2019 Future Tech EXPO

Future Tech,
Leading Your Life

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Faced with technology challenges ahead, in Taiwan we have three important strengths: the industries own the key core of technology, the talents in R&D are expert in integration between software and hardware, and the diverse society cultivates the spirit of innovative design. Taiwan is known in the world for nurturing sophisticated talents, as Microsoft set its first Asian IoT innovative center in Taiwan; Google's biggest R&D base outside the US, as well as Microsoft's AI image processing R&D center that is only second to its North American headquarter in scale, are also both located in Taiwan.

Taiwan's Power in Originality Shines in the New Trend of Scientific Research

But for Taiwan to continue to have a place in the global industry, we also need a clear strategic mindset, which is the one I have been promoting in recent years: "Small Economy, Smart Strategy". Being a small nation, in Taiwan we should possess the big mindset and big strategy that a small nation should have; we should find partners to fight together, so as to put together our resources at hand and exert the leverage effect, creating a bigger cross-industry synergy.

Being a Professor in the past, I witnessed many forward-thinking breakthrough technologies all over the place in campuses in Taiwan, however due to legal restriction and separation between the academia and industry, all these marvelous results can only be put into research papers devoured in college libraries; at the same time, I also visited everywhere in the industry, and discovered that companies do not have the corresponding enhancement ability regarding technology to cope with future challenges, so they have no choice but to purchase these technologies from abroad. With this in mind, a critical platform that can physically allow results from scientific research to industrialize, FUTEX, was then born; the spirit of this exhibition is to create an ecological system that can facilitate close cooperation between the industry and academia.

FUTEX 2019 will take place from 5th to 8th of December with a bigger scale, and multiple forward-thinking technology forums will also be held. What you will see in the exhibition are research results that have reached scientific breakthrough in campuses and may realize their industrial applicability in near future; we hereby invite distinguished guests from all industries as well as our scientific research partners to come and pay a visit.

Minister, Ministry of Science and Technology, Taiwan


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AI & IOT Application

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Speaker-aware Speech Enhancement

R&D UNIT **Yuan Ze University** /Shih-Hau Fang; Yu Tsao; Jeih-weih Hung; Syu-Siang Wang; Fu-Kai Chuang

Technical Introduction

The overall system first extracts embedded speaker identity features using a neural network model, then the deep neural network speech enhancement takes the augmented features as the input to generate the enhanced spectra. With the additional embedded features, the speech enhancement system can be guided to generate the optimal output corresponding to the speaker identity.

Scientific Breakthrough

(1) Only two models are used to implement a speaker-aware SE system, and thus effectively decrease the computation complexity. (2) When comparing with DDAE, SaDAE improves 7.86% and 8.17% quality and intelligibility scores in noise conditions, respectively. (3) The best quality and intelligibility improvements when comparing SaDAE with DDAE over testing speakers are 28.27% and 21.00%, respectively.

Industrial Application

The denoising capability in assistive listening devices is limited by the volume, and requires a new design to improve the speech enhancement function. The demand is one factor that leads to the development on robots or IoT, which normally provide a speech interface. The variated speaker or noise environments degrade the quality of the provided services, and remains an important issue for the industry.

表 1 在雜訊環境下，實驗 DDAE、SaDAE 及原始測試語料的平均 PESQ, STOI 及 SDI 結果

Testing	PESQ	STOI	SDI
Noisy	2.0280	0.7493	1.1450
DDAE	2.1987	0.7225	0.7501
SaDAE	2.3715	0.7815	0.3228

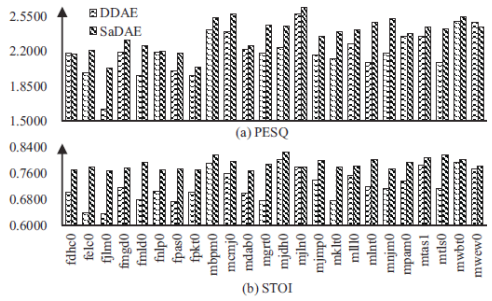

Figure 1: *The detailed results of (a) PESQ and (b) STOI with*

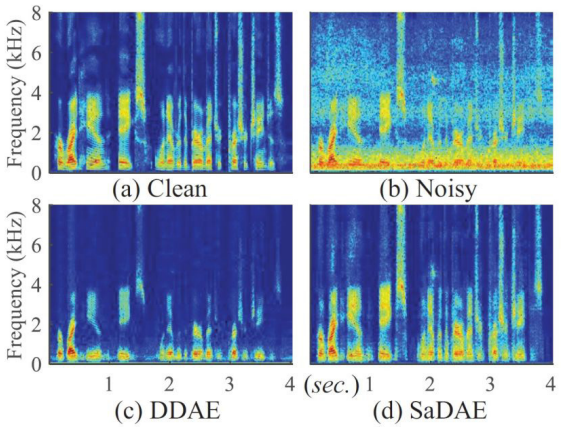

Figure : *Spectrum comparisons for (a) Clean and (b) Noisy utterances, and noisy processed by (c) DDAE-based and (d) SaDAE-based SE systems.*

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An integrated system of AI affective computing and multimodal physiological signals in patients with high-risk of cardiovascular disorder

R&D UNIT **Kaohsiung Medical University, National Chung Cheng University, National Chiao Tung University** / I-Mei Lin; Wai-Chi Fang; Sung-Nien Yu

Technical Introduction

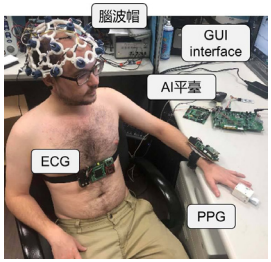
The technology aims to develop an AI-based emotional detections (anger, sadness, happiness, and neutral) and multimodal physiological signals (ECG, EEG, and PPG) integrated system, and apply to patients with cardiovascular disease. Patients monitor their emotional and physical status and administer bio-neuro-feedback to improve their well-being, track disease progression, and prevent adverse prognosis.

Scientific Breakthrough

1. An improved CNN/RNN architecture was developed to perform the AI online training and inferences for physical and mental monitoring. It was implemented as an AISoC chip with the TSMC-28nm process.
2. An EEG-ECG-PPG multimodal intelligent computing platform was developed to perform a variety of system functions for emotion recognition. This system combines IoMT concept and network security technologies, integrating into the cloud and terminal environment to build a diverse healthcare field effectively.
3. A high-performance emotion recognition AI algorithm was developed. The accuracies of our proposed emotion recognition system with ECG-PPG and EEG signals achieved 87.5% and 77.68%, respectively.

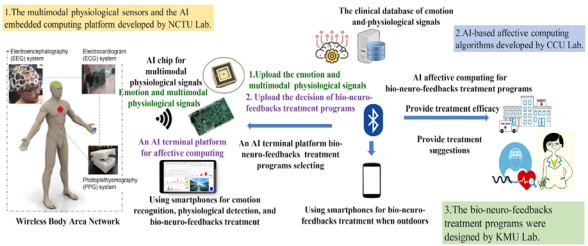
Industrial Application

(1)The AI-based integrated system uses AI-algorithm on affective computing for bio-neuro-feedback intervention. The technology moves forward from hospital to home-based self-monitoring on mental and physical health and has profound potential for the home care and medical industry. (2) With this technology, we would cooperate with MedKing company to develop a validated AISOC chip and multimodal affective computing platform. The product combines IoMT and network security technologies to meet the commercial demands of high-security home-based healthcares and clinical psychotherapy.



Demonstration of the Integrated System Design Prototype

The Portable PPG Sensor Module



The Proposed Mental Healthcare Scenarios and its End-to-End AI-Enhanced System Design

Mobile Magnetic Survey System

R&D UNIT **National Central University** / Chien-Chih Chen ; Yung-Chieh Chuang ; Yi-Chen Chu

Technical Introduction

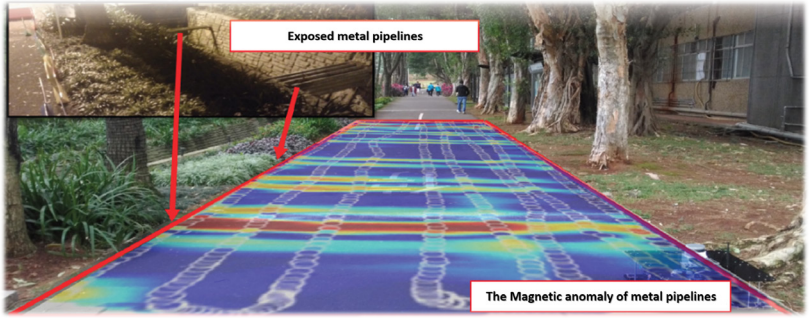
Mobile Magnetic Survey System is composed of 20 precise and sensitive magnetic detector arrays, which are used for measuring the 3D magnetic fields. With the LiDAR positioning system and attitude rotation, the magnetic vector field can analyze the magnetic field intensity at different positions. In addition, the visualized map can help users to evaluate the metal body location and depth.

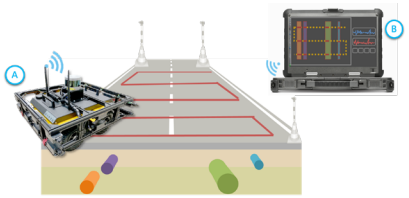
Scientific Breakthrough

Mobile Magnetic Survey System breaks through the limitations of single point measurement, uses multiple magnetic detectors to record 3D magnetic fields. Therefore, it can quickly record the magnetic signals to reduce the effect from the magnetic diurnal variations. Besides, the interference of internal instrument and the deviation caused by the attitude are also corrected to improve the detection accuracy.

Industrial Application

Mobile Magnetic Survey System is mainly applied to the detection of subsurface metal pipelines. Before the road excavation works, the system scan the distribution of metal pipelines, to prevent the accidental interruption of living systems such as gas pipelines and power lines. Besides, the system can also be used for the subsurface metal structure scanning, anti-terrorism detection, and buried disaster detection and pose-disaster assessment.





A Robot → detect subsurface metal pipelines
B Operation and analysis system → visualized map in real time
Others: remote control, WiFi AP, Traffic cone

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Real-time identification of crop losses using UAV imagery

R&D UNIT **Nation Chung Hsing University**

Ming-Der Yang Distinguished Professor; Hsin-Hung Tseng Ph.D. student; Yu-Chun Hsu Ph.D. student

Technical Introduction

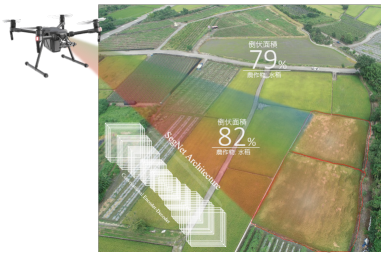
The technology integrates 1000+ times of UAV imaging experiences with labeled rice lodging images for training. A rice lodging recognition model using deep learning reaches 90% accuracy. The recognition model can be deployed in a microcomputer mounted on UAVs to implement edge computing. While taking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

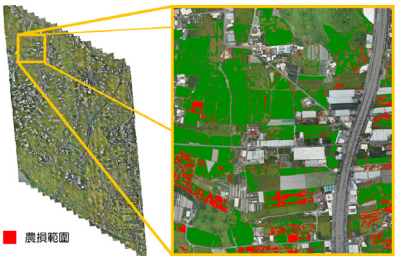
Scientific Breakthrough

- The technology employs AI image segmentation and edge computing and builds an agricultural disaster image database that enables surveying personnel to instantly identify crop loss and damage distribution.
- The technology employs AI cloud and parallel computing greatly decrease the time consumption and labor-intensive survey by saving 75% cost and increasing 25 times efficiency of agriculture loss subsidy.

Industrial Application

- Accurately quantifying agricultural loss and saving manpower and time for loss subsidy.
- Can be beneficial to agricultural practitioners, such as UAV hardware and software developers, agricultural insurance companies, and pesticide fertilizer companies et cetera.
- Further research can be extended to large-scale rice field management and agriculture disaster detection.





free5GC: 5th generation mobile core network

R&D UNIT **National Chiao Tung University** / Jyh-Cheng Chen

Technical Introduction

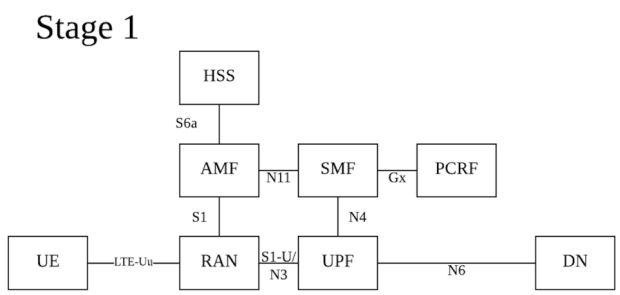
Although there are few open-source core network projects, none of them are conformed to 3GPP Release 15 (R15). The free5GC is the first one in the world based on 3GPP R15. The ultimate goal of free5GC is to implement a full commercial, operational core network including Operation, Administration and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

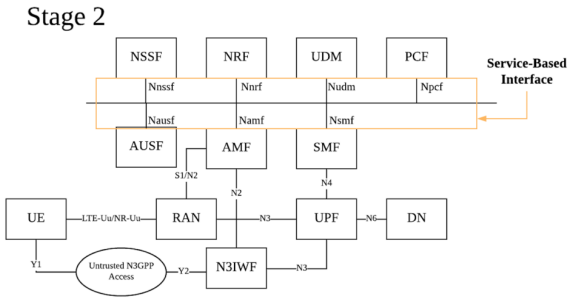
Scientific Breakthrough

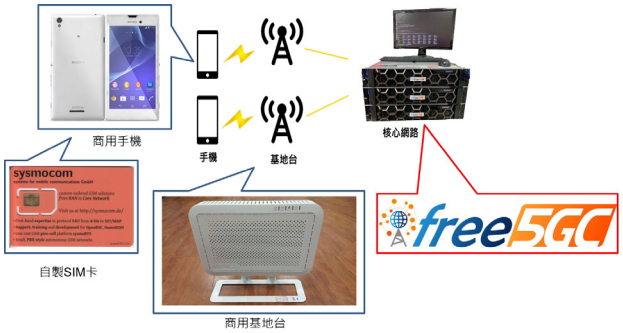
The free5GC (https://www.free5gc.org/) is the first open-source 5th generation mobile core network based on the specifications defined by 3GPP.

Industrial Application

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.







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Video-based blood pressure measurement with AI technology and its applications in digital health and smart healthcare

R&D UNIT **National Chiao Tung University** / Dr. Bing-Fei Wu

Technical Introduction

The technology is video-based blood pressure monitoring which will help people know the continuous BP status in real time. Also, the contactless measurement can make a daily health record. We have conducted clinical trials in hospitals and established a large database to optimize AI solution. The system joins the physicians' specialty to analyze the users' health status with AI, and takes care of human life with technology.

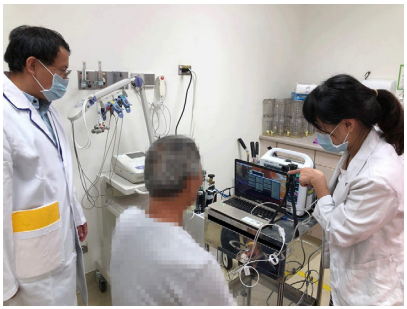
Scientific Breakthrough

The technical highlights:

1. Commercialized, contactless and continuous BP measurement technology
2. Fast output
3. Feasible to measure with glasses wearing
4. High-precision compared to medical grade instruments
5. Conduct clinical trials with hospitals to collect actual data to optimize the AI solution.
6. Join physicians' expertise and predict disease with AI

Industrial Application

Contactless blood pressure monitoring can be applied to many fields, and currently work with cardiology, anesthesiology, etc. to develop disease risk prediction such as hypertension, stroke. The technology can be used in hospitals to have warnings of individual abnormal conditions and the daily health record of markets such as home care and silver healthcare. Long-term observations provide more reference for medical staff and more peace of mind for family.



AI Pathology Liver Tumor Analyzer

R&D UNIT **National Cheng Kung University** / Pau-Choo Chung; Wei-Che Huang; Qi-En Xiao; Hung-Wen Tsai; Nan-Haw Chow; Kuo-Sheng Cheng; Tseng-Lung Yang

Technical Introduction

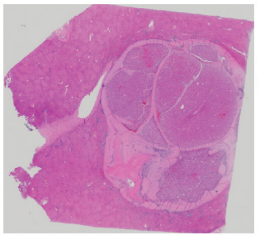
Based on the characteristics of liver pathology images, an assistive liver tumor detection and grading system -- AI Pathology Analyzer -- is developed through the integration of the tumor features and an invented multiscale tumor detection deep neural networks. The AI Pathology Analyzer (AI-PA) can automatic highlight the suspicious liver tumor areas, compute their quantitative values, and estimate the tumor grading. The results are built into structure reports to be used by the pathologists.

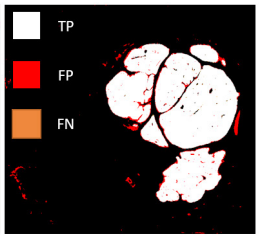
Scientific Breakthrough

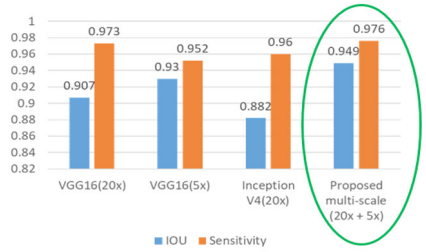
The main technique focus is the invention of a multiscale deep neural network which accurately fuses images of different resolutions to achieve a more accurate liver tumor detection. A high-scale (resolution) image shows more details, but it also lacks surrounding features; On the other hand, a low-scale image contains more surrounding features but lacks image details. Our invention provides a method to accurately combine feature maps from different resolutions to achieve a higher accurate tumor detection.

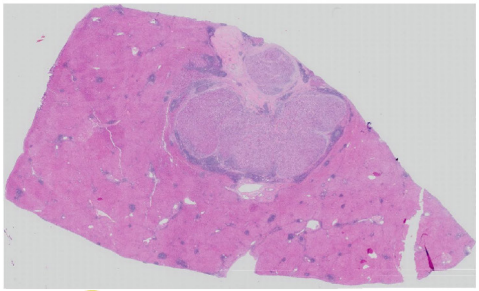
Industrial Application

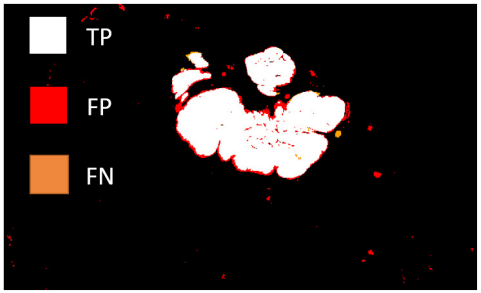
For medical images, the multiscale deep neural network can be applied to the detection of tumor, portal area, necrosis, and etc. Besides, combined with computer-aided calculations for quantitative properties, the system can provide doctors with more objective diagnosis and assessments of the patients. It also paves the foundation to personal precision treatment. As such, in addition to economic benefits, it also contributes to the health and well-being for all human beings.

