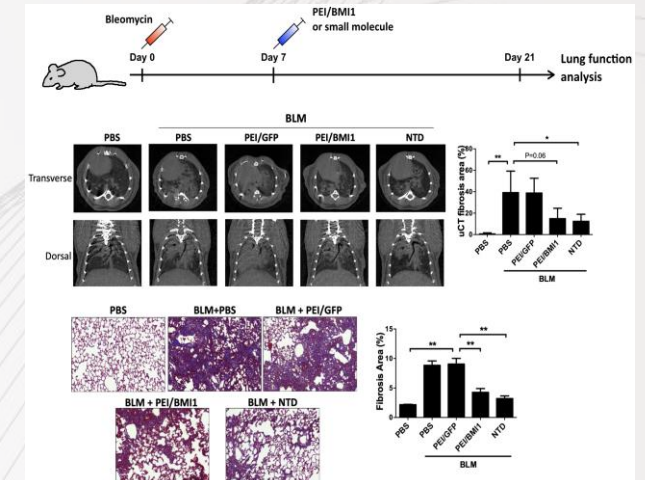
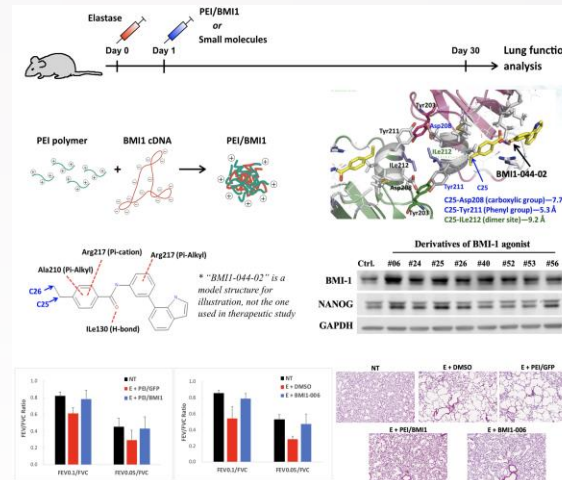
This is a regenerative biomedical technology, which aims to address the human chronic lung diseases that currently has no pharmaceutical approach for efficient control or therapy, such as COPD and lung fibrosis. The principle is to induce the in vivo reprogramming of endogenous alveolar epithelial cells through activation of stemness factor BMI1, which potentiates the repair of injured tissues.

Scientific breakthrough

Instead of transplanting in vitro propagated stem cells to injured organ, the current technology induces vivo reprogramming of endogenous alveolar epithelial cells through activation of stemness factors. This technology avoids the complexity of in vitro propagation of stem cells and safety concerns, and induces more efficient tissue regeneration because of the intrinsic property of target cells.

Industrial applicability

COPD and lung fibrosis are major public health problems with high and growing prevalences globally. Unfortunately, no pharmaceutical approach to date was able to control or restore the syndrome of these diseases. The current technology induces lung tissue repair based on in vivo reprogramming of endogenous lung epithelial cells, holding promise to be first therapeutic approach for these diseases.

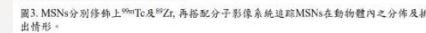
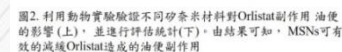
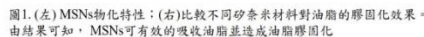


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This technology is mainly solved the side effects of anti-obesity drug, including soft stools or oily stools, and regulate oil absorption and metabolism as an additive in food. During the experiment, the curing phenomenon of MSNs/oil and oily stool reduction in animal were observed. In conclusion, MSNs can effectively reduce the side effects of Orlistat and elevating life quality.

According to the advantages of drug delivery system MSNs adsorbs oil and is removed with excrement from the GI tract through oil curing. The precise mechanism of oil in the curing process is critical for this project. We clarify the mechanism by physicochemical analysis and optical/nuclear imaging system. It's attractive as a material for effectively reducing the side effects of Orlistat and elevating life quality.

The market of anti-obesity drug has been limited by uncontrollable side effects, such as steatorrhea and oily stools. MSNs could function as oil curing agent to adsorb and solidify excess GI tract non-degraded oil. Indeed, minimizing or eliminating undesirable side effects constitutes the key to greatly improving Orlistat-type drug market dominance and accompanying customer satisfaction.