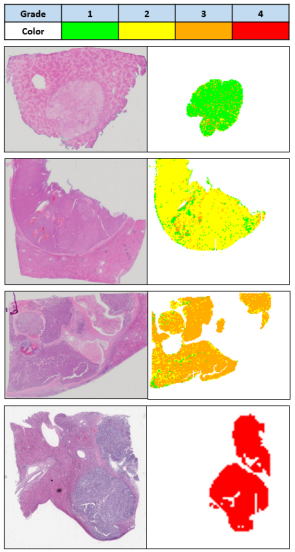












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Efficiency Boosting System for Computer Numerical Control Milling Machine Based on AI and Big Data Analytics

R&D UNIT **National TsingHua University** / Chen-Fu Chien, Tsing Hua Chair Professor; Sheng-Kai Lin, Research Assistant; Chi-Hang Chen, Research Assistant; Zih-Hao Lin, Research Assistant

Technical Introduction

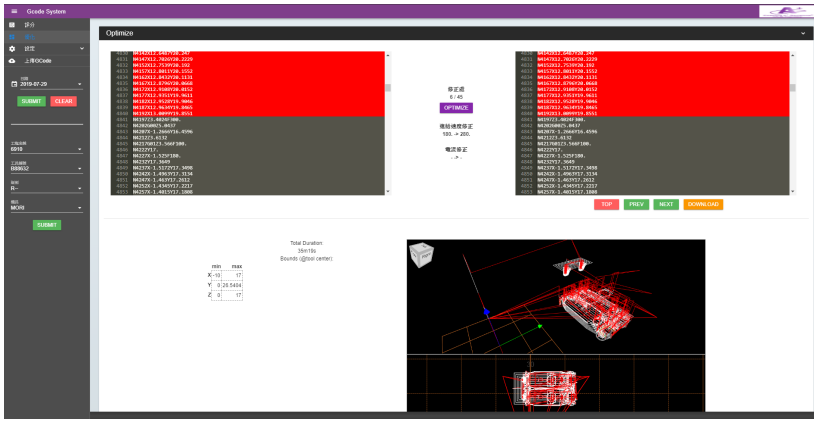
This technique combines several AI models to predict performance precisely under the condition which the sensor is with noise data, and optimizes speed rate based on this AI forecasting model. At the same time, practical requirements and limitations of workpiece surface roughness and tool machine's current loading are well considered. This technique provides decisions which support optimizing parameters of computer numerical control (CNC) milling machine, and keeps high efficiency and enhances energy conservation simultaneously.

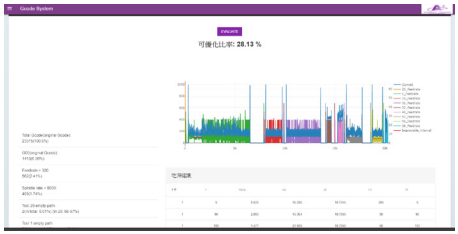
Scientific Breakthrough

Our technique has developed a decision support system(DSS) which is suitable for all CNC machines, the optimized NC program can be derived from the NC programs imported to the system by NC programmer. Through our technique, NC milling process can decrease 30% processing time. For those NC programs already optimized by NC programmer, our technique can still decrease 8% to 15% processing time.

Industrial Application

In metal fabrication industries, CNC machine is one of the key facilities in manufacturing industries including automotive, aerospace, etc. We integrate the current sensor and CNC machine controller sensor to capture the detailed log during manufacturing processes. The technique we proposed can optimize the parameters of processing scripts to enhance the manufacturing efficiency. Furthermore, we build the DSS with AI models to support the manufacturing, and the technique could potentially be applied to other industries.





Personalized emotion sensing for spoken dialog interface

R&D UNIT **National Tsing Hua University** / Chi-Chun (Jeremy) Lee; BIIC Lab

Technical Introduction

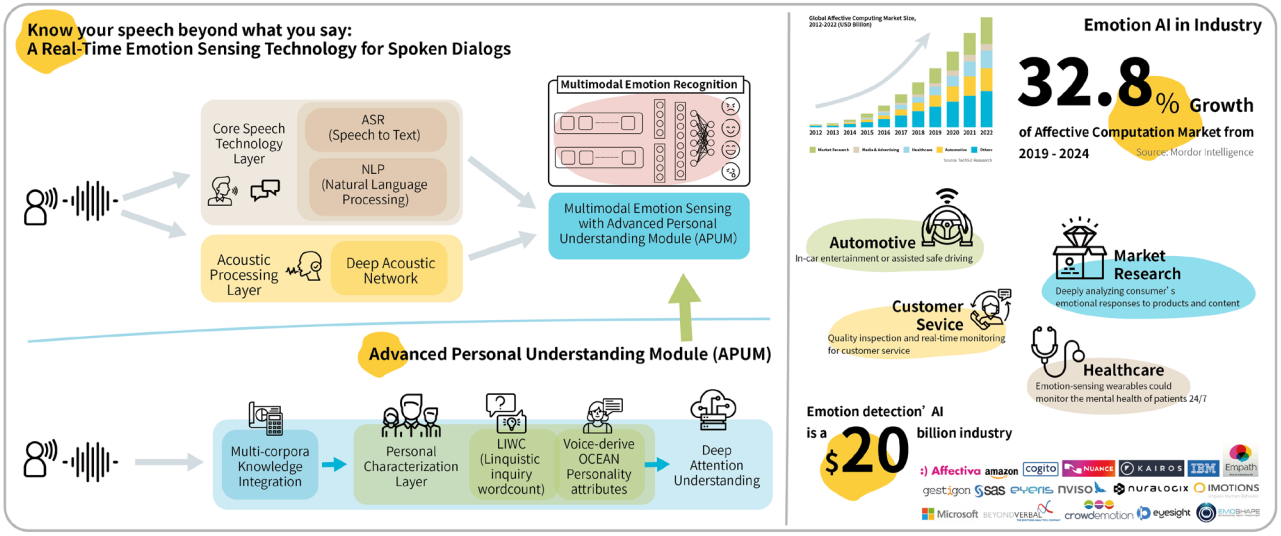
Recently, emotion-AI is becoming essential. Yet, the expression of emotion differs between individuals due to a variety of idiosyncratic human factors. Our solution integrates automatic speech recognition and text analysis, and learns an unsupervised individual space, formed our emotion recognition module. 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 Application

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.



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Web-based Diagnostic System for Assessing Psychiatric Disorders

R&D UNIT **National Yang Ming University** / Albert C. Yang; Shih-Jen Tsai

Technical Introduction

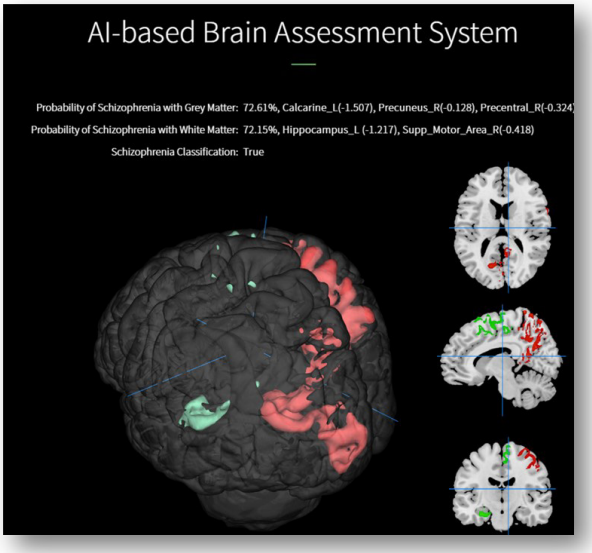
The AI-based web diagnostic system provides an online assessment tool for diagnosing schizophrenia. The Explainable Deep Neural Network classifier is deployed to analyze gray matter and white matter to derive diagnostic classification of schizophrenia. The structural brain abnormalities associated with schizophrenia is visualized on the AI-based web diagnostic system at individual level.

Scientific Breakthrough

The deep learning model developed in this research can provide diagnostic assessment and identify specific brain deficit associated with schizophrenia, with an accuracy of 87.5% diagnosing schizophrenia using gray matter image, or 91.7% using white matter image. We also established a complete solution of web-based platform as an intelligent medical tool used in research and clinical practice.

Industrial Application

Our technology is to employ the web diagnosis platform and deep learning model to provide the diagnosis of schizophrenia based on routine brain imaging used in the hospital. This platform can potentially extend to major neuropsychiatric diseases, providing precise evaluation for medical professionals, increasing quality of medical care and establishing connections to digital medicine industry.



Using 3-D Capsule Network for Nodule Detection in Lung CT Image

R&D UNIT **National Taiwan University** / Prof. Ruey-Feng, Chang; Prof. Yeun-Chung, Chang; Dr. Sin-Ming, Chen; Ph.D Yao-Sian, Huang; M.S. Yu-Sheng, Lin

Technical Introduction

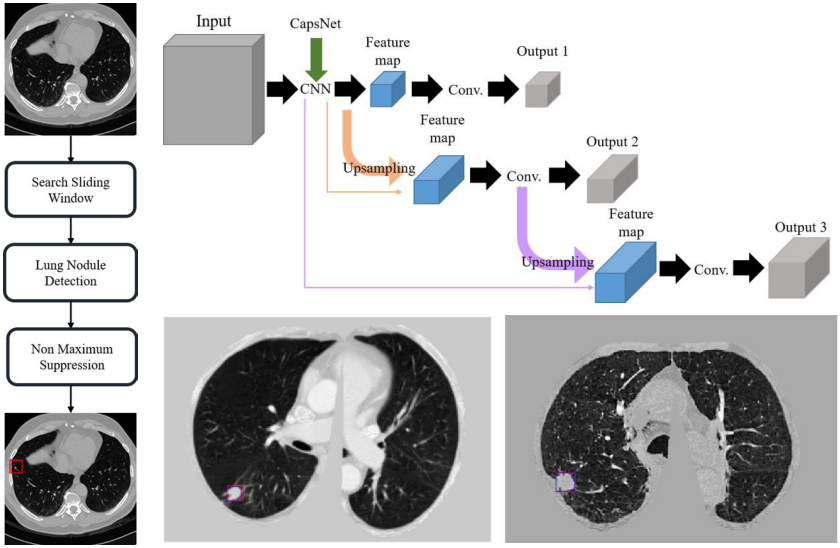
The computer-aided nodule detection system in CT image consists of the search sliding window, YOLOv2 architecture, 3-D CapsNet, skip connection, and post-processing. First, the CT image is divided into numerous VOIs by sliding window. Second, a 3-D CapsNet based on YOLOv2 architecture and skip connection is applied to the VOIs for classifying VOIs as nodule or not. Finally, the non-maximum suppression algorithm is performed to decide the final detection result.

Scientific Breakthrough

The CADe system focuses on using 3-D CapsNet in YOLOv2 detection module to solve the problems of object rotation and feature shift. Simultaneously, the skip connection is also applied to network to overcome the vanishing-gradient problem for raising the accuracy and downgrading the false positive rate. Compared to previous literatures, our system has better performance and uses fewer computation parameters.

Industrial Application

It is necessary for the physician to spend more time to review image because of the enormous digitalized medical image. The CADe with deep learning can handle enormous digitalized medical image, reduce reviewing time, and provide various nodule information for reducing the misdetection rate. As powerful learning capability, it can economize the cost in system design and update system functionality by collecting image.



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5G Low Latency Massive Access Technology

R&D UNIT **National Taiwan University**
Prof. Hsuan-Jung Su; Prof. Borching Su; Prof. Tzi-Dar Chiueh; Dr. Yenming Huang

Technical Introduction

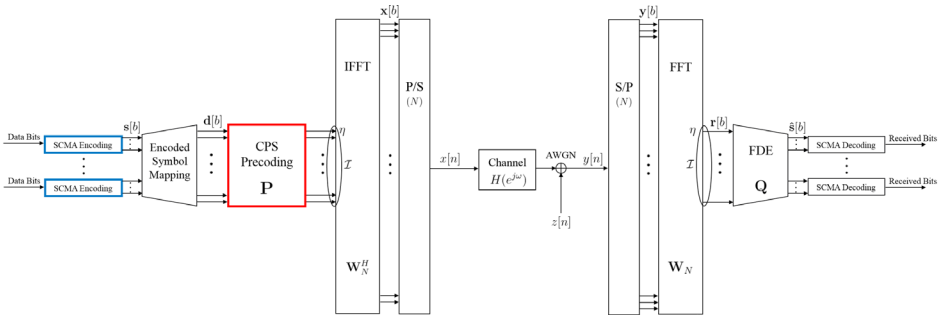
The CPS-OFDM technology by NTU enjoys the best spectral efficiency and design flexibility among the 5G candidate new waveform designs. CPS-OFDM is integrated and jointly optimized with the high performance SCMA by Univ of Surrey to achieve high communication efficiency, high reliability, low latency,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

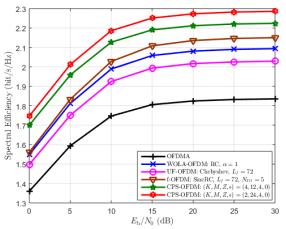
Scientific Breakthrough

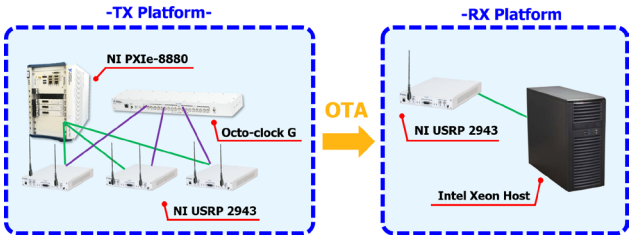
By imposing the flexibility in frequency and time, the CPS-OFDM by NTU enjoys the best spectral efficiency and design flexibility among the 5G candidate new waveform designs. The CPS-OFDM jointly optimized with the high performance SCMA by Univ of Surrey can achieve high communication efficiency, high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

Industrial Application

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







Super AI HPC System & AI Box

R&D UNIT **National Taiwan University of Science and Technology** / Ching-Wei Wang

Technical Introduction

Super fast terapixel server allows multiple users to view and analyze gigapixel and terapixel images with mobile devices, such as iPhones, iPads, Android mobiles, or laptops at the same time. Users could annotate and analyze the data using built-in tools such as 3d effect, color deconvolution, color quantification, nuclei/object detection, length and area measurement, and quantitative reporting system.

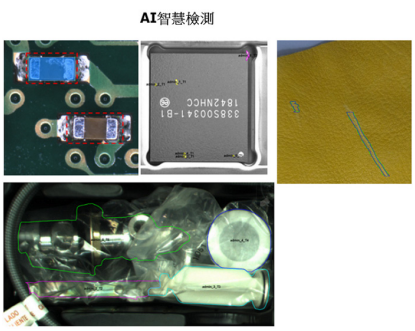
Scientific Breakthrough

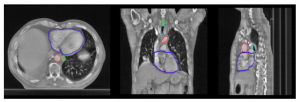
Super AI HPC System can quickly builds, trains, and deploys large-scale machine learning models. A small amount of data can be used to quickly build an AI model, which can be optimized for the original model without re-establishing the model. It takes only 1 day to build a new AI model. The AI model recommendation function sorts the user-created AI models and recommends the user’ s optimal AI model.

Industrial Application

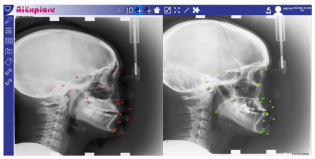
AI Explore AI HPC platforms have been used in various applications:

■Digital Pathology ■Industry 4.0 (Real time defect detection) ■Dental X-ray Image Analysis ■Smart City and Surveillance ■Wafer Inspection ■IC Inspection ■Copper Foil Inspection ■LCD Panel Inspection ■PCB Inspection ■Process Quality Improvement ■X-ray Image Analysis ■Cancer Cell Image Analysis ■Face Recognition

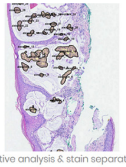




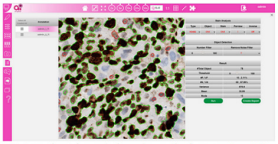
Automatic Segmentation of THoracic Organs at Risk in CT images (Heart, Aorta, Trachea, Esophagus) by Our Deep Learning AI System in Seconds



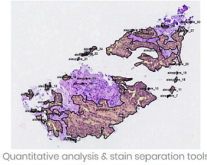
Landmark Detection and Difference Analysis



Quantitative analysis & stain separation tools



Automatic stain analysis and quantitative report on WSI



Quantitative analysis & stain separation tools

Automatic stain analysis and quantitative report on WSI

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AIoT smart aquaculture management systems

R&D UNIT **National Taiwan Ocean University** / Chang, Chung-Cheng

Technical Introduction

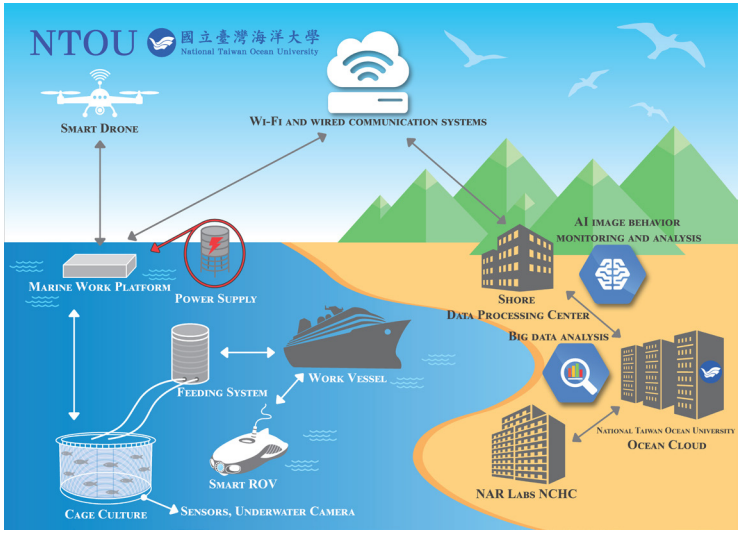
Our team construct an AIoT smart aquaculture management system. The management system mainly consists of: (1) Image Behavior Monitoring and Analysis Subsystem (2) Smart Feeding Subsystem (3) IOT Subsystem including underwater sensors, ROV, and Drone (4) Cloud Subsystem (5) Big Data Analysis Subsystem.

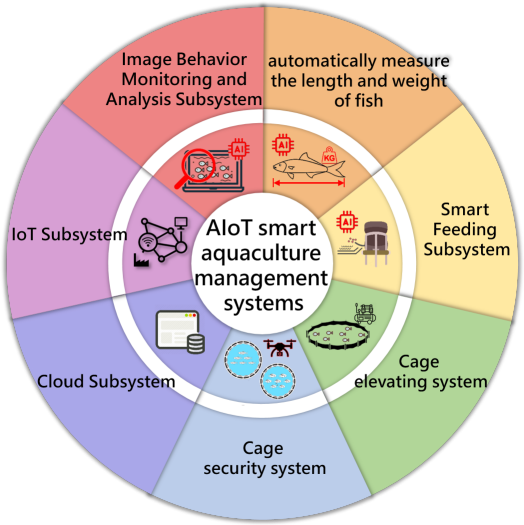
Scientific Breakthrough

Except in some developed countries like Norway, United States, and Japan, cage culture is still mainly conducted by massive manpower. The innovative combination of AI (Artificial Intelligence) and IoT makes it possible to ensure the safety of cages in the presence of severe storms or strong typhoons, improve the feed conversion rate (FCR), as well as lower the overall operational cost.

Industrial Application

With the functionality optimization and full automation provided by AIoT and big data analysis, we will be able to build a smart Aquaculture Management System which is useful in lifting off the barrier for fishermen to start up the offshore cage culture, reducing the overall operating costs, and even solving the problem of future food shortage.





Taiwania 2 & Taiwan Computing Cloud

R&D UNIT **National Center for High-performance Computing** /Dr. Shepherd Shi, Director General

Technical Introduction

TWCC provides services with up-to-date container technology. Through optimized AI software, developers can quickly deploy, which increases efficiency by 40% compared with the past. In addition, it supports high-speed parallel computing. A further increase of 30% compared with current cloud services. Moreover, TWCC will integrate AI programs and tools from different domestic fields to become the largest model marketplace in Taiwan.

Scientific Breakthrough

Taiwania 2, supercomputer, is capable of performing AI training with 1.76 M images/s, shortening the pathogen identification from 7 days to 5 hours, disease detection from 1 week to 12 hours, and tumor marking from 48 hours to 1 hour. In addition, it provides up-to-date container technology as a service increasing efficiency by 40%, supports scheduling multi-nodes and GPUs, and the performance of high-speed parallel computing is 30% higher than other cloud services.

Industrial Application

TWCC services have been used to the smart robots, self-driving, FinTech, smart manufacturing, smart medical/ healthcare, and smart city, as well as Forward-looking Infrastructure Development Program and academia such as the plan for AI research centers. It will promote industries and use AI to bring innovation, value-added and application, and the vigorous development of domestic industries and AI widely used application fields.

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Multilayer Cybersecurity Defense Service and System Development

R&D UNIT **National Center for High-performance Computing** / Yi Lang Tsai, Research Fellow

Technical Introduction

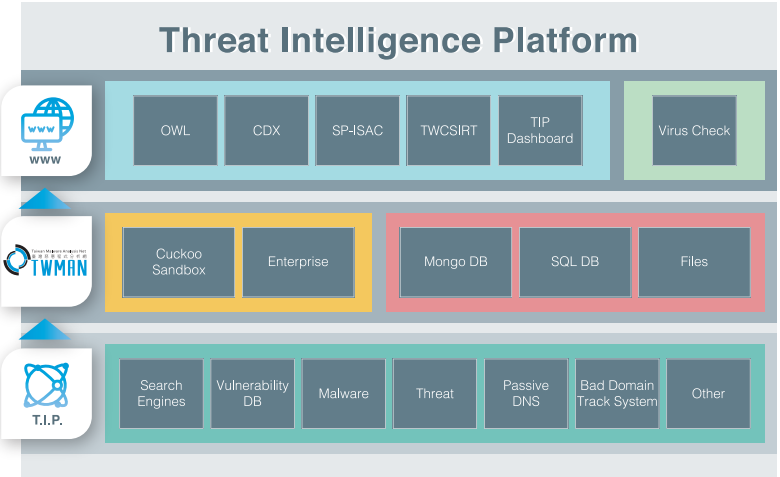
1. CDX is to provide an environment for long periods of time in coordination with school courses, including the simulation of a real company's network environment with randomly selected vulnerabilities in cyber defense contests.
2. Honeynet and Malware Knowledge Base simulates system and application vulnerabilities and then monitors the cyber-attacks and the corresponding traffic flow.

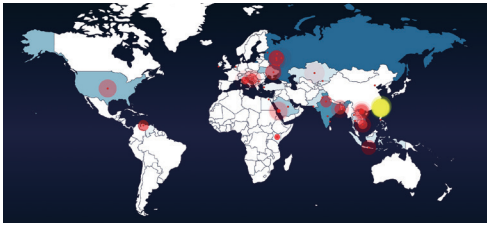
Scientific Breakthrough

1. CDX environment deployment only takes 90 seconds to complete, and CDX can create an exclusive isolated environment for information security researchers. Over 20 million samples of malware are provided to academic research units free of charge.
2. Malware classification searching and filtering functions are built in Malware Knowledge Base to help users find the malware samples quickly.

Industrial Application

1. Provide the Indicators Of Compromise (IOC) for the development of cyber security industry.
2. Exchage the cyberdefence intelligence by using the international standards STIX and TAXII.
3. Enhance the capabilities of cyberdefence for enterprise.
4. Focused on 5G and IOT as the upcoming key industrial applications.





Ted-ICU AI Platform

R&D UNIT **Taipei Medical University** / Ray-Jade Chen; Yu-Sheng Lo; Lan-Ying Kang; Kuang-Hung Hsu; Chao-Chi Chen; Yu-Tao Chang; Yi-Chen Tseng; Hsing-Nan Hou; Wan-Lin Chou; Zheng-Jay Hsieh; Christine Chen

Technical Introduction

Ted-ICU AI Platform :

1. Provide a single view of patients'EMRs and vital signs
2. Support remote ICU monitoring
3. Online labeling tool & Expandable AI algorithms repository
4. Disease-specific prediction models
5. Standardized EMR templates

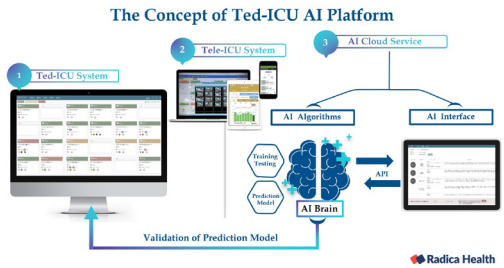
Scientific Breakthrough

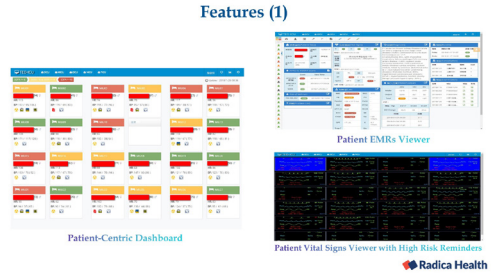
Ted-ICU AI Platform :

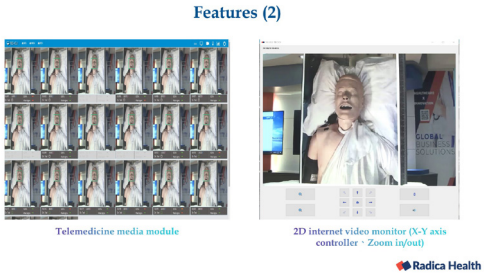
1. Consolidating electronic medical records and physiological data
2. Using AI algorithms to build the disease-specific diagnostic prediction model
3. Supporting tele-ICU care model

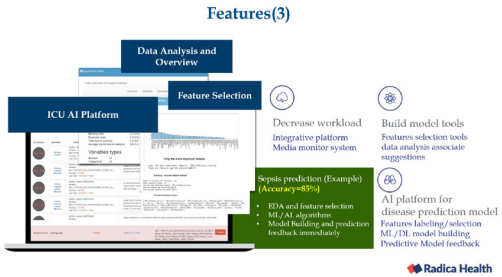
Industrial Application

Through reshaping the smart ICU care model, providing multi-point remote healthcare service, and AI-assisted recommendation, the Ted-ICU AI platform can predict changes in high-risk conditions and introduce therapy and prevention at an early stage.









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Vacuum Functional Coating Technology

R&D UNIT **National Synchrotron Radiation Research Center**

Chin-Chun Chang Associate Engineer; Che-Kai Chan Associate Scientist; Chin Shueh Assistant Engineer

Technical Introduction

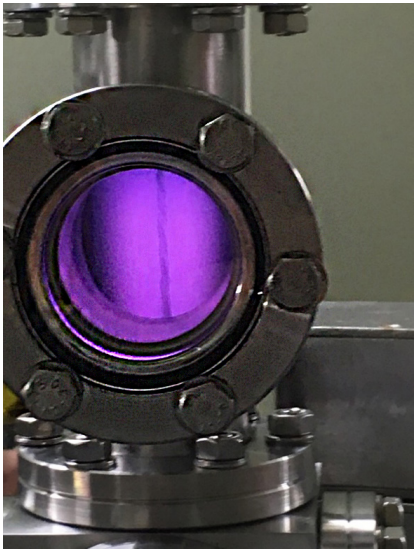
Here we prepare a non-evaporative getter (NEG) film using magnetron sputtering. A vacuum chamber with a sputtered NEG film can maintain ultra-high vacuum (2×10^{-10} Torr level) without any pump after activation. The activation temperature can be controlled below 200 ° C according to different process conditions. The activated NEG film adsorbs residual gases in the vacuum system to achieve the UHV.

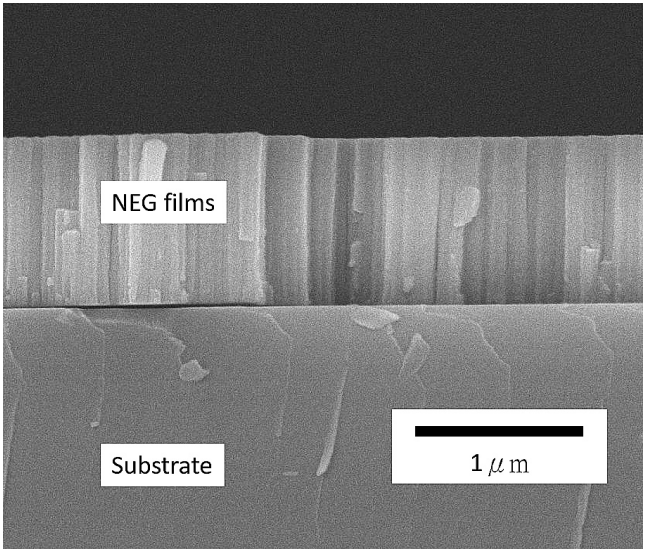
Scientific Breakthrough

With continuous expansion of the application field of getter materials and changes in the application background. The research team has prepared an 1 m evacuated chamber straight tube with a long pipe diameter of 27 mm successfully, and an ultra-high vacuum environment (2×10^{-10} Torr level) is achieved without vacuum pump after activation.

Industrial Application

Since the non-evaporative getter (NEG) film is immune to the size and geometry of chamber, it is often used in a narrow chamber in the accelerator. Further, in microelectromechanical system (MEMS), the conventional packaging is getting smaller due to technologies in recent years, so that the use of NEG film provides advantages for MEMS, which have small space occupancy and large gas absorption.





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In-situ Large-scale X-ray Mirror Measurement Technology

R&D UNIT **National Synchrotron Radiation Research Center**
Shang-Wei Lin Assistant Engineer; Duan-Jen Wang Researcher

Technical Introduction

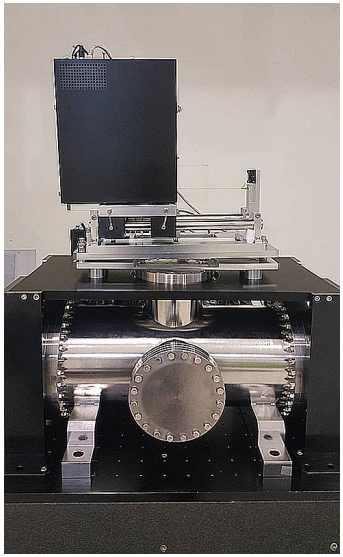
The long trace profiler (LTP) can be used to measure the figure and intermediate frequency roughness of an X-ray mirror. The measurement process is accurate, high-speed and non-contact. The radius of curvature for the measurement may be ranged from a value from 5 m to infinity, such that the surface profile feature can be measured in the range with a longitudinal resolution of 0.15 nm.

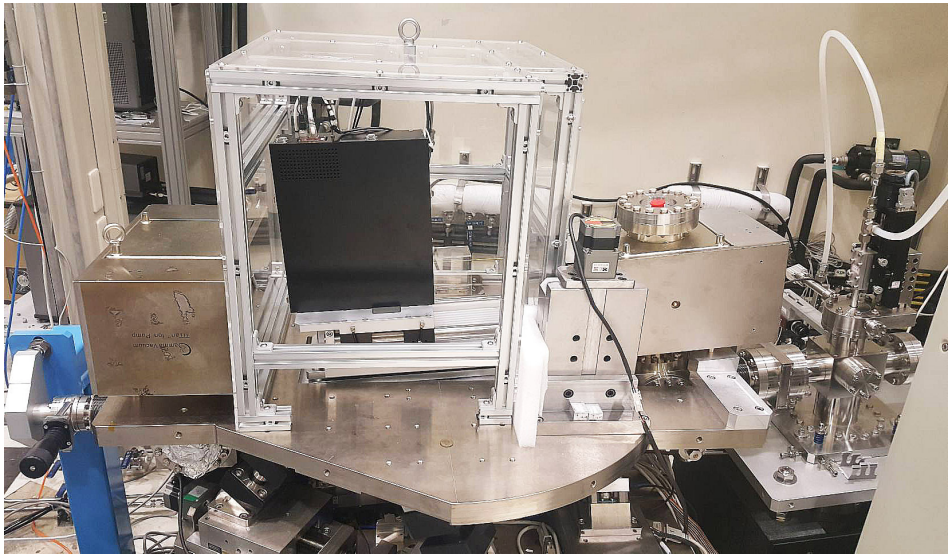
Scientific Breakthrough

A large-scale X-ray mirror measurement was carried out on an active spectrometer and an active spectrograph for TPS 41A1 of Taiwan Photon Source to observe the variation with a raise of 10 nm for active grating after heating. The slope error of the grating mirror after being heated is corrected instantly on beamlines, so that there can be a 25,000 of resolving power for a photon energy of 510 eV.

Industrial Application

Optical measurement and design capabilities of NSRRC and manufacturing capacity of domestic vendors are integrated, as well as technical applications of domestic vendors are developed and a variety of customized and high-value X-ray optical products are designed & developed and fabricated domestically, which, for example, can be used to measure mirror fabrication and installation result.





Photon Generation in Magic School

R&D UNIT **National Synchrotron Radiation Research Center**
Jyh-Chyuan Jan Associate Research Scientist

Technical Introduction

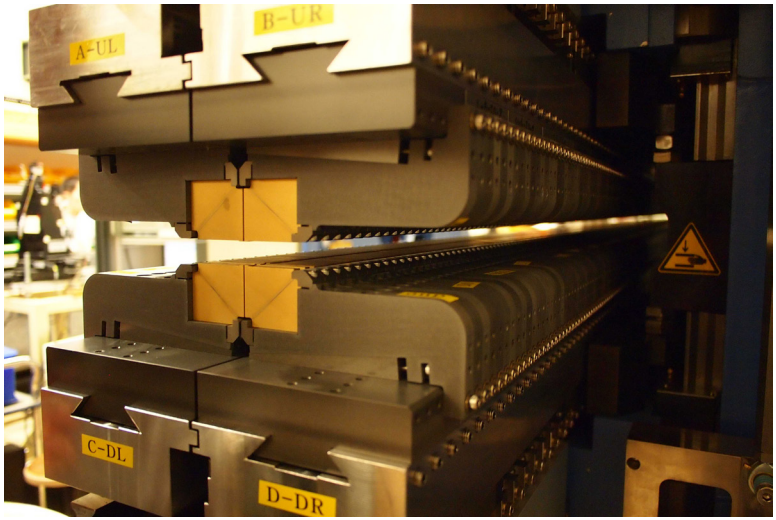
NSRRC, which is one of the worldwide top magnet design teams, is capable of the magnetic field simulation, mechanism design and magnetic field measurement. Related technologies include electromagnet technology, permanent magnet technology, vacuum technology, low temperature technology and superconductivity technology.

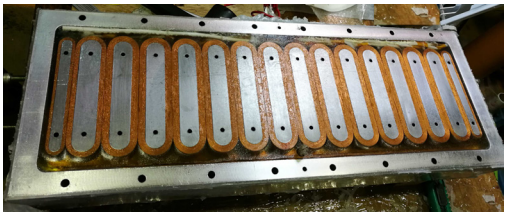
Scientific Breakthrough

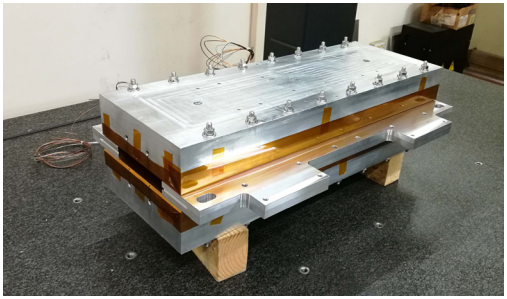
Undulator (U100), elliptical polarization undulator (EPU56) and 3 sets of 3.2 T superconducting wiggler magnets (IASW) are homemade and are operating in Taiwan Light Source (TLS). 3.5 T superconducting magnet is homemade and is installed and operating in Siam Photon Source, Thailand (SPS). 2 sets of EPU48 are homemade and are operating in Taiwan Light Photon Source (TPS).

Industrial Application

Magnets are widely used in our life, for example, nuclear magnetic resonance imaging (MRI) provides better medical diagnosis and provides a powerful detection tool for brain science. The high temperature superconducting magnet, which is advantageous of high magnetic field and exemption from the use of liquid helium, is one of the options for future MRI magnet development.