Potential of Ambient Mass Spectrometry in Toxicants Identification

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Technical introduction

Through combining the cutting-edge technology of TD-ESI/MS to its comprehensive database library of toxicants, a fast-track toxicant analytical platform and a set of standard operating procedures are developed that enables the emergency physicians to access correct toxicological information within a short turnaround time and rescue the poisoned patients based on accurate laboratory data.

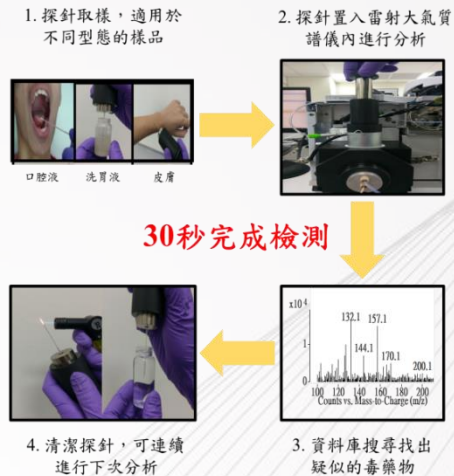
Scientific breakthrough

Traditional mass spectrometric technologies such as LCMS and GCMS must reduce matrix effect in order to accurately quantify. Therefore, it was needed to do complicated pretreatment prior to analysis and lead to be labor and time-consuming. Compared to ambient mass spectrometry, it is more suitable for emergency medicine due to the fact it required only a few minutes to complete one analysis.

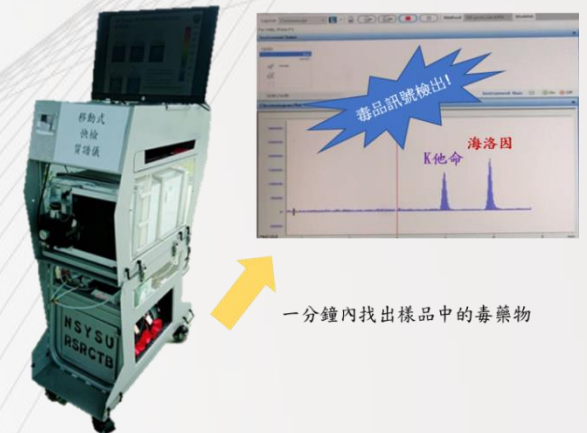
Industrial applicability

This screening platform of ambient mass spectrometry is capable of identifying rapidly chemicals that are incorporated in its comprehensive toxicant database library. Its application in clinical toxicology through a set of standard operating procedures allows emergency physicians to obtain correct information in a short period of time and treat the poisoned patients in a precise and timely manner.

雷射大氣質譜儀檢測流程 (急診醫療)



大規模毒藥物快速 (反毒)



The Development of Smart Contact Lens System: Taking Dry Eye Syndrome Diagnosis as an Example

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Technical introduction

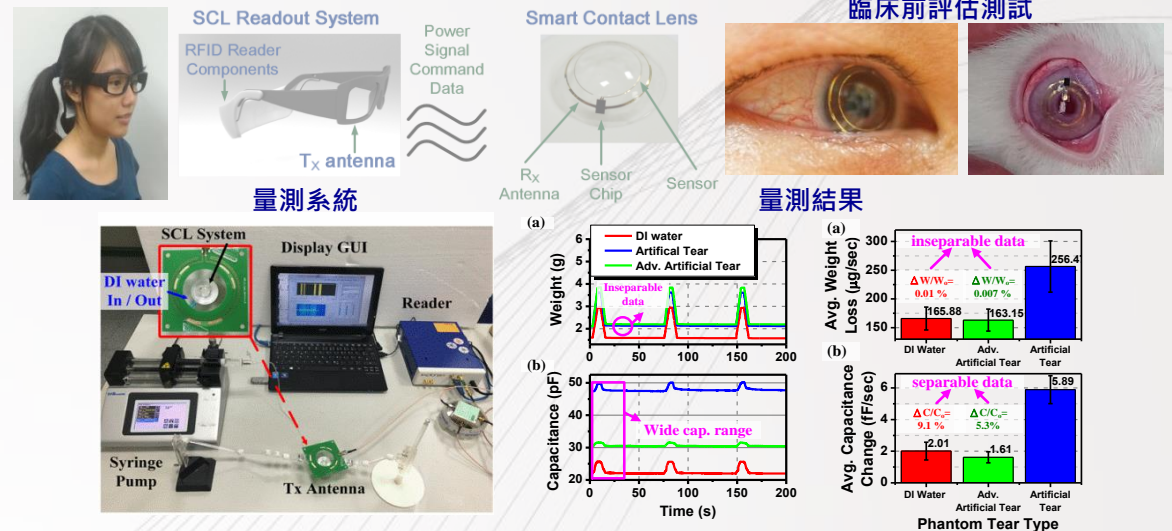
This project proposes a smart contact lens ideally capable of simultaneously observing the tear evaporation rate, the tear osmolarity, and the ocular surface temperature. To solve the shortcoming of the current difficulty in quantifying DES, assist doctors in the diagnosis of dry eye conditions, the effectiveness and selectivity of drugs, the treatment status and recovery level.