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Ubiquitous RF Energy Applications

R&D UNIT **National Synchrotron Radiation Research Center**
Tsung-Chi Yu Assistant Scientist

Technical Introduction

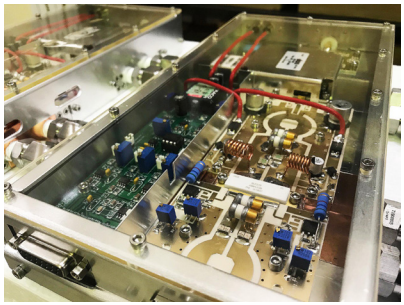
A huge microwave power/RF power, which is generated by reasonable number super-imposition of smaller-power solid-state power sources, becomes a future trend. To meet the trend, NSRRC has developed a technology to combines multiple kilowatt-level RF power sources to tens of kilowatts to replace the vacuum tube that needs a high-voltage power supply and become more and more expensive.

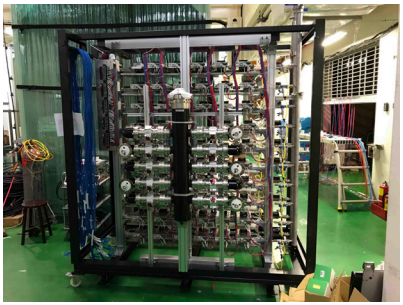
Scientific Breakthrough

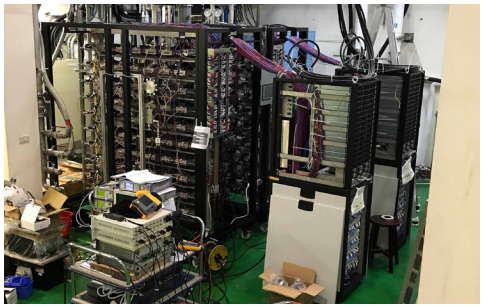
NSRRC integrates a planar balun to achieve push-pull operation power amplifier with excellent quality RF power source. The integration of an RF power chip with a water-cooled base is applied to have superior heat dissipation and extended life of the power chip. Multi-port power combiners for in-phase operation at various power levels are also developed to have scale extensibility in various applications.

Industrial Application

The fully-solid-state RF power source is designed in CW mode which can satisfy various power application base on a single power unit. The high-quality and high-stability characteristics is especially suitable for electron beam acceleration. Other industrial applications such as aeronautical communication, plasma excitation, laser generation and microwave heating are also applicable.







On-chip integrated quantum polarization-entangled photonic source

R&D UNIT **National Central University**
Yen-Hung Chen, Distinguished Professor and Hung-Pin Chung, Postdoctoral Research Fellow

Technical Introduction

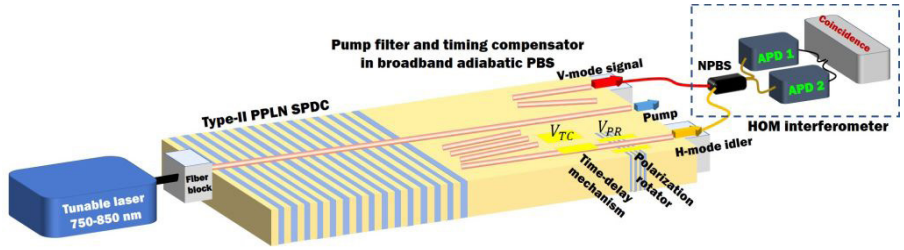
We have developed a unique integrated quantum polarization entangled photon source, in addition to generating quantum polarization entangled photon pairs, the source also integrates a special adiabatic optical light transfer array to perform the on-chip pump filtering, signal and idler mode splitting, timing compensation, and polarization rotation for facilitating the building of a stable and verstaile photonic qunatum source for many key quantum applications such as quantum computation and quantum communication.

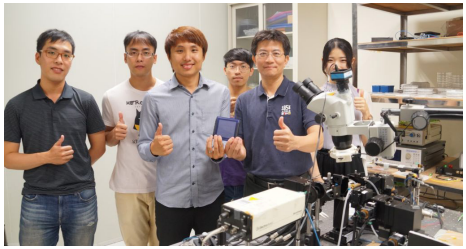
Scientific Breakthrough

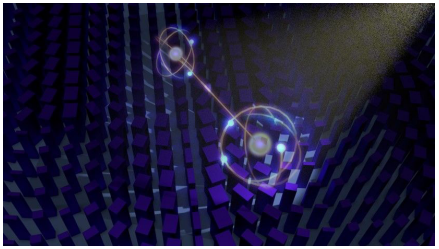
The integrated quantum polarization-entangled photon source has been experimentally characterized in Australian National University using the ultra-compact quantum polarization state tomography technique. When the cm-long photonic quantum chip is further combined with a nanometric scale metasurface, the space and time required for quantum tomography experiments can be greatly reduced, expediting the miniaturization and practicability of quantum computers. This study was published in Science in 2018.

Industrial Application

Due to its superior computing speed and truly parallel processing capability, quantum computers greatly improve the crisis and risk in the predictive accuracy of energy, finance, climate change, etc. Besides contributing to the quantum computing, our technology can facilitate the construction of unconditionally secure communication systems and making breakthroughs to astronomical, high-energy physics, and military science and technologies that involve large-scale complex computing events, making the dream qunatum world come true.







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Monolithic hybrid type quantum dots micro-light-emitting diodes for the full-color pixel array

R&D UNIT

National Chiao Tung University / Hao-Chung Kuo, Distinguished Professor; Chien-Chung Lin, Professor; Sung-Wen Huang Chen, Research Assistant; Yu-Ming Huang, Research Assistant; Zhen-You Liao, Research Assistant; Yi-Yuan Chen, Research Assistant; Yu-Chien Hsu, Research Assistant; Jia-Rou Zhou, Research Assistant; An-Jye Tzou, Research Assistant

Technical Introduction

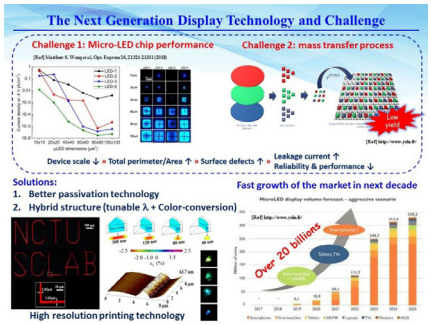
A wavelength tunable micro-light-emitting diodes fabricated by the nanometer-level etching technology, the strain-induced engineering can effectively shift the emission wavelength from green to blue. Meanwhile, we introduced the ALD thin film for the passivation layer, and the super inkjet printing system used to form the color-conversion layer to emissive red light. Finally, a hybrid type full-color micro-LED has been fabricated with the monolithic epitaxial wafer.

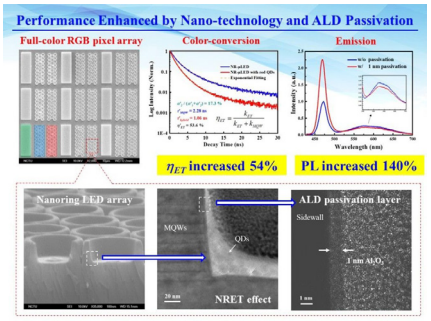
Scientific Breakthrough

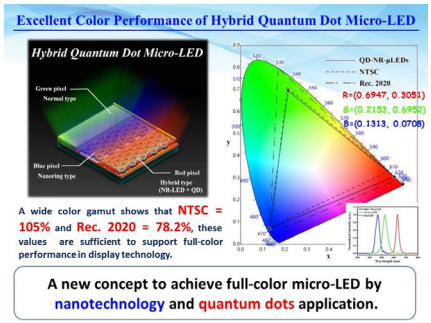
1. Monolithic micro-LED RGB full-color pixel array.
2. Enhanced photoluminescence intensity by 140% through ALD passivation.
3. Quantum dots printing technology with excellent uniformity, ultra-narrow line width (< 2 um).
4. A wide color gamut determined by the overlap area of NTSC and Rec. 2020 is approximately 105% and 78% that sufficient to support full-color performance in display technology.

Industrial Application

1. Reduced the number of mass transfer, improving the process yield and throughput by monolithic RGB micro-LED.
2. Micro-LED can be widely applied to various type of displays and VLC application.
3. Some traditional semiconductor process can be replaced by high precision printing technology.
4. Atomic layer deposition is a promising method to improve the performance of III-V semiconductor.







Monolithic 3D-IC Strucuture and Fabrication Using Location-Controlled-Grain Technique

R&D UNIT **National Chiao Tung University**

Distinguished Professor Kuan-Neng Chen; Chair Professor Chenming Hu; Professor Po-Tsang Huang

Technical Introduction

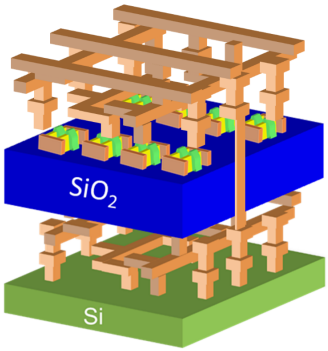
The location of controlled-grain Si island is determined by the pattern of "cooling holes". The grain size is determined by the distance between "holes" due to lateral grain growth using pulse laser crystallization. This predictability allows the transistors and circuits to stay away from the grain boundaries for monolithic 3D-IC.

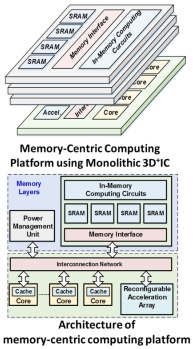
Scientific Breakthrough

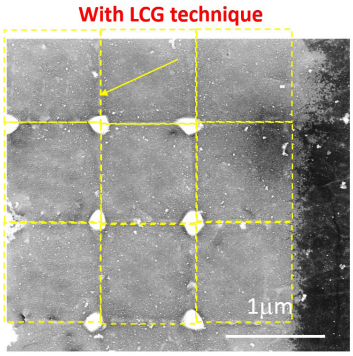
Monolithic 3D integration provides efficient connectivity of circuits and decrease power consumption, enhance system performance and reduce chip size. A BEOL location-controlled technique using pulse laser anneal process for fabricating monolithic 3D FinFET circuits within Si grains is proposed. Spatially separating devices and grain boundaries provides a promising solution for developing practical monolithic 3D-IC.

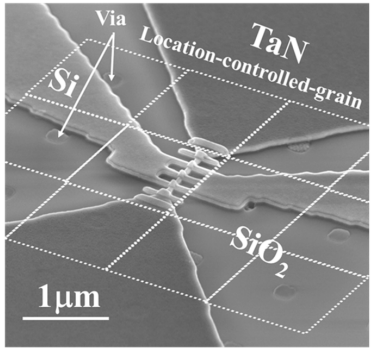
Industrial Application

Monolithic 3D integration is an emerging and promising technology that offers a path for high performance, high connectivity, multi-function, smaller form factor, and potential cost reduction. It is appropriated for the development of IoT devices and for the design of neuromorphic computing.









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Fabrication of dye-sensitized solar cells by printing process and its applications on Internet-of-Things (IoT)

R&D UNIT **National Cheng Kung University**

Chair Prof. Yuh-Lang Lee; Dr. I-Ping Liu; Yun-Yu Chen; Yu-Syuan Cho

Technical Introduction

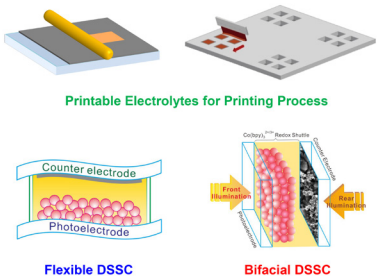
On base of the advantages of dye-sensitized solar cells (DSSCs), including easy fabrication process, low cost, and the high energy conversion efficiency under room light conditions, DSSCs were utilized as self-power suppliers for devices involved in Internet-of-Things (IoT) systems.

Scientific Breakthrough

1. Gel-electrolyte of DSSCs are prepared for operation by printing process. This technique is beneficial for the pore filling and the roll-to-roll production process of DSSCs.
2. Highly active and light transmittance counter electrodes are prepared which are used to fabricate bifacial DSSCs. The cells can work on both front and the back sides, producing more energy.

Industrial Application

1. Development of gel-type electrolytes for DSSCs. The electrolytes with printing properties can be applied to the roll-to-roll process for mass production of module devices.
2. Development of highly catalytic and transparent counter electrodes.
3. Light harvesting in both outdoor and indoor environments.



Superconducting-quantum-bit simulation chip (SC-qubit simulation chip)

R&D UNIT **National Tsing Hua University** / IoChun Hoi

Technical Introduction

Superconducting qubit is the basic structure for constructing the quantum computer in the current approach. The superconducting-quantum-bit simulation chips (SC-qubit chip) that consist of 1-4 qubits are manufactured locally by domestic researchers. The SC-qubit chip is designed for simulation of artificial atoms, their mutual interactions and their interactions with microwaves and vacuum fluctuations.

Scientific Breakthrough

The novelty of SC-qubit chips lies in its design which aims to use SC-qubits to amplify microwave, simulate artificial atoms and their mutual interactions. We demonstrate that when SC-qubit strongly couples with microwave, it can be used to amplify microwave with amplitude gain being 7%. Furthermore, two qubits that interact with waveguide can be used to generate large collective Lamb shift (0.8% of energy level).

Industrial Application

The Superconducting qubit simulation chips that consist of 1-4 qubits are designed for simulation of artificial atoms and their mutual interactions. If it is further developed, it can be scaled up to have many qubits and even beyond 50 qubits in one chip so that its simulation power goes beyond that of nowadays classical computers. By that time, the simulation chips will have real industrial applications.

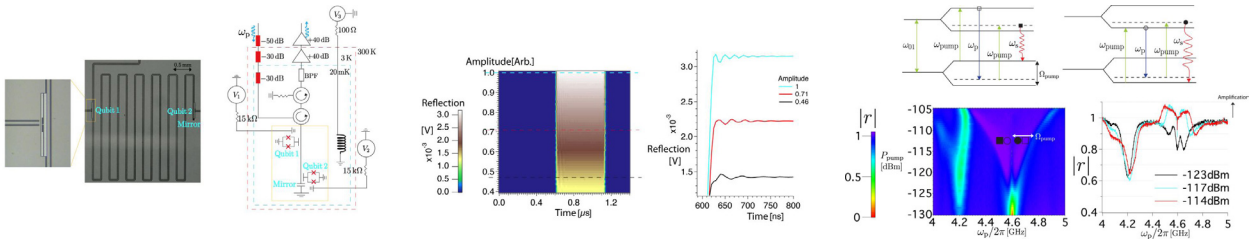


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Table-top ATTO-EUV laser source

R&D UNIT **National Tsing Hua University** / MING-CHANG CHEN; HUNG-WEI SUN; PEI-CHI HUANG

Technical Introduction

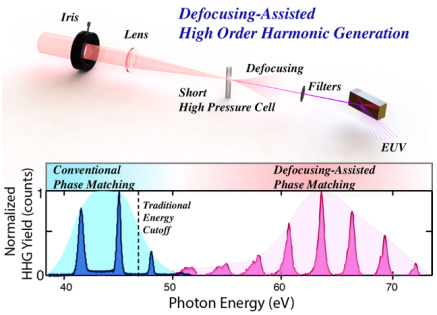
Prof. Chen's research team at IPT NTHU achieved a breakthrough to build table-top coherent EUV light source. This new accessible and reliable EUV light source makes a lot of the first possibilities, enabling the dynamics of chemical reactions, nano-materials and bio-molecular systems to be studied with unprecedented temporal and spatial resolution, e.g. coherent 13.5nm EUV light source for nm-scale defect inspection.

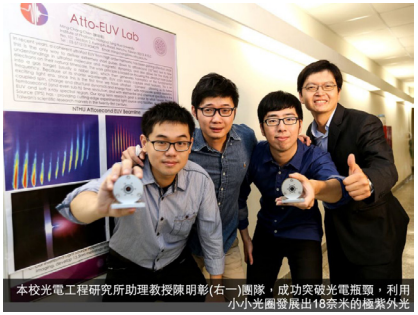
Scientific Breakthrough

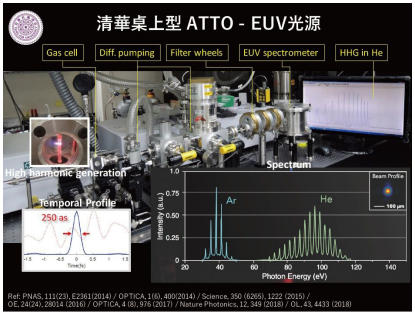
Chen's lab found accidently that by adjusting the aperture size of the iris they could precisely control the EUV's bandwidth and central wavelength. This was the breakthrough everyone had been looking for, since the simple iris actually increased the up-conversion yield of 18 nm more than one order of magnitude because of the phase mismatch between the infrared ray and the converted EUV light.

Industrial Application

EUV has been widely used in scientific research in such areas as materials, electronics, biology, medicine, physics, chemistry, chemical engineering, geology, archeology, energy, environmental protection, and micro-mechanics. Especially, EUV has been the key technology for the next generation high-volume manufacturing of semiconductor devices. The table-top EUV light source will definitely make great impacts in industries.







Embedded Smart Textile Arrays Display Module

R&D UNIT **National Taipei University of Technology**
Professor Syang-Peng Rwei; Associate researcher CHOU TZU WEI; Professor Guo-Ming Sung

Technical Introduction

National Taipei University of Technology (NTUT) announces the latest approach "embedded smart textiles arrays display module" (ESTAD module). The ESTAD module involves twoparts, and one is circuit and the other is control box. The circuit is to attach the fabric seamlessly, and this could be twisted and rubbed to fit various design. The control box is designed smaller than the current form to put in the pocket or somewhere hidden in the potential application.

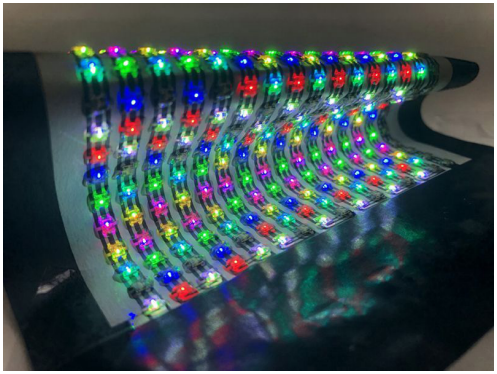
Scientific Breakthrough

1. Integration of circuit and textile to decrease the size of the module: The ESTAD module is to coat circuit on fabric seamlessly and transmit electric current more efficient. The coated circuit could be foldable, twisted, rubbed and waterproofed.
2. Wireless Internet of thing function: This can be done from the phone's app in the future, including changing colors, entering simple text and animations as a demo.