Scientific breakthrough

Currently, only TearLab offers a dry eye analysis system in the market. but the system can't measure continuously; the device developed by this project puts a variety of sensors into the contact lens. Through the record for a long time, it could obtained the relationship between ocular surface signal, and the daily behavior, and achieve the early prevention and early treatment.

Industrial applicability

The system developed by this project covers the prospect technology areas of MEMS, RF system, IC design, signal processing, and contact lens manufacturing. The achievement will be applied to the two major industries of biomedical electronics and ophthalmology care, so that the ICT industry will jump from production and manufacturing 3C products to high-end biomedical electronic medical equipment.



A Novel Blood Based Multi-Biomarker Modeling for Predicting Neurodegenerative Disorders by Machine Learning

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Technical introduction

We constructed a model to differentiate different neurodegenerative diseases by using blood-based biomarkers. Linear Discriminant Analysis (LDA) was used to reduce dimensions and MICE (Multivariate Imputation by Chained Equations) was used for missing value treatment and choose CART model to predict missing value imputation. This machine learning model would be used for early detection of neurodegenerative diseases.

Scientific breakthrough

Alzheimer's disease (AD) and Parkinson's disease (PD) are the most common neurodegenerative disorders. We developed a machine learning algorithm and established a 3D model by reducing the multidimensional information from the blood levels of individual blood biomarkers. The developed 3D analytic model promptly differentiates the disease groups, and also reflect the disease severity in either AD or PD spectrum.

Industrial applicability

Our developed machine learning algorithm and established model could provide indispensable tools for intelligent data analysis incorporating multidimensional blood biomarkers to efficiently achieve the goal of early pre-clinical diagnosis of neurodegenerative disorders. This easily accessible blood-based markers combined with machine-learning platform could be applied for early detection of AD or PD in the pre-clinical stage in the aging society.

Figure 1. Alzheimer's disease (AD) and Parkinson's disease (PD) clinical progression and biomarker profile

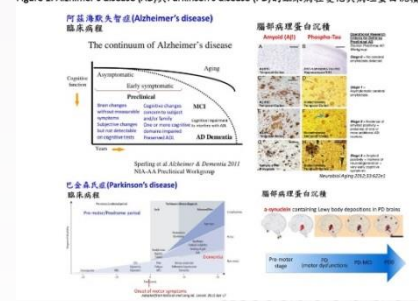
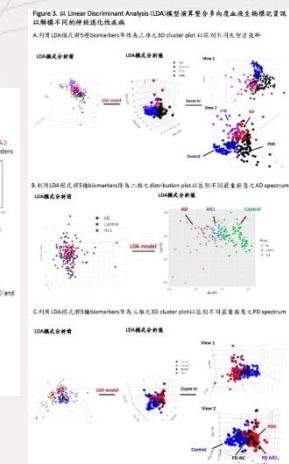
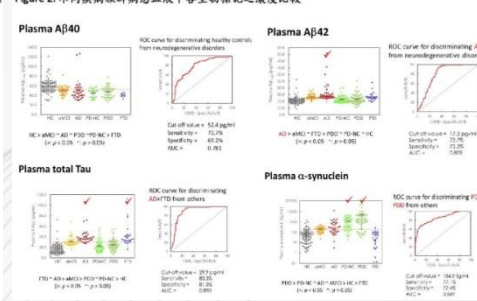


Figure 2. Blood biomarker levels in different disease groups



Wireless Biomedical Theranostic System on a Chip

National Tsing Hua University

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Technical introduction

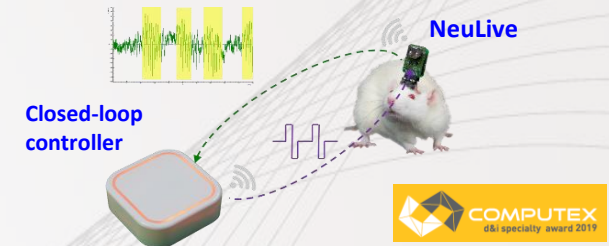
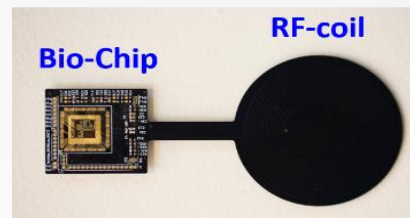
This project designs a biomedical theranostic chip for neural disorders. It can not only function as an implantable device for treating the Parkinson ' s disease, depression, dementia, but also monitor physiological signals in wearable devices. For the development of medical device, the NeuLive system based on the microchip can accelerate the pre-clinical data collection and verification.

Scientific breakthrough

Compared to the brain stimulator in clinical applications, the bio-electronic medicine based on the proposed microchip is able to record and stimulate neurons. In addition, the microchip supports the closed-loop control on stimulation, enabling personalized, precise treatments. Moreover, the implant size is as small as a single chip, greatly reduces the risk or complication of surgery.

Industrial applicability

The proposed microchip can underpin the bio-electronic medicine for treating neural diseases, or monitor physiological signals in wearable device, or facilitates the design of wireless, miniaturized instrument for brain research with small animals.



Brand	NTHU	Medtronic	Boston Scientific	Abbott/ St. Jude
Name	BrainDys	Activa PC	VERCISE	INFINITY
Stimulation	○	○	○	○
Recording	○	×	×	×
24-hr Monitoring	○	×	×	×
Adaptive Stimulation (Biomarker)	○	×	×	×
Stimulation Target (Target depth)	STN/Gpi (>80mm)	STN/Gpi (>80mm)	STN/Gpi (>80mm)	STN/Gpi (>80mm)
Battery Implant	No	Yes	Yes	Yes

Waterproof Multifunctional Energy Textile for Universally Collecting Energy from Raindrops, Wind, and Human Motions and as Self-Powered Sensors

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Technical introduction

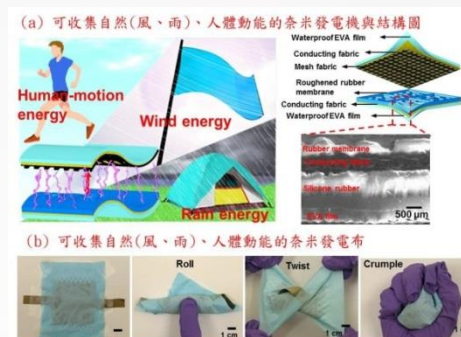
The first waterproof fabric-based multifunctional triboelectric nanogenerator that can produce electricity from natural tiny impacts (rains and winds) and body movements is presented. It can not only serve as a flexible, adaptive, wearable, and universal energy collector but also act as a self-powered fabric-based interface. This multifunctional yet nimble energy device can provide new vision for decentralized, remote, and wearable energy technologies.

Scientific breakthrough

This is the first demonstration of single energy device that can scavenge energy from both natural tiny impacts and human motions, together with the advantages of waterproof and fabric characteristics. The merits enable to break the limitations from forms, water, and weathers to collect various energy resources, largely broadening the using spectrum of energy devices in either alternative or wearable energy uses.

Industrial applicability

The new fabric-based energy device can not only enlighten the development of decentralized and remote energy but also promote a new-generation wearable energy and technology. All of the processes and materials of the device are suitable for industrial manufacturing, which can be largely benefit for the practical decentralized and wearable energy use.



Five-Axis Heavy Cutting CNC Vertical Hypoid Gear Generator with Intelligent Manufacturing/ CPS Systems Integration Technology

National Chung Cheng University

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Technical introduction

The special gear processing software was developed to calculate the cutting path. The CNC gear generator with high flexibility was utilized to process all kinds of special gear teeth and dress the gear precision by control feedback and compensation. Conversational human-machine interface has contributed to simplification of modification program and operator.

Scientific breakthrough

The major competitors, such as Klingelnberg and Gleason, also head toward this trends to develop the concept under the mature CNC technology in recent ten years. Our product can not only save the cost on the expensive modified mechanism and compensation device, but also increase the processing efficiency and production capacity compared to the conventional gear machine.