Industrial Application

1. Foldable coating circuit: It can be applied to flexible LED advertising screens. There are two specifications of full color 50/50 LED and 20/20 LED currently.
2. Application of clothing: The conductor wire of the display module can be extended, and the electronic control system can be placed anywhere in the clothing according to the clothing design.





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Ultra-Low Frequency Raman Spectroscopy Technology

R&D UNIT **National Taiwan University** / Yu-Ming Chang

Technical Introduction

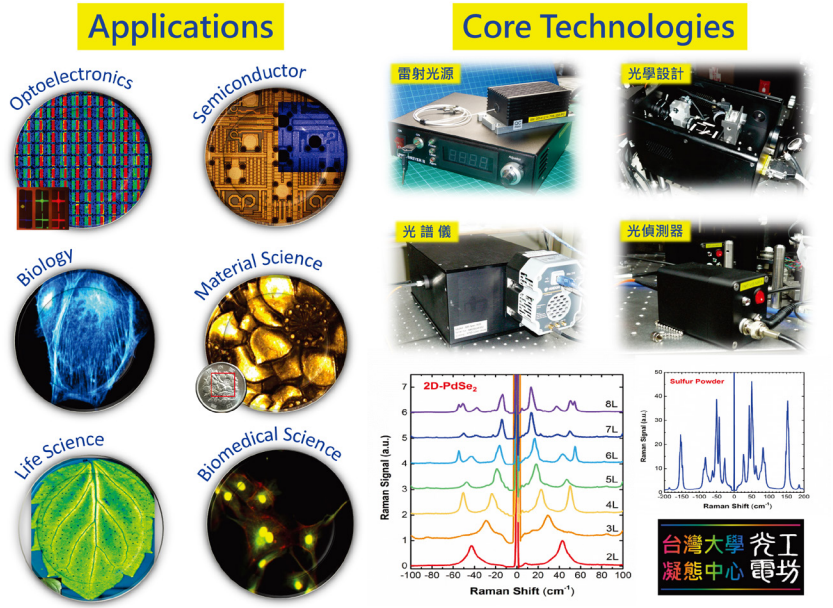
ULF Raman spectroscopy utilizes novel VHG filters to spectrally clean up the laser line before ULF Raman spectroscopy is measured with a single grating spectrometer in conjunction with CCD camera. The availability and accessibility of UFL Raman spectroscopy opens new opportunity to reveal key information such as intermolecular structure characterization, pharmaceutical polymorph identification, and material phase and interfacial structure determination.

Scientific Breakthrough

We establish the know-how technology to spectrally clean up the laser line down to <10 cm^{-1}, before one measures ULF Raman spectroscopy with a single grating spectrometer. UFL Raman spectroscopy opens new opportunity to reveal key information such as intermolecular structure characterization, pharmaceutical polymorph identification, and material phase and interfacial structure determination.

Industrial Application

ULF Raman spectroscopy can reveal key information such as intermolecular structure characterization, polymorph identification, and material phase and interfacial structure determination. The potential applications include : 2D materials and their van der waals heterostructures, metal halides, pharmaceutical polymorphs, semiconductor structure, graphene, carbon nanotubes, and material crystallization and structural transformation.



Innovative Wireless Positioning and Tracking System

R&D UNIT **National Taiwan University** / Professor Shau-Gang Mao

Technical Introduction

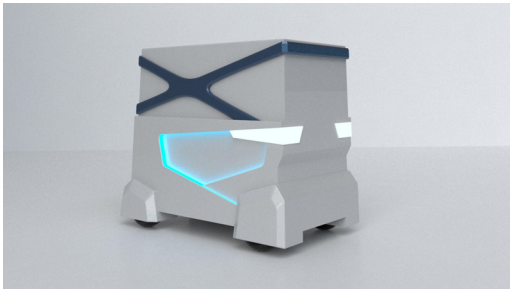
iTech was founded by Professor Shau-Gang Mao of National Taiwan University, an expert in the areas of wireless communication and signal processing. Its technology has been recognized in the Macronix Golden Silicon Awards.iTech is a pioneer in adopting AI-powered technology that combines efficient hardware architecture and signal processors.

Scientific Breakthrough

1. iShield drone detecting and tracking technology developed by iTech can identify UAVs even in a dense urban environment. Moreover, the RF signals of drone operators can be intercepted and analyzed. Hence, UAVs and their pilots can be identified and tracked simultaneously.
2. iPosition can be used in non-GPS and non-line-of-sight environments. With our innovative AI algorithms, iPosition can identify the cm-accuracy locations of thousands of targets simultaneously within one second. Then, locations and trajectories of multiple targets can be uploaded to the cloud service for data analysis and management.
3. iFollow 2.0 is based on the combination of advanced wireless communication system and efficient signal processing algorithm. iFollow 2.0 provides the world's first cost- effective solution for the smart droid to achieve auto-following function without using conventional image recognition technology. iFollow 2.0 devices adopt the AI-powered wireless communication technology which combines efficient hardware architecture and advanced signal processor to achieve the cm-level active tracking and passive sensing functions.

Industrial Application

1. iShield can localize any UAV device 24 hours a day, 7 days a week, whether it is sunny, rainy, day, night or harsh. Compared to other products, iShield can be easily moved and quickly erected, and can be detected by AI spectrum identification technology. The iShield detection system can localize the position UAVs and it is suitable for military use, home, airport, government, shopping malls and other places to protect personal privacy, trade secrets and security.
2. iPosition can be used hospitals, playground, school, supermarket…etc. It is the perfect tool to analyze consumer behavior and logistics management.
3. iFollow can work efficiently even if the target is in the scenario of no GPS signal or the color of the target is similar to any object nearby. Hence, using iFollow, any robot can find its way in the dark or on a path with obstacles or even on a narrow passage.



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Modular Polymeric Nanoshells for Precision Antiviral and Anticancer Vaccination

R&D UNIT **Academia Sinica** / Dr. Che-Ming Jack Hu; Dr. Hui-Wen Chen; Dr. Leon Lin; Bing-Yu Yao

Technical Introduction

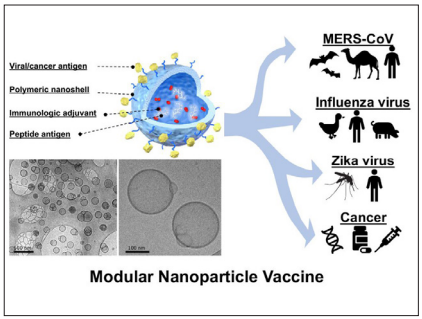
Effectively inducing cytotoxic T cell expansion has been a critical challenge in vaccine development. To address this challenge, an entirely biodegradable polymeric nanoshell was invented to couple antigens and adjuvants for safe and potent immune potentiation. The invention has been adopted for precision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

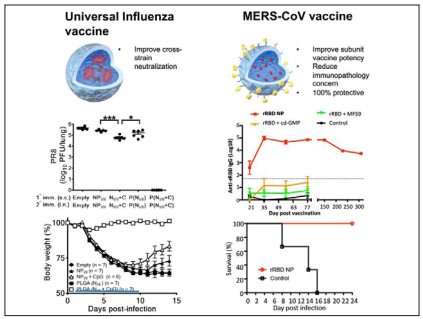
Scientific Breakthrough

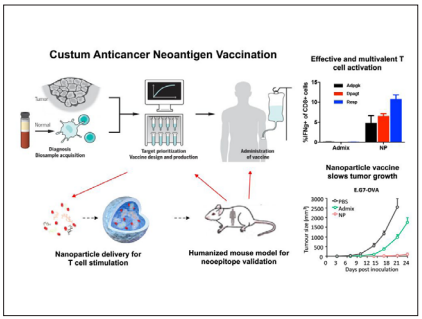
The biodegradable polymeric nanoshell fundamentally addresses the critical challenge in nano-encapsulation of water soluble and combinatorial compounds. The T cell stimulating capacity stemming from the nanoshell-based vaccines is unparalleled by any viral vector or non viral vector-based vaccine platforms.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

Industrial Application

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 nanomedicne development for drug and biologics delivery.







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Bacteria With Detoxification Pump That Can Eliminate Antibiotics from Bacteria Body to Produce Drug Resistance

R&D UNIT **National Synchrotron Radiation Research Center**
Chun-Jung Chen Deputy Director; Hong-Hsiang Guan PostDoc

Technical Introduction

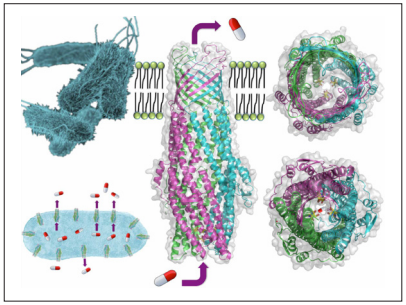
X-ray diffraction technology is used to analyze the drug efflux pump, ST50, form *S. Typhi*. The drug efflux mechanism for multiple drug resistant (MDR) *S. Typhi* and the potential location for antigen of market-based typhoid detection reagent are understood through this ST50 structure. It could help develop the more effective typhoid detection reagent and the new antibiotics against MDR *S. Typhi*.

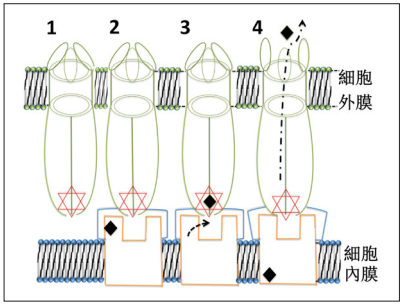
Scientific Breakthrough

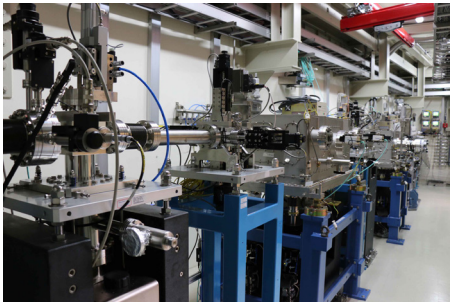
1. The protocol for the preparation of massive, high-purity drug efflux pumps, ST50, from *S. Typhi* are set up.
2. The X-ray structure of ST50 is determined.
3. Possible antigenic active regions of ST50 for patients' antibody detection are determined.
4. The 3D structure of the active region of ST50 for drug efflux is determined.

Industrial Application

1. It can be applied to research and develop a new generation of typhoid detection reagent with better effect than TYPHIDOT.
2. The new antibiotics against drug-resistant *S. Typhi* can be developed using X-ray protein structure-based drug design and development technology.







A genomic marker guided roadmap to treat hepatocellular carcinoma

R&D UNIT **CHANG GUNG MEDICAL FOUNDATION**
Chau-Ting Yeh, Professor, and Kung-Hao Liang, Associate Researcher

Technical Introduction

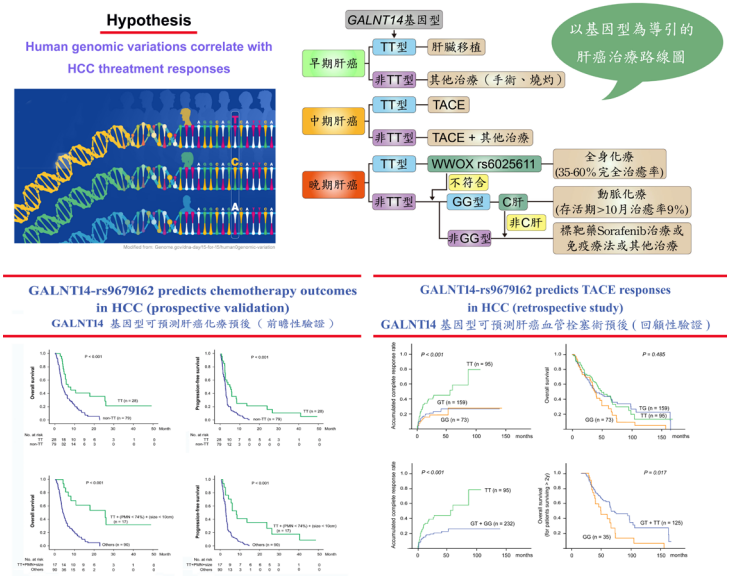
This is a method for the purpose of identifying single nucleotide polymorphisms (GALNT14 genotypes) using any somatic DNA sample to predict whether a patient suffering from HCC will respond to combination chemotherapy or TACE. Accordingly, physicians can decide whether the HCC patients should receive chemotherapy or TACE. This method could also predict prognosis in multiple gastrointestinal cancers.

Scientific Breakthrough

We are the first to identify an SNP, rs9679162, of which the genotype can predict the response to a 5-FU-based combination chemotherapy in patients with HCC. This SNP has also been shown to predict the efficacy of TACE in patients with HCC. More interestingly, the genotype is also related to the prognosis of colorectal cancer, esophageal cancer, cholangiocarcinoma and gastric signet ring cell carcinoma.

Industrial Application

Basing on our finding, we have developed a kit to examine the genotype of rs9679162 in several GI cancers to provide personalized and optimized anti-cancer treatments. Currently, this method has been successfully transferred to the Department of Laboratory Medicine in Linkou Chang Gung Memorial Hospital and the Center has established a self-funded clinical assay. We are now actively promoting it.



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An Anti-Obesity Nanotechnology to Modulate Oil Absorption In Vivo

R&D UNIT **National Health Research Institutes**

Leu-Wei Lo; Chung-Shi Yang; Shih-Hsun Cheng; Cheng-Ze Liao; Chia-Hui Chu; Li-Jie Lin

Technical Introduction

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.

Scientific Breakthrough

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.

Industrial Application

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.

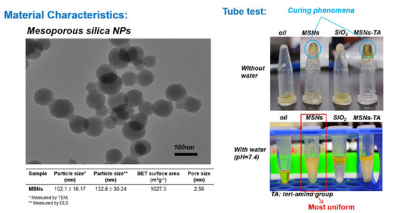


Figure 1. The morphology and physicochemical properties of MSNs (left) and effect of various silica nanomaterials on oil solidification (right). Only unmodified MSN can effectively adsorb oil and creative solidification.

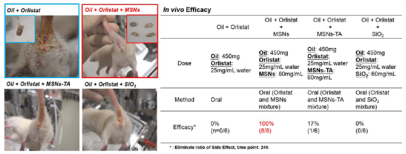


Figure 2. Exogenous fecal observation (left) after fed with oil, orlistat and various type of nanoparticles in rats and efficacy of side effect reduction (right). Oily stool formation was observed in the Orlistat group, while solid stool formation was observed in MSNs group, which indicates MSNs can effectively reduce the side effects of Orlistat. The side effects determination by the Bristol Stool Scale.

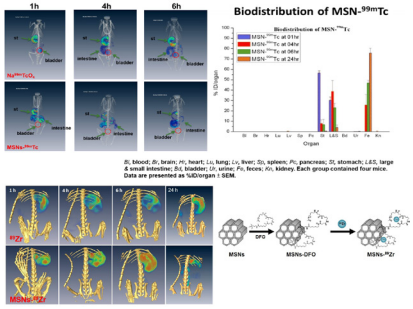


Figure 3. The gastrointestinal distribution of mice though oral administration by multimodalities biomedical images. The primary images can be clearly seen that the majority of MSNs gradually excreted out through the GI tract, and no assimilation of intestine.

Bi-specific antibodies and uses thereof

R&D UNIT **Kaohsiung Medical University; Academia Sinica**
Tian-Lu Cheng; Steven R. Roffler; Bing-Mae Chen; Chien-Han Kao; Yi-An Cheng; Kai-Wen Ho

Technical Introduction

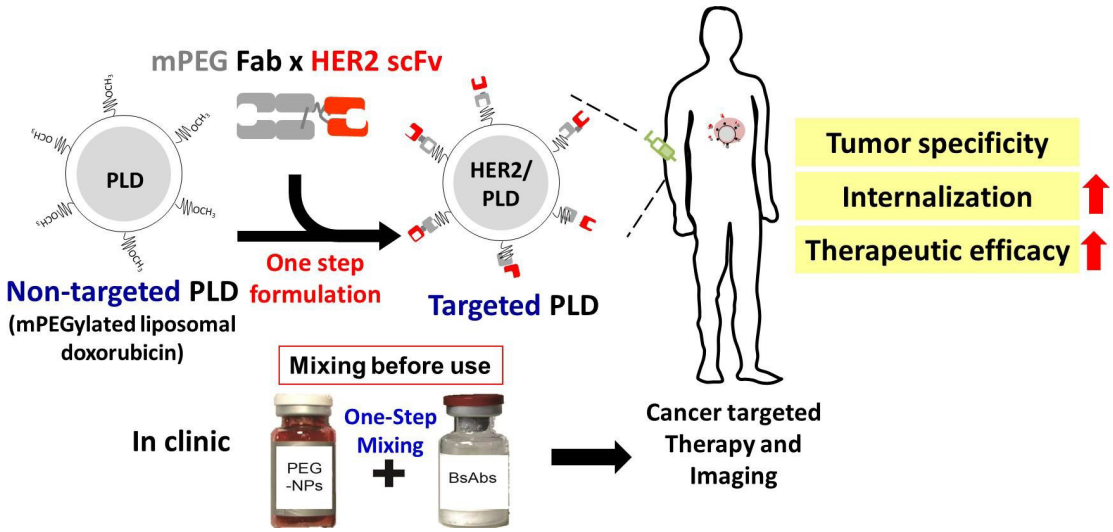
We developed a humanized bifunctional antibody (mPEG×tumor marker), and the anti-PEG end can be non-covalently modified to bind any PEGylated nano-drug or a contrast agent by "one-step formulation". The non-covalent binding solved the problems of chemical modification such as the masking of the antibody binding site, heterogeneity, drug instability. The other end of the bifunctional antibody can specifically identify any tumor marker for effective poisoning.

Scientific Breakthrough

1. One-step formulation & non-covalent bond modification combined with any PEGylated nanomolecule
2. Non-covalent bond modification solved the problems caused by chemical modification, such as masking antibody epitope, heterogeneity, and drug instability after modification.
3. Specific target cancer metastasis cancer for treatment
4. Can be replaced with different cancer targets and drug accumulation for all cancers

Industrial Application

1. No need to modify the nano-drugs production and confer the nano-drugs with tumor-speicficity
2. Can be applied to all PEGylated nano-drugs and contrast agents
3. Diversity of tumor targets (personalized medicine)
4. "Humanized" bifunctional antibodies meet FDA standards and could accelerate the clinical trial processes and reduce the research costs.