Industrial applicability

1. Gear is the key machinery component for processing and transmission of power. It can be widely utilized in transmission equipment for automobile, precision machinery, agricultural machinery, aerospace etc.
2. Increase production capacity and precision through power skiving and special facial milling and cutting.
3. We can provide customers with high-efficiency and high-precision total gear processing solutions.



Ultrasonic Toolholder Module

National Chung Hsing University

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Technical introduction

The ULTRASONIC technology and the Non-contact power transmission technology offers high quality and efficient machining for ceramic and other brittle materials. Depending on the workpiece requirements, our product allows higher feed and infeed, which increases machining efficiency for at least 30%, longer tool life and significantly better surface finishes.

Scientific breakthrough

Non-contact power transmission technology achieve high-speed and high-stability ultrasonic processing without concerning contact material.

Ultrasonic Machining Module also equips intelligent monitoring function, solving difficulties in various machining situations.

The kinematic overlapping of the tool rotation with an additional oscillation effects a reduction of the process forces by up to 40 %.

Industrial applicability

Ultrasonic machining module is mainly used for advanced material processing. Which offers high quality and efficient machining for ceramic and other brittle materials. Also, plug-and-play design can be easily applied to various industries. The function of dynamic tracking also solves the difficulties encountered by customers in various processing environments without the use of special-spec tools.



External Field-Free Spin-Orbit Torque Magnetic Random Access Memory

National Tsing Hua University

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Technical introduction

1. STT-MRAM: scaling down (submicron scale) along with issues of magnetic property and integration with semiconductor processing.
2. SOT-MRAM: fundamental understanding on mechanism, integration with STT-MRAM and CMOS for readout.
3. VCMA-MRAM: understand the mechanism behind the observable VCMA phenomenon, integration with other RAMs for write/read.

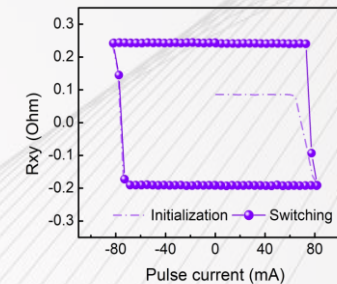
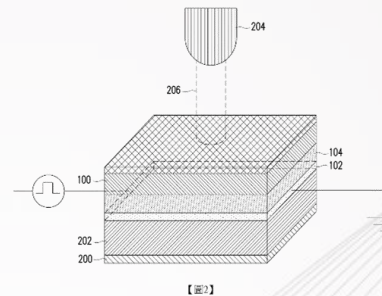
Scientific breakthrough

1. 50 nm STT-MRAM on 28nm CMOS has been done with thermal stability above 350 °C.
2. 8x8 STT-MRAM arrays with independent write/read capability.
3. Micromagnetic simulation for boosting the switching efficiency.
4. Failure analysis for increasing the life of device.
5. New SOT-MRAM system based on antiferromagnet with higher magnetic stability.

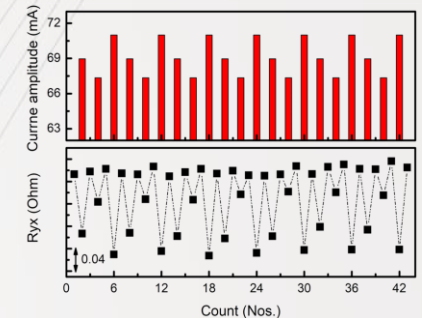
Industrial applicability

For the purpose of low-power consumption, intelligent, and novel sensing, spintronics-based MRAM definitely plays an important role. This proposal aims at integrating all the research resources regarding MRAM and encouraging the research group devoting to studying MRAM-correlated projects. An advanced platform for MRAM processing, analysis, and design will be developed.

1. SOT驅動磁矩翻轉



2. 多重磁態性質



Neuromorphic Intelligent Visual System for Low-Power Edge Devices

National Tsing Hua University

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Technical introduction

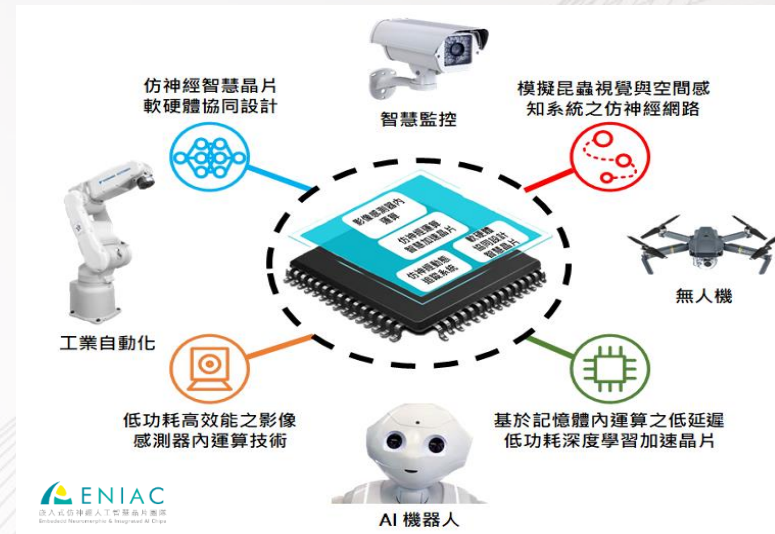
1. Low-Power Processing-in-sensor CMOS Image Sensor
2. Implementation of Low-Power and Low-Latency Deep Learning Chip based on Neuromorphic Intelligence (collaborated with MOST 108-2622-8-007-009)
3. Development of Neuromorphic Chip based on The Fruit Fly Visual and Spatial Sensory Systems
4. Hardware-Software Co-Design for Neuromorphic AI Chips

Scientific breakthrough

1. The computational CMOS image sensor (C2IS) with array-parallel computing can perform always-on feature extraction.
2. Multi-precision computing in SRAM increases the DNN accuracy and performance.
3. Based on real NN to design a low power object tracking neuromorphic chip with learning rule.
4. FlexNet resolves the issue that incurs >30% extra accuracy loss when changing the bit width of AI chips at run time.

Industrial applicability

1. Apply on low power edge devices in future which enables the smart vision everywhere.
2. Our work can be applied on the IoT device, realize low power and smart computing.
3. This system can be implemented in low-powered unmanned vehicles, enabling them to void dangerous objects and to perform visually guided landing.
4. FlexNet is an enabling technique of battery-powered AI products without a large heatsink such as smartphones and drones.



Application of Cyber-Physical Sensing (CPS) 3D Stereo Modeling for Fruit Tree Growth Monitoring

National Chiao Tung University

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Technical introduction

The core technology includes lightweight UAV, heterogeneous sensor integration, obstacle avoidance, group flight automatic flight control, RTK precision positioning system and fruit tree 3D stereo modeling technology. The UAV can be used for 3D scanning and spectral information collection. The information can use for fruit tree growth monitoring, nutrient analysis, and fruit quality monitoring.

Scientific breakthrough

This project develops a group flying UAV modeling system, which can automatically collect 3D stereo information, and combine multi-spectral image to establish fruit tree growth process. Through the self-made RTK precision positioning system, and group fly automatic flight control, it can instantly and periodically position between fruit trees to provide 3D and spectral data for the growth process.

Industrial applicability

The project hopes to establish a Cyber-Physical Systems (CPS) 3D modeling for fruit tree growth monitoring, long-term 3D modeling and spectral detection, and provide fruit tree growth history monitoring services. At present, can use this technology to establish a 3D fruit tree growth process, and to use the spectrum to distinguish the fruit sweetness and moisture content for screening and grading.



Green and Smart Agricultural System (Using A.I. to Predict Functional Compound Production of Chinese Medicinal Plants)

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Technical introduction

In agriculture, the team has developed a “Chinese Medicinal Functional Compound Prediction A.I. System” that can predict compounds production during cultivation period. Moreover, in application, we have implemented a smart agricultural platform-AgriTalk to link the “Functional Compound Prediction System” and “Smart Fertilization System” to provide a comprehensive management in farm production.