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Mobile Application for Anti-Doping & Gastroenteritis Defender

R&D UNIT Kaohsiung Medical University
Mei-Chich Hsu; Yu-Tse Wu; Chien-Chang Ho; Chih-Wei Chang; Ching-Chi Yen

Technical Introduction

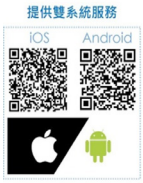
1. The 'Mobile Application for Anti-Doping' covers more than 40,000 pharmaceuticals and allows athletes to check whether the target products are prohibited for usage in- or out-of-competition simply via typing in the product names.
2. Utilizing nanotechnology, the 'Gastroenteritis Defender' elevates the oral bioavailability of the active compound andrographolide and effectively prevents gastrointestinal inflammatory disorders.

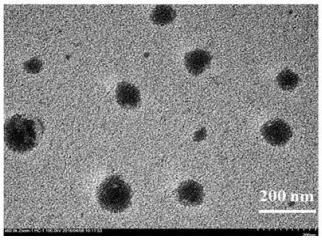
Scientific Breakthrough

1. The 'Mobile Application for Anti-Doping' is the first mobile application in Taiwan developed for anti-doping purpose. It is also the only one in the world that includes the data of Chinese herbal products.
2. The 'Gastroenteritis Defender' is the first andrographolide nano-formulation product which remarkably enhances the absorption of andrographolide thereby ameliorates gastrointestinal inflammatory conditions.

Industrial Application

1. The 'Mobile Application for Anti-Doping'has been widely used in 2018 Asian Games. The app as a reliable tool has been frequently used by athletes, parents, coaches and medical personnels.
2. The 'Gastroenteritis Defender' could be further commercialized in many types of preparations. The technology with its industrial applicability is able to drive demand for nutritional supplements in sports industry.





High sensitivity hepatitis B virus large surface protein chemiluminescence quantitative ELISA kit

R&D UNIT **National Cheng Kung University/National Cheng Kung University Hospital**

Professor Wenya Huang; Professor Chia-Jui Yen; Associate Professor Pin-Nan Cheng; Ms. Yun-Ping Lee

Technical Introduction

A high-sensitivity quantitative ELISA detection system for the large HBV surface (LHBS) protein was developed. It includes monoclonal antibodies for LHBS and chemiluminescent sandwich ELISA method. Clinical tests of the ELISA prodcuts have been performed in CHB cases. The LHBS detection methods and products have been filed for US provisional patent and will be submitted for the IVD approval.

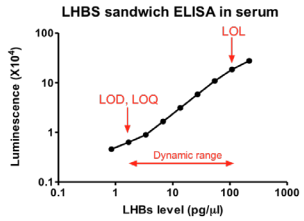
Scientific Breakthrough

1. In-house development of a series of high-sensitive and -specific monoclonal antibodies for LHBS. 2. Establishment of the chemiluminescence quantitative HBV LHBS detection kit. 3. Clinical tests to examine clinical significances and applicabilities of the HBV LHBS quantification kit, and to evaluate LHBS as a novel biomarker in hepatitis and HCC.

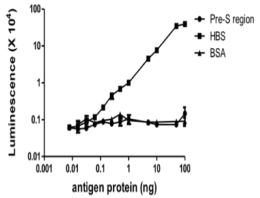
Industrial Application

Early detection of the patient's responses to anti-viral therapies can greatly benefit the decision or modification of treatment plans. The LHBS chemiluminescence quantification ELISA kit products developed can be marketed in Taiwan and other HBV epidemic countries such as China and some South East Asian countries. The products stand a good potential for high market value.

LHBS chemiluminescence sandwich ELISA kit with excellent detection LOD and LOQ and high dynamic range in serum of HBV carriers

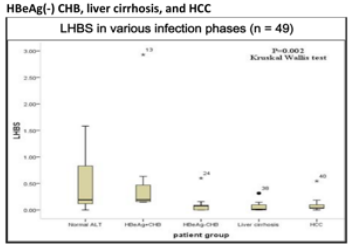


Highly sensitive and specific monoclonal antibodies for the LHBS chemiluminescence ELISA system



Serum LHBS levels in various HBV infection phases

LHBS levels in the phases of immune tolerance, HBeAg(+) CHB, HBeAg(-) CHB, liver cirrhosis, and HCC



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Glycan-masking and glycan-unmasking hemagglutinin antigens for universal influenza vaccine development

R&D UNIT **National Tsing Hua University** / Suh-Chin Wu; Shih-Chang Lin; Wen-Chun Liu; Yun-Ju Huang

Technical Introduction

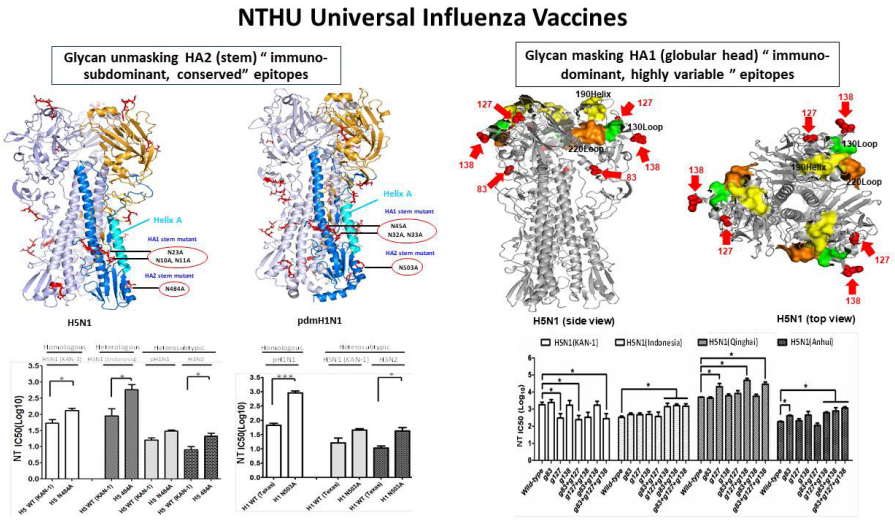
The invention provides a glycan-masking and/or glycan-unmasking hemagglutinin, wherein the glycosylation site(s) is added on globular head or removed on stem. The glycan-masking and/or glycan-unmasking hemagglutinin may induce neutralizing antibody against influenza virus, and cross-reactive protection against different subtye viruses. The invention also provides a method for manufacturing these antigens for universal influenza vaccine development.

Scientific Breakthrough

The hemagglutinin is the major antigen to elicit neutralizing antibody and protective immunity against influenza virus infection. We invented the site-specific glycan-unmasking and/or glycan-masking methods on the hemagglutinin glycoprotein, wherein the glycosylation site(s) is removed on the conserved stem region or added on the hypervariable globular head region. The glycan-unmasking and/or glycan-masking hemagglutinin can be used as novel antigens to elicit broadly neutralizing antibody against influenza virus, and cross-reactive protection against different subtype viruses. The invention also provides a method for new antigen design for universal influenza vaccine development.

Industrial Application

The market for seasonal influenza vaccines, sized at US$2.8 billion in 2008–2009 across the major markets, not including the potential of pandemic vaccines. The annual rate of influenza vaccine is approximately 12.6%. Our invention provides a glycan-masking and/or glycan-unmasking hemagglutinin antigen design, which can be further used for developing “universal influenza vaccines".



Composition for treating lung fibrosis and emphysema and therapeutic method using the same

R&D UNIT **National Yang-Ming University**

Dr. Erh-Hsuan Lin; Dr. Ching-Huei Lin; Dr. Cheng-Wen Wu; Dr. Oscar Kuang-Sheng Lee

Technical Introduction

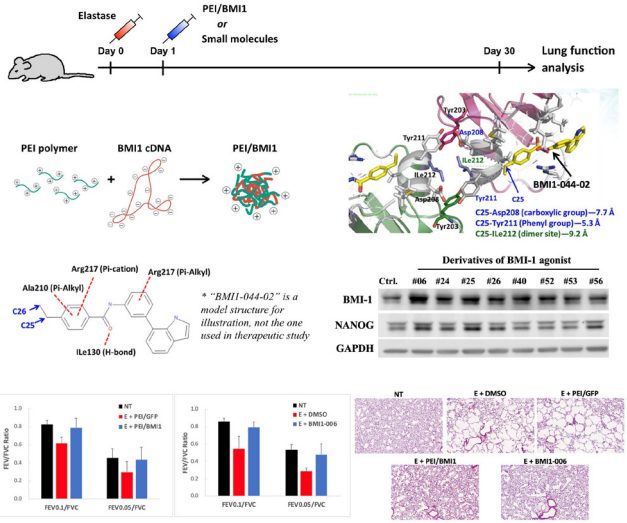
A therapeutic approach for chronic lung diseases such as COPD and fibrosis, via in vivo reprogramming of endogenous alveolar epithelial cells.

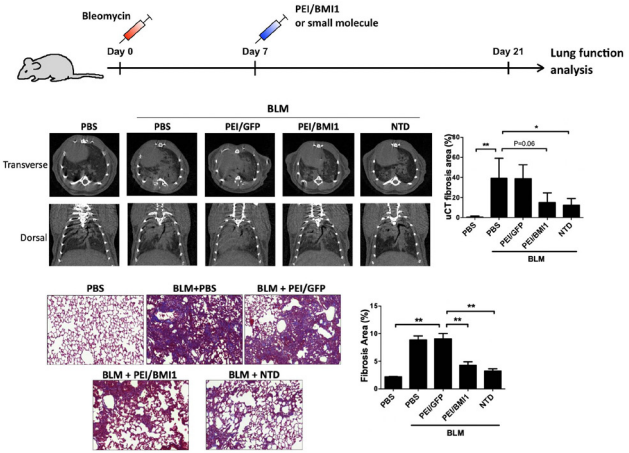
Scientific Breakthrough

Instead of transplanting in vitro propagated stem cells to injury site, this technology induces vivo reprogramming of endogenous lung cells for therapy.

Industrial Application

COPD is currently the 3rd most common cause of death globally, and along with lung fibrosis, have no effective therapeutics in clinic. The novel technology would be a ray of hope for patients.





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RSV VACCINE COMPOSITION COMPRISING HEPATITIS B VIRUS-LIKE PARTICLES AS ADJUVANT

R&D UNIT **National Taiwan University** / Prof. LI-MIN HUANG; Dr. JEN-MIN HUANG

Technical Introduction

In this project, we have reorganized several highly immunogenic sites and structurally essential regions to maintain it in a pre-fusion state and use it as main antigen in our RSV vaccine candidate (RSV-F005). To induce a mucosal immune response, intranasal administration route was chosen. New mucosal adjuvant (H-muad) has been tested in threee animal models.

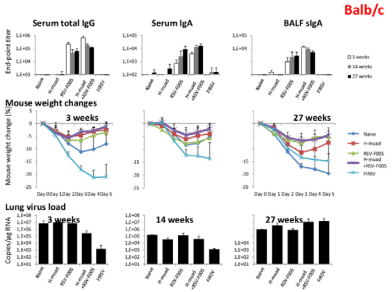
Scientific Breakthrough

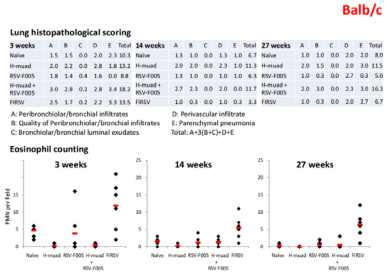
We constructed a modified RSV F protein, RSV-F005, to mimic the natural trimer conformation of the RSV F protein. The purified recombinant H-muad protein has been confirmed by TEM to form virus-like particles. The efficiency of H-muad to enhance mucosal immune responses was also fully evaluated in our mouse experiments with RSV candidate vaccine RSV-F005.

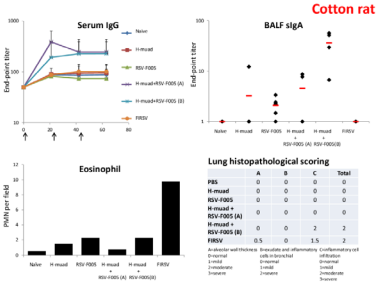
Industrial Application

RSV vaccine is a brand new market segment. The treatment market of RSV is estimated to be reaching $2.3 billion in 2024.

The FDA has been very conservative in reviewing and approving new vaccine adjuvants due to concerns about inappropriate side effects. Our candidate adjuvant H-muad is non-active and relatively safe nanoparticles. The global market for vaccine adjuvants is estimated to increase from $470 million in 2016 to $770 million in 2021.







Finding cures – New platform and techniques for the development and testing of new drugs for ataxia

R&D UNIT **National Taiwan University** / Dr. Wen-Sung Lai; Dr. Yufeng Jane Tseng; Dr. Hai-Gwo Hwu; Dr. Chih-Min Liu; Dr. Chung-Ming Sun; Dr. Yu-Li Liu; Dr. Chunhwei Tai; Dr. Ming Che Kuo

Technical Introduction

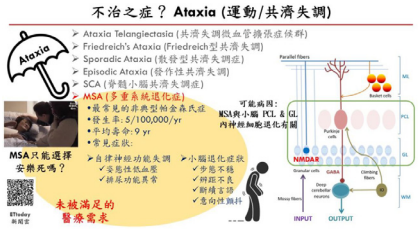
Our inter-institutional research team developed RS-D7, a novel NMDAR modulator/DAO inhibitor as a drug candidate for the treatment of ataxia/MSA. Based upon the core symptoms, we designed and applied preclinical mouse behavioral phenotyping techniques and clinical motor assessments to demonstrate the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

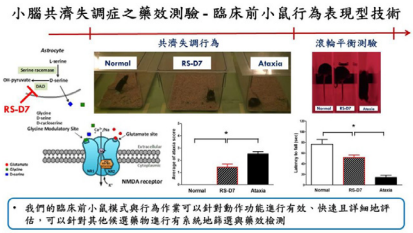
Scientific Breakthrough

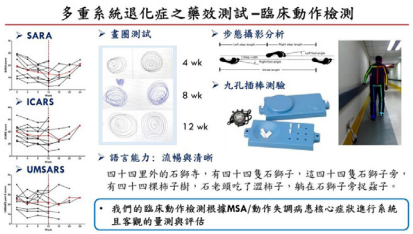
Ataxia is an urgent unmet medical need. Our research team aims at developing novel NMDAR modulators and exploring new indications for RS-D7. Comparing with TAK-831 from Takeda, we successfully applied preclinical mouse behavioral phenotyping techniques and clinical motor assessments to demonstrate the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

Industrial Application

1. We received several awards, e.g., 2016 Mentoring Program of Novartis Venture Fund, 2016 & 2019 National Innovator Award, and 2017 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.







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Develop of novel anti-diabetic agents via targeting endogenous lipid mediators

R&D UNIT **National Taiwan University** / Prof. Lee-Ming Chuang; Dr. Yi-Cheng Chang
National Health Research Institutes / Dr. Ming-Shiu Hung; Dr. Lun Kelvin Tsou

Technical Introduction

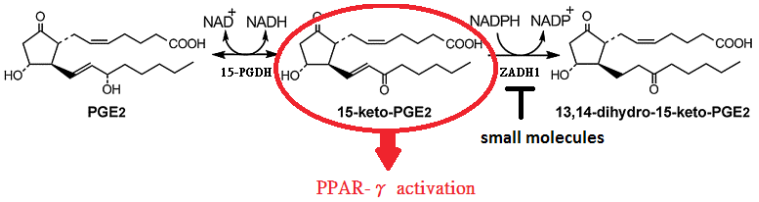
PPARγ is the master regulator of glucose metabolism.15-keto-PGE2 is an endogenous PPARγ ligand whitch is degraded by ZADH1. We found that increasing 15-keto-PGE2 promotes glucose uptake. We identified several ZADH1 inhibitors which could increase 15-keto-PGE2 and promote glucose uptake via activating PPARγ. Our results showed that inhibition of ZADH1 is a novel approach to treat type 2 diabes mellitus

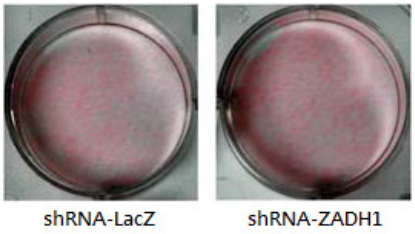
Scientific Breakthrough

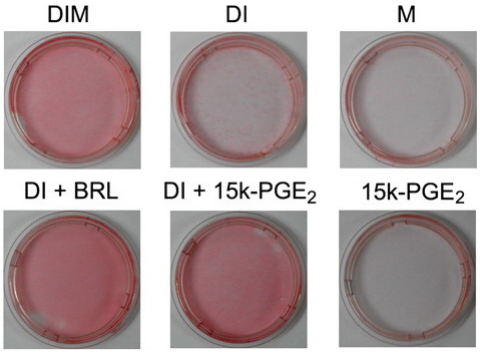
The widely used ant-diabetic agent, thiazolidinedione (TZD) lower glucose by activating PPARγ. However, TZD has significant side effects including weight gain, water retention, and osteoporosis. We found that 15-keto-PGE2 is an endogenous PPARγ ligand. Inhibiting ZADH1, the degradating enzyme of 15-keto-PGE2, could increase 15-keto-PGE2 and promote glucose uptake and is a novel strategy for treating diabetes

Industrial Application

Diabetes mellitus is a global epidemic disease. TZD is widely used to treat diabetes mellitus. However, it is associated with several adverse side effects. The development of ZADH1 small molecule inhibitor is a novel therapeutic strategy for treating diabetes without the side effect of TZD.





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For food safety: Establish a rapid screening and detection system for pesticides through high-precision enzyme display technology

R&D UNIT **Academia Sinica** / Yu-Chan Chao; Lin-Li Liao; Chih-Hsuan Tsai; Chuan-Yu Liao

Technical Introduction

We have displayed acetylcholinesterase on insect cell membrane for the detection of OP and CB pesticide residues. Our system saves a lot of cost and time compared to GC-MS and LC-MS analyses. It also avoids the need of enzyme extraction and purification from flies, which are necessary for conventional biochemical methods. Therefore, this is a fast, accurate and economical choice for pesticide residue screening.

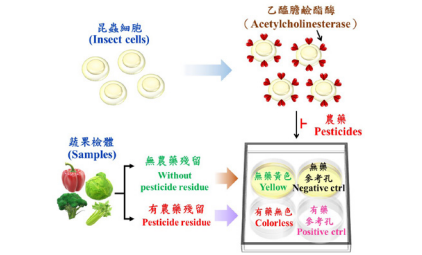
Scientific Breakthrough

The present technology displays acetylcholinesterase on the cell surface for pesticide detection. It replaces the tedious and laborious process of extracting acetylcholinesterase from insects, avoiding loss of activity, structural damage, and enzymatic degradation during the purification process. We have also successfully developed a method to maintain full acetylcholinesterase activity on cells for easy storage and transport. The system has thus made important breakthroughs in technology and applications.