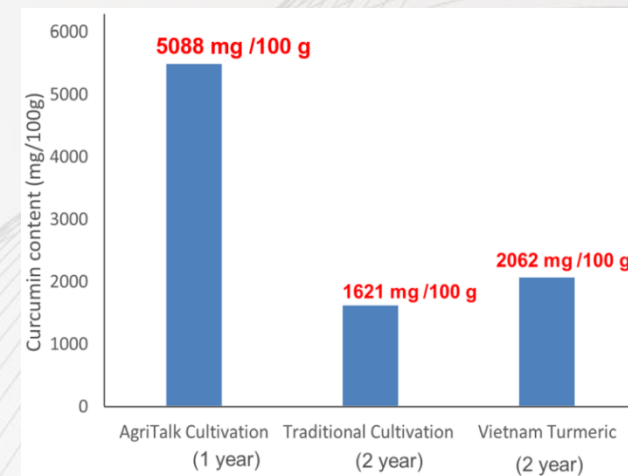
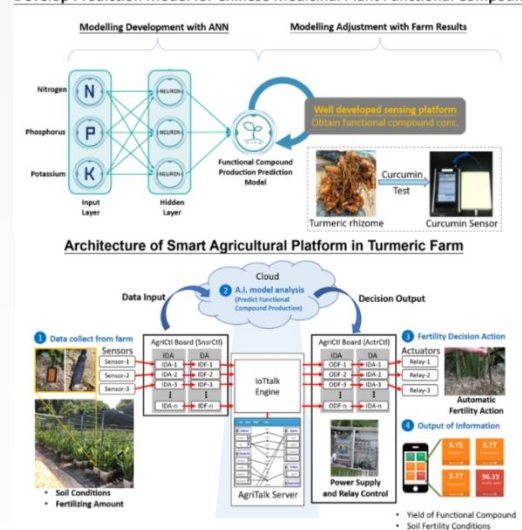
Scientific breakthrough

The different between the “Chinese Medicinal Functional Compound Prediction A.I. System” and recent systems is that we go beyond quantity prediction and focus on predicting functional compound production inside the crops during cultivation and tell the farmers instantly to improve crop management efficiency in farms and achieve good quality control in medicinal plants production.

Industrial applicability

The global market of Chinese Medicinal Plants is estimated to reach 80 billion USD dollars in year 2020. In this huge market, the “Functional compound prediction system” can definitely assist the agricultural enterprises to monitor the amount of those important functional compounds produce inside the crops to ensure good quality production and finally guarantee their profit.

Develop Prediction Model for Chinese Medicinal Plant Functional Compound



Switch on a Coming Era to Preservation of Agricultural Produce

Food Industry Research and Development Institute

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Technical introduction

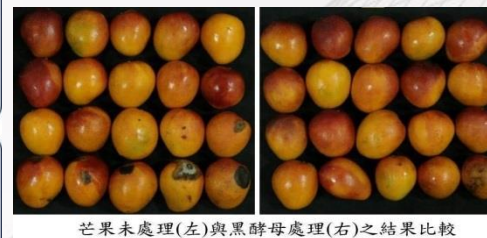
To develop a potential preservative from microorganisms, *Aureobasidium pullulans* was the positive candidates. In a laboratory scale, we introduced the *Aureobasidium pullulans* broth into a practical delivery chain to simulate the commercial process. For disease severity and banana degreening, the results indicated we could obtain a better consistency and longer storage time for exports as well.

Scientific breakthrough

Thanks to BCRC (Bioresource Collection and Research Center), the *Aureobasidium pullulans*, exhibited over 50% inhibition to the Anthracnose. For mango and banana, the corresponding disease severity was lowered by 70% with the cell broths. Therefore, it is rather promising for development of natural biological agents instead of chemical preservatives and also presented a multi-effect performance.

Industrial applicability

Aureobasidium pullulans could inhibit the occurrence of fruit pathogen; therefore, it is worthwhile to be used as a natural preservative. In environments, it provided a very friendly situation for agricultural cultivation without harmful emissions. In particular, the introduction of *Aureobasidium pullulans* could easily combine with the current operation practice and expand the export capacity.



芒果未處理(左)與黑酵母處理(右)之結果比較



以黑酵母處理香蕉對於催熟前(左上、左下)後(右)之結果比較

Baseball Finger Force Sensing and Wireless Transmission Device with Time-Series Big Data Analysis System

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Technical introduction

This pressure-detection smart baseball obtains applied force, dynamic and inertial features of pitcher during pitching. Through the connection between wireless module and terminal, data will be transferred and provides vibration as a pitching signal. Also, precise adjustment is achievable through back-end analysis and customized training formulation, which enhances pitching ability, optimizes training, and improves pitcher ' s condition assessment.