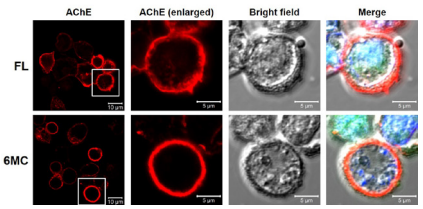
Industrial Application

The system is an innovative commercial product displaying acetylcholinesterase on cells for pesticide detection. We have also successfully developed a technique to dry cells that maintains intact acetylcholinesterase activity in microplates, making it easy to store and transport. The whole operation is simple and easily-promoted. Since the system is more precise and greatly reduces the production cost, it can surpass current systems using purified enzymes for better international marketing.

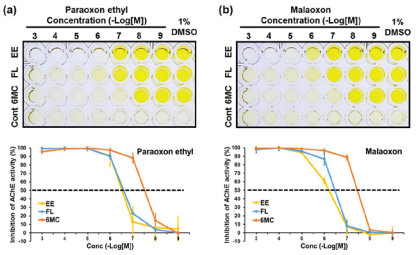
Our system develops a new technology to display acetylcholinesterase on insect cells for quick detection of pesticide residues in fruits and vegetables



Acetylcholinesterase (AChE, red fluorescence) can be displayed on cells for rapid detection of pesticides (FL and 6MC are two different acetylcholinesterases)



The cells in the 96-well plate display acetylcholinesterase and accurately and rapidly detect pesticides (a, b are two government-approved pesticides)



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Microfluidic motile sperm separation sorter

R&D UNIT **CHANG GUNG MEDICAL FOUNDATION** / Hong-Yuan Huang; Da-Jeng Yao

Technical Introduction

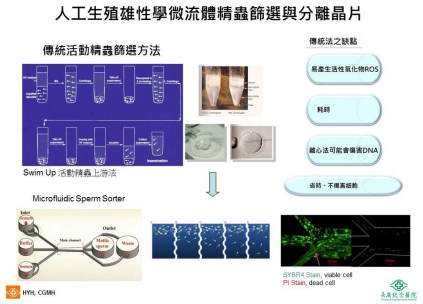
The microfluidic chips have been used to sort human motile sperms of oligospermia patients based on the phenomena of laminar flow. The sorted motile sperms recovered for the purpose of insemination in assisted reproduction.
The prototype of chips has been developed in the lab under National Tsing Hua University. Furthermore, the mass production has been conducted to accomplish the disposable chips.

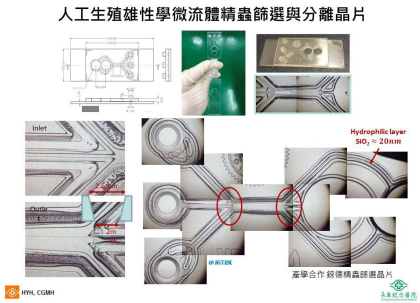
Scientific Breakthrough

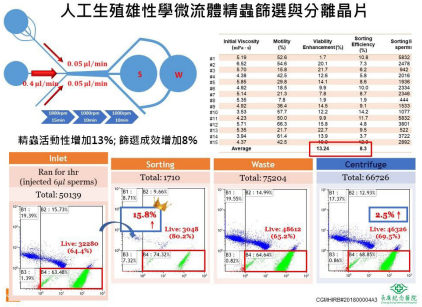
Chang Gung Memorial Hospital cooperates Tsinghua University to develop microfluidic sperm separation chip. It can screen sperm with good activity increased 13% and screening effectiveness increased by 8% after microfluidic sorting. This technology can simultaneously separate the motile sperm non-invasive conditions, which can expect to improve the fertilization rate and embryo implantation rate.

Industrial Application

The research developed a continuous microfluidic system on the biomedical chip to screen the motile sperm, to avoid the sperm damage caused by the sperm DNA fragmentation and the peroxide generation caused by the traditional centrifugal method. This technology can simultaneously separate non-centrifugal and non-invasive conditions motile sperm, which can improve the sperm fertilization rate and subsequent implantation.







Ambient Mass Spectrometry for Rapid Drugs and Toxin Identification

R&D UNIT **National Sun Yat-Sen University** / Jentaie Shiea

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 Application

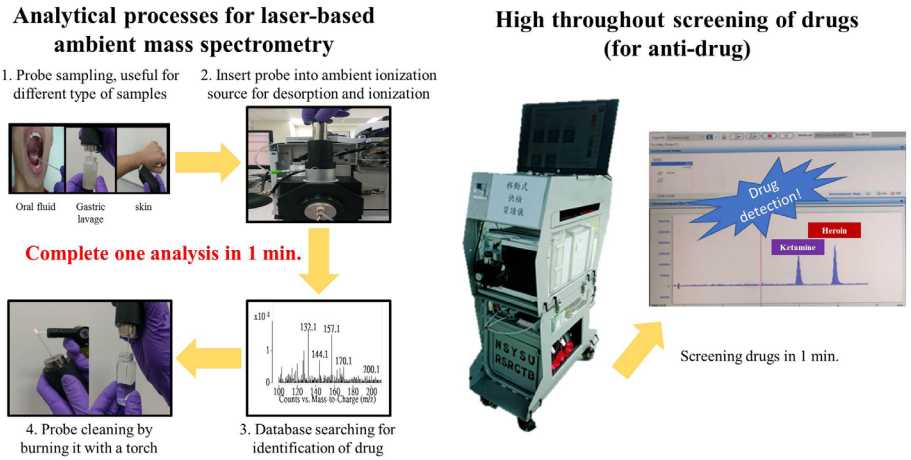
This screening platform of ambient mass spectrometry is capable of identifying rapidly chemicals that are incorporated in its comprehensive toxicant database library. Its application in clinical toxicology through a set of standard operating procedures allows emergency physicians to obtain correct information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

Anti-Drug, On-site Identification!

Complete hundreds drugs analysis in 1 min.

No sample pretreatment, Sensitivity is extremely high (ppb level).

Mobile ambient mass spectrometry for on-site analysis.



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IoT of Food Allergen Detection System

R&D UNIT **National Central University** / Chen-Han Huang; Hsing-Ying Lin; Wen-Hao Chen

Technical Introduction

We use an advance material as the core technique to integrate nanomaterials, biotechnology, IoT, and AI model into building up "IoT of Food Allergen Detection System." In addition to conducting highly extraction by nanoparticle, we restrain the non-specific binding of biological detection by the key material successfully and promote the accuracy and precision.

Scientific Breakthrough

Different from the traditional biochemical detection, we develop the new biological detection technique by the special material. By applying the special coated magnetic nanoparticle, it can conduct highly extraction for the biological sample and restrain the problem of non-specific binding of detection successfully. Therefore, compared with the traditional technique, our system owns higher sensitivity, accuracy and improves the traditional electrochemical algorithms to decrease the detection time substantially.

Industrial Application

This technique not only allows people who suffer from food allergy to enjoy safety diet, but also applying to other food safety detection such as environmental hormones, pesticides, food poisoning, and DNA detection for tracking the upstream of food resource to provide food industry and restaurant for monitoring, quality control, and building up food traceability records. In addition to this, it can be widely applied to the tracking of disease or the field of early cancer detection.

Thermoresponsive nanobrush surface enabling continuous harvest of stem cells

R&D UNIT **National Central University** / Chair Professor Akon Higuchi; Distinguished Professor Yuan Chang; Research assistant Hsing Fen Li and Post Doctoral Fellow Tzu-Cheng Sung

Technical Introduction

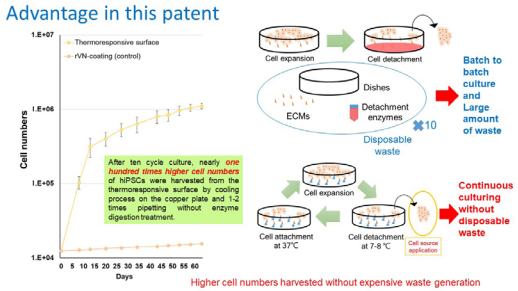
A stem cell continuous harvest method was proposed.
In this method, stem cells are partially detached. The remaining cells are continuously cultured by expansion in fresh culture medium.

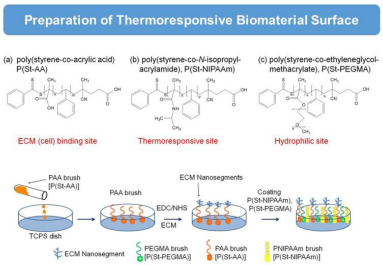
Scientific Breakthrough

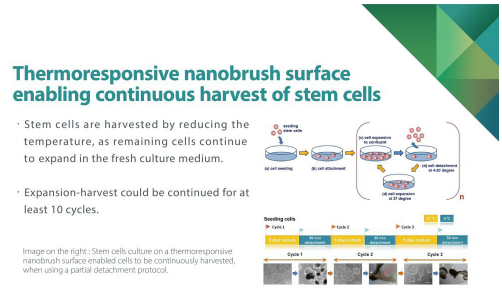
We develope thermoresponsive nanobrush that Human ES and iPS cells can be detached when decreasing temperature of culture medium. This partial detachment process of stem cells is used for a continuous stem cell harvest system. Stem cells can be continuously harvested in each replaced culture medium on the same dishes or microcarriers for many cycles due to the partial detachment of stem cells.

Industrial Application

We develop a prototype bioreactor system enables continuous harvesting of human ES and iPS cells via the partial detachment of stem cells cultured on nanosegment-immobilized biomaterials (dishes or microcarriers), broadening the number of individuals that can perform stem cell culture to hospital and cell bank, university, research institute, and industry settings.







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New Era of Personalized Medicine - the First Taiwanese Human Lung-on-a-chip System

R&D UNIT **National Chiao Tung University**

Prof. Guan-Yu, Chen; Jia-Wei, Yang; Sheng-Jen, Cheng; Shiue-Luen, Chen; Chong-You, Chen; Ko-Chih, Lin

Technical Introduction

Our team has developed technology to build lung-on-a-chip with the aim of creating alternatives for animal research and achieving more accurate and reliable preclinical experimental data.The chip's rapid and effective screening ability will help the clinical community to reduce costs and drastically shorten the drug-development process.

Scientific Breakthrough

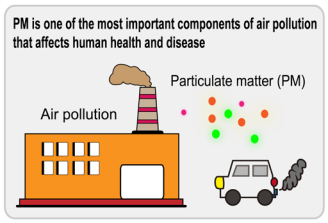
Scientific breakthroughs:

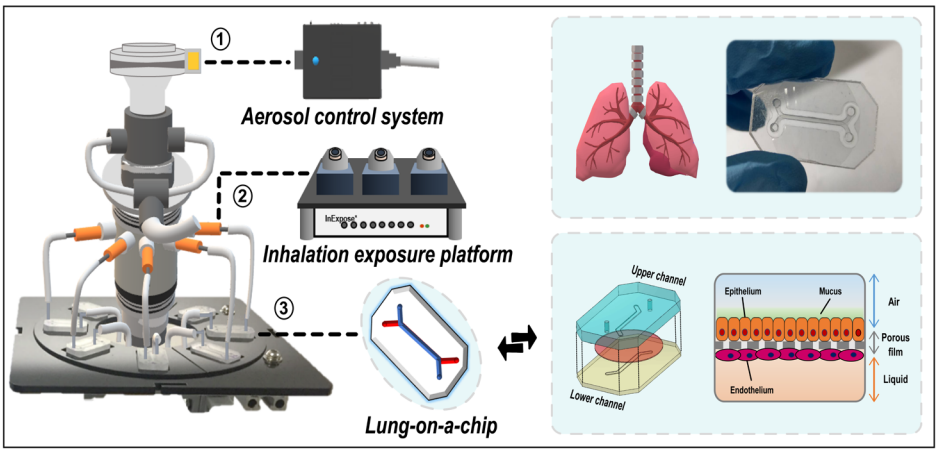
1. Individualized biomimetics
2. Health impacts of air pollution
3. Diversified and rich data
4. Simplification of technological requirement

Compared with organ-on-a-chip companies newly established in EU and America, our technology can better simulate the actual level of the tissues and organs, while also developing an even more innovative alveolar and gas exposure system.

Industrial Application

This technology is intended to be integrated with the local resources of Taiwan, encouraging related biochip/drug development/animal experiment industries. As new companies with only 1-2 core technologies may face severe domestic and foreign competition. Our platform promises to integrate and provide opportunities to transform and build upon existing strengths by collaborating in the development of biomimetic chips and precision medicine.





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

R&D UNIT **National Chiao Tung University**

Jin-Chern Chiou, Professor; Yu-Chieh Huang, Ph.D; Shun-Hsi Hsu, Ph.D; Kuan-Ting Yeh, Ph.D student

Technical Introduction

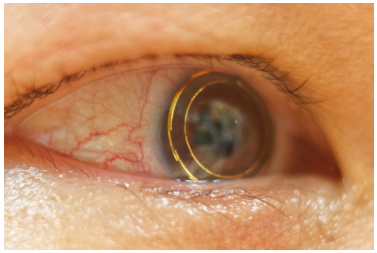
This project proposes a smart contact lens ideally capable of simultaneously observing the tear evaporation rate, the tear osmolarity, and the ocular surface temperature. To solve the shortcoming of the current difficulty in quantifying DES, assist doctors in the diagnosis of dry eye conditions, the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

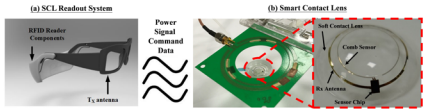
Scientific Breakthrough

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 Application

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.





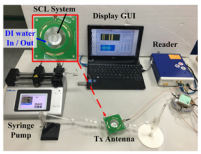
☐In order to consider the user's comfort and practicality, there will be two major design concepts, namely:

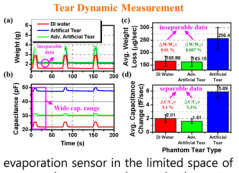
- **Smart Contact Lens, SCL :**

The sensing system will be embedded in the soft contact lens. The sensing system will include multiple sensing components, sensing chips and transmission antennas. The sensing system end will not set any energy storage components due to the size and geometry constraint of the contact lens, so the power supply of the sensing system will be converted from the received external RF power signals to achieve the purpose of sensing. This design provides a convenient measurement method that is not affected by behavior and actions.

- **Smart Contact lens Reader, SCL Reader :**

The external reading system is mainly used for signal reading and energy transmission. After the sensing system end sends the sensing signal, the smart contact lens reader will receive the signal and convert it into a signal that can be processed by the back-end circuit. The use of glasses as a readout system to reduce the wireless transmission distance can effectively reduce the transmit power required by the system, and can also effectively reduce the size of the transmission antenna.





We embedded capacitive tear evaporation sensor in the limited space of soft contact lens. When the tear evaporates, it causes a change in the water content in the contact lens. The change of dielectric coefficient of contact lens material induced by the change of water content causes a slight change in the capacitance value. Therefore, the tear evaporation can be estimated based on the result of the capacitance change situation. Figure shows the comparison between the measured results of different liquid evaporation (DI Water、Artificial Tears、Advanced Artificial Tears) and the actual liquid weight loss.

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Ultra-Efficient Microfluidic Sperm Sorter

R&D UNIT **National Chiao Tung University** / Chain-Shu Hsu; Bor-Ran Li; Chung-Hsien Huang

Technical Introduction

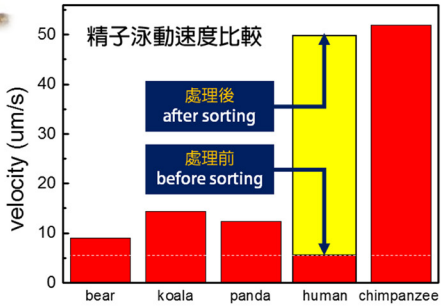
We developed a new type of microfluidic chip with utilizing the characteristic of sperm anadromous instinct for high-throughput sperm separation. The process can be finished in 10 min, which is 10 times faster than the conventional design. Experiment reveals that the qualified sperm motility was raised up from 30% to 99% and linearity (LIN) up from 0.2 to 0.85 via sorting by our microfluidic chip.

Scientific Breakthrough

We developed a new type of microfluidic chip with utilizing the characteristic of sperm anadromous instinct for high-throughput sperm separation. Experiment reveals that the qualified sperm motility was raised up from 30% to 99% and linearity (LIN) up from 0.2 to 0.85 via sorting by our microfluidic chip. In addition, the sorted sperms are typically without DNA fragmentation.

Industrial Application

We developed a new type of microfluidic chip with utilizing the characteristic of sperm anadromous instinct for high-throughput sperm separation. Experiment reveals that the qualified sperm motility was raised up from 30% to 99% and linearity (LIN) up from 0.2 to 0.85 via sorting by our microfluidic chip. In addition, the sorted sperms are typically without DNA fragmentation.



Flexible PPG sensor patch

R&D UNIT **National Chiao Tung University** / Dr. Paul C.-P. Chao

Technical Introduction

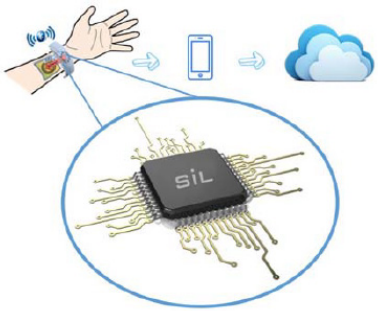
A flexible PPG sensor patch for measuring pulsations of blood vessels estimating ambulatory blood pressure monitoring (ABPM). The measured quality PPG signals are analyzed to estimate blood pressure (BP), heart rate (HR), blood oxygen (SpO2) and atrial fibrillation (A-Fib) and avoid motion artifacts. In this way, with subject's physiological condition apprehended accurately.

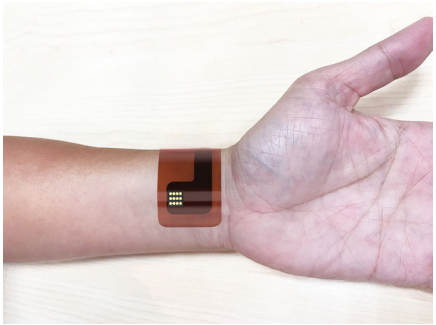
Scientific Breakthrough

The PPG sensing patches with arrayed sensor effectively overcome the inevitable problem of wearable devices what sensing quality is seriously subjected to the motion artifacts of the subject's wrist during motion and mi-positioning of the patch to the blood vessel. Therefore, the developed patch can measure the fore mentioned target bio-signs with much higher accuracy than commercial health bracelets.

Industrial Application

The technology aims to the development of a flexible PPG sensor patch for long term biosensor and transfer wireless data to health management system or cloud for biological analysis. The patch is portable and easy to combine with wearable device or healthcare system for various personal product integration.