Scientific breakthrough

Due to the underdeveloped 3D pressure detection technology and difficulties in installing pressure detection in baseball, the available equipment for measuring finger pressure is rare in local and foreign market. This technology can instantly capture finger pressure while analyzing pitcher ' s control of the ball, providing instant correction for pitcher ' s performance.

Industrial applicability

The main business opportunity of this technology is its customizability. Through Big Data analysis and customized training from professional coach, data obtained from the pitching can improve pitching ability. This technology can be integrated with various relevant sports training, and has great potential in both application and business opportunity when integrated with 3D pressure detection, IoT and sports data analysis.



A Sport Training System and Devices

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Technical introduction

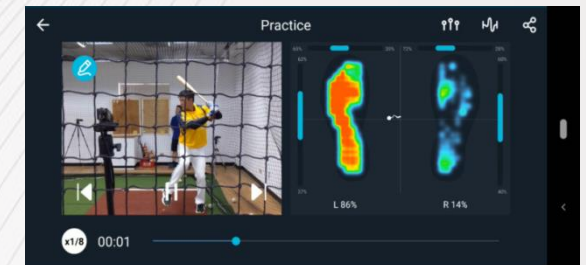
Our system uses wireless insole in the shoes to measure foot plantar pressure of athletes.

Scientific breakthrough

Current wireless insole foot plantar pressure measurement system is very expensive, made it not viable for athletes training. Our system is wireless, affordable, and easy to use. Users use our APP on their smartphones to recode, and they replay foot plantar pressure and video simultaneously. Our system analyzes their swing and use AI to find proper drills to help the users to improve.

Industrial applicability

The system can be used in baseball, golf, tennis, badminton, and any sport that involve swing motion, or any sport that weight shifting is critical for athletes' training process. Without our system, it is difficult to show the athletes how they are really using their feet.



Probabilistic Seismic Hazard Analysis (Psha) · Epidemic-Type Aftershock Sequence (ETAS)

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Technical introduction

After the publication of TEM PSHA2015. Updated version to the TEM PSHA2019, we considered updated seismogenic structure database, newly identified structure with 3D geometry, an earthquake catalog to 2016, state-of-the-art seismic models, and site amplification factors.

The ETAS (Epidemic-Type Aftershock Sequence) model aims to forecast the aftershocks from a large mainshock in real-time and reduce its effectiveness.

Scientific breakthrough

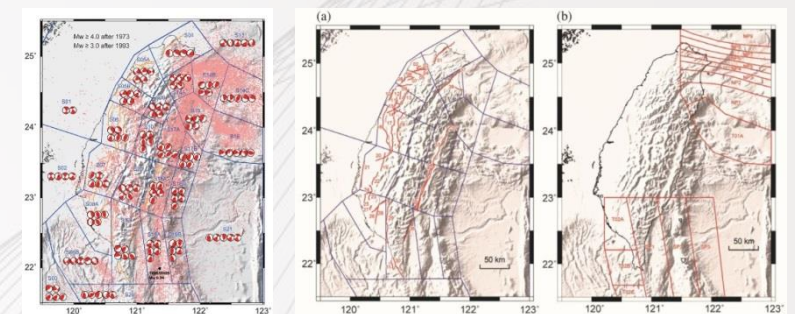
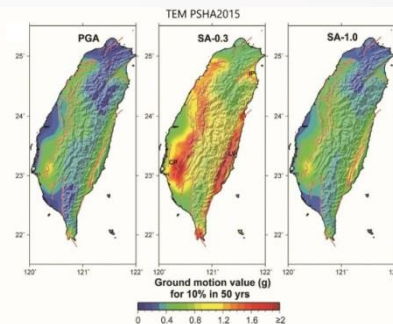
PSHA-2019 implementing a time-dependent factor through Brownian Passage Time model. Including possibility of earthquake on multiple-structure. The first seismic hazard map incorporating site condition in Taiwan.

The ETAS model could be used to develop a real-time aftershock forecasting system and offer the possible effect of the aftershocks within 24 hours after the main shock.

Industrial applicability

Three features of PSHA-2019: Implementing a time-dependent factor for a better seismic model. Including possibility of earthquake on multiple-structure to estimate plausible disaster scenarios. First seismic hazard map incorporating site condition in Taiwan.

The real-time aftershock forecasting system can offer the aftershock information, its possible damage, and the reference of the slightly damaged buildings and the manufacturing operations.



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