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A legendary luminous nano-pearl

R&D UNIT **National Cheng Kung University**

Chen-Sheng Yeh(Distinguished Chair Professor); Prof. Chia-Hao Su; Liu-Chun Wang; Zheng-Zhe Chen

Technical Introduction

The legendary luminous nano-pearl, $ZnGa_2O_4:Cr^{3+}$(ZGC), material is viewed as a long-lasting luminescent phosphor which can avoid tissue autofluorescence interference for in vivo imaging detection. The well-defined concave cubic ZGC finding much stronger long-lasting luminescence in X-ray excitation uses a low dose of 0.5 Gy to provide deep seated tissue (liver) imaging with a continuous emission of 3 h in the hepatic tumor.

Scientific Breakthrough

The chromium-doped zinc gallate, $ZnGa_2O_4:Cr^{3+}$, material is viewed as a long-lasting luminescent phosphor which can avoid tissue autofluorescence interference for in vivo imaging detection. The cubic ZGC revealed a specific accumulation in liver and 0.5 Gy used at the end of X-ray excitation was sufficient for imaging of deep seated in clinical applications.

Industrial Application

The excellent long-lasting luminescence leads to significantly improve signal-to-noise in bioimaging. Using X-ray source has beyond the limitation of the penetration depth in tissue under in situ external excitation. These advantages let this nano-platform give the precision in diagnosis of diseases, e.g. malignant tumors, in the deep-seated organs in combination of optical navigation surgery.

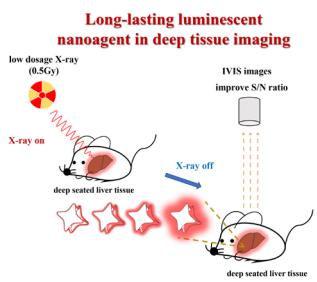


Figure 1. The longendary luminous nano-pearl, $ZnGa_2O_4:Cr^{3+}$ (ZGC), material is viewed as a long-lasting luminescent phosphor which can be excited by 0.5 Gy X-ray and avoid tissue autofluorescence interference for *in vivo* imaging at deep seated liver tissue.

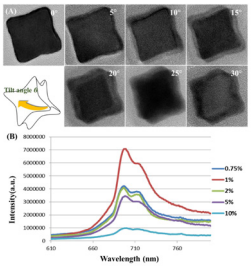


Figure 2. (A) Structural characterization of ZGC nanocubes which TEM images were captured by titling from 5° to 30°. (B) Luminescent spectra of ZGC nanocubes excited by 250 nm as a function of Cr dopant concentration.

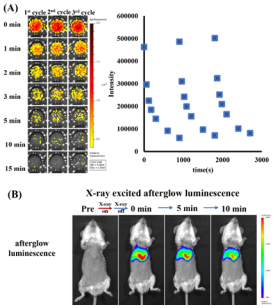


Figure 3.
(A) Long-lasting luminescence for hepatocellular carcinoma cells with PEGylated ZGC nanocubes following excitation using a clinical X-ray linear accelerator. Recharging decay curves of PEGylated ZGC nanocubes recorded following 0.5 Gy of X-ray irradiation, corresponding recharging decay images subjected to IVIS capture.
(B) In vivo bioluminescence of the respective intravenous injection of PEGylated ZGC nanocubes for the healthy mice following excitation using a clinical X-ray linear accelerator, there was no autofluorescence to interference the signal.

A therapeutic gel for diabetic wounds

R&D UNIT **National Cheng Kung University** / Lynn L.H. Huang

Technical Introduction

The therapeutic gel used for the treatment of diabetic wounds has the effect of promoting epidermis and dermis regeneration. The compositions of the gel can effectively prevent wound infection, promote cell migration and hyperplasia, and increase neovascularization, collagen production, and thus accelerate the process of wound healing with seamless.

Scientific Breakthrough

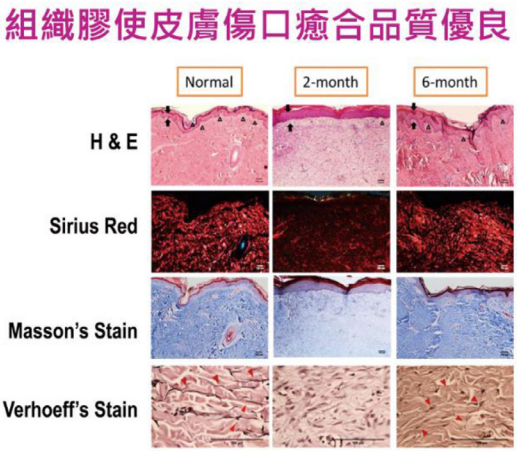
Diabetic wounds are not easy to heal and vulnerable to infection and other difficulties. Our diabetic wound gel does not have the shortcomings such as cancer crisis, and has obtained patents in Taiwan, the United States, Europe, et al. It is well formulated to promote tissue regeneration without cytotoxicity, can effectively stimulate local neovascularization, and thus accelerate wound healing.

Industrial Application

Such well-formulated therapeutic gel can first be applied for tissue regeneration of diabetic wounds. The product can also be applied for skin regeneration of all kinds of wounds including surgery wounds, burn wounds, ulcers, bedsores, etc. The composition can also be used as the core component of other medical products for various tissue regeneration.

A prototype of the therapeutic gel for diabetic wounds

The therapeutic gel can effectively accelerate the process of wound healing with seamless



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Rapid diagnostic device for monitoring the abnormal growth of the endometrial tissue

R&D UNIT **National Tsing Hua University** / Chao-Min Cheng; Ting-Chang Chang

Technical Introduction

This rapid diagnostic device for monitoring the abnormal growth of the endometrial tissue is expected to allow women to detect whether VEGF and IL-6 are too high at home in a simple and rapid manner. These two factors are also increasing in some gynecological cancers. Through the new device, it is convenient for women to self-monitoring women physiologically-relevant diseases or possible causes of abnormal bleeding in the future, and seek appropriate medical treatment early.

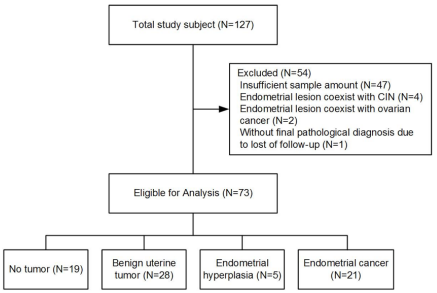
Scientific Breakthrough

There are no rapid screening products for VEGF and IL-6 applied to the abnormal bleeding test. The technology focus is to increase the device detection limit. The rapid diagnostic device for self-monitoring the abnormal growth of the endometrial tissue is to detect both IL-6 and VEGF in vaginal discharge, and will be the first medical product that can detect these two biomarkers at home.

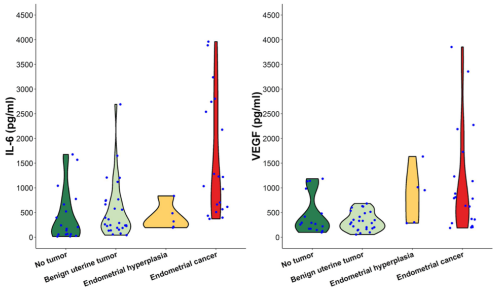
Industrial Application

In view of the fact that the endometrial cancer proportion in Taiwan has increased year by year, this rapid diagnostic device for self-monitoring the abnormal growth of the endometrial tissue can be used to clarify the high-risk group. It is also possible to provide a home screening IVD tool for women who are unable to seek medical care in time due to certain factors.

Clinical Study and Patient Case Analysis



IL-6 & VEGF as the potential rapid screening biomarkers



The method to test these two biomarkers (IL-6 and VEGF) is mainly based on the ELISA results of the previous clinical studies. We can classify the test subjects into no tumor, benign uterine tumor, endometrial hyperplasia and endometrial cancer. Based on the results, we could develop the rapid diagnostic device for monitoring the abnormal growth of the endometrial tissue, which is expected to allow the ladies to know whether VEGF or IL-6 is high at home in a simple and rapid manner.

國立清華大學 NATIONAL TSING HUA UNIVERSITY

Wireless Biomedical Theranostic System on a Chip

National Tsing Hua University

R&D UNIT All team members formed by the collaboration among H. Chen; Y.C. Chang; S.R. Yeh; C.C. Hsieh; K.T. Tang; P.H. Hsieh; Y.T. Liao; UMC Osbert Cheng; BPS P. Chang; CGMH M.Y. Cheng

Technical Introduction

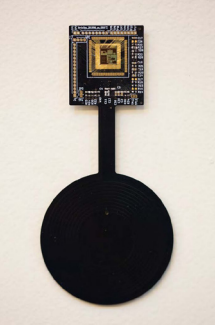
This project designs a biomedical theranostic chip for neural disorders. It can not only function as an implantable device for treating the Parkinson's disease, depression, dementia, but also monitor physiological signals in wearable devices. For the development of medical device, the NeuLive system 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 Application

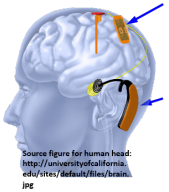
The proposed microchip can underpin the bio-electronic medicine for treating neural diseases, or monitor physiological signals in wearable device, or facilitates the design of wireless, miniaturized instrument for brain research with small animals.



■ 本案創新： **Personalized DBS**

植入式生物晶片Biochip
- Real-time recording
- Closed-loop
- Personalized stimulation
- Miniature
- Battery free

External Controller/Battery
- Wireless
- AI-monitoring
- External
- Easy to replace battery



Brand	NTHU	Medtronic	Boston Scientifc	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
Price (USD)	**$10 K**	$13 K	$13 K(est.)	$13 K (est.)

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Microfluidic Sensing System for On-Site Rapid Detection of Acute Kidney Injury Biomarker

R&D UNIT **National Tsing Hua University, Chang Gung Memorial Hospital** / Chien-Chong Hong; Tong-Miin Liu; Yong-Chang Chen; Chung-Hang Wong; Chian-Lang Hong; Chih-Chung Lin; Yun-Ching Huang

Technical Introduction

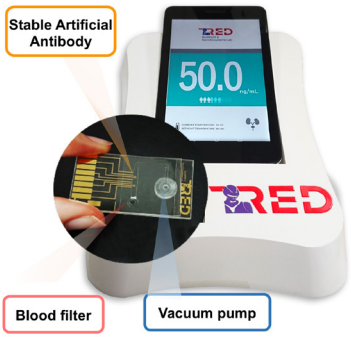
This product provides Microfluidic sensing system for on-site rapid detection of early-stage acute kidney injury for the hospital's intensive care unit, operating room, nephrology department and cardiology department. It can replace the lengthy and cumbersome traditional instrumentation and easily access at the point of care.

Scientific Breakthrough

The technology combines a disposable blood filter sensing chip, a molecular imprinting technology (bionic plastic antibody), a vacuum module, and a microbead blood cell filtering device. This technique allows clinicians to early diagnose acute kidney injury. Compared with the current ELISA method, the accuracy is similar, and it is faster and cheaper.

Industrial Application

This portable and disposable integrated chip takes only a drop of finger-tip blood and 10 minutes to quickly, easily and accurately detect early kidney damage. Therefore, this technique enables clinicians to diagnose golden 48 hours for salvage kidney and avoid life-long dialysis and multiorgan failure.



	Our product	Competitor
LOD	10 ppb	10 ppb
Detection Range	10-3000 ppb	10-1500 ppb
Precision (CV)	3%	3.3%
Detection Time	10 minutes	hours ~ days

Detection Time : 10 min
Detection Range : 10-3000 ppb
Sensitivity: ~86%
Specificity: ~84%
Vacuum pump CV: 3%
Blood filter <90 sec, purity 100%

15 invention patents were certified
(include US, Japan, EU and Taiwan)

A Manual Centrifuge and Paper Devices for Point-of-Care Diagnosis

R&D UNIT **National Taiwan University**
Prof. Chien-Fu Chen;Dr. Chung-An Chen;Shi-Jia Chen; Chao-Hsuan Liu

Technical Introduction

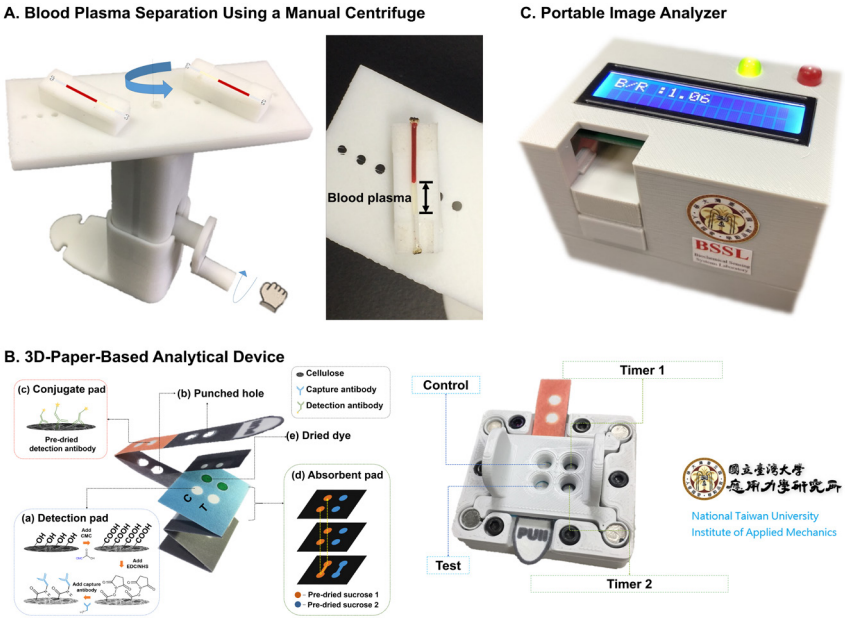
Here, we introduce an electricity-free centrifuge platform based on a manual centrifuge. The provided centrifugal force is sufficient to produce a plasma purity of 99% separated in as little as 2-3 min.
We then performed an immunoassay on a paper device and the results were observed by a portable reader. As a result, the detection limit of the C-Reactive Protein is 1 ng/mL, with a total turnaround time of 7 min.

Scientific Breakthrough

Here, we introduce an easy and electricity-free centrifuge platform based on a manual centrifuge. The provided centrifugal force is sufficient to produce a plasma purity of 99% separated in 2-3 min.
The plasma can then be tested and analyzed using a paper device and a portable reader at the point of need.

Industrial Application

We expected these techniques can be widely used for the applications of personalized medicine and precision medicine.



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A novel blood based multi-biomarker modeling for predicting neurodegenerative disorders by machine learning

R&D UNIT **National Taiwan University**

Professor Ming-Jang Chiu; Professor Jyh-Shing Roger Jang; Shu-I Chiu; Dr. Chin-Hsien Lin

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 dectection 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 Application

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. Alzhimer's disease (AD)與Parkinson's disease (PD)的臨床病程變化與病理蛋白沉積

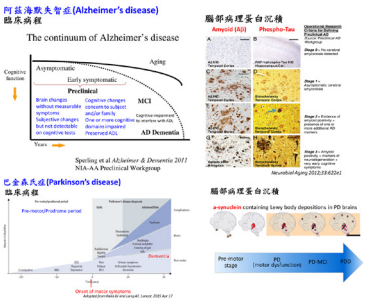


Figure 2. 不同疾病族群病患血液中各生物標記之濃度比較

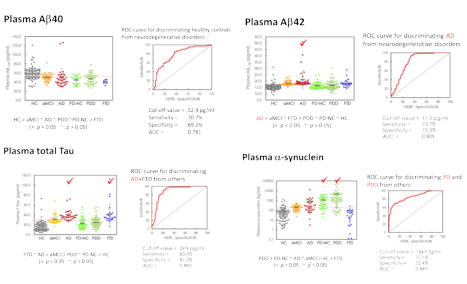
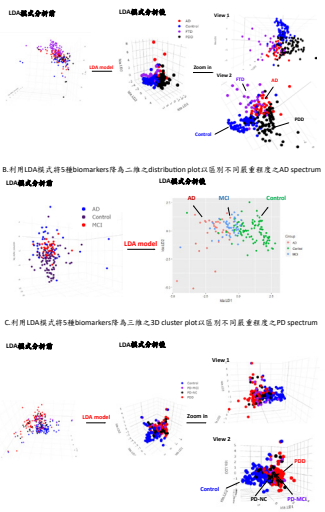


Figure 3. 以 Linear Discriminant Analysis (LDA)模型演算整合多向度血液生物標記資訊以辨識不同的神經退化性疾病

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Thermoelectric Ever-Charge Portable Charger

R&D UNIT **Academia Sinica** / Yang-Yuan Chen Cheng-Lung Chen

Technical Introduction

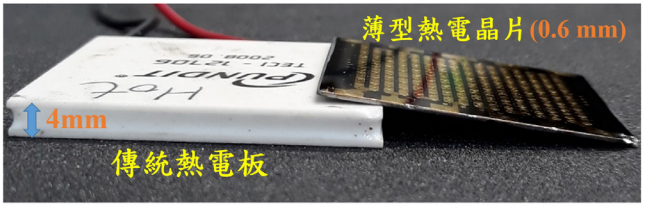
This technology develop a "Thermoelectric Ever-Charge Portable Charger" for the applications in auxiliary charging of consumer electronics and fast self-charging for outdoor sensors. Technically, a sputtering deposition and a semiconductor photolithography technique are combined to fabricate p-n materials and connection procedures. The thermoelectric performance of the device is further optimized through a low-temperature heat treatment.

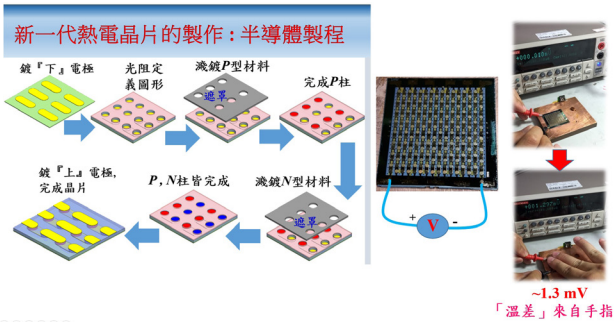
Scientific Breakthrough

Technically, the uniform and large-area Bi2Te3 films can be grown on the substrate by a sputtering method. The outstanding performance of films not only overcomes the shortcoming of bulks, but also rivals to the best record in Nature. We have also integrated the semiconductor process and metal masks to improve the production yield. The proof-of-concept devices are available for 128 and 442 pairs.

Industrial Application

Recently, thermoelectric power generation by waste heat has created lots of valuable applications and economic benefits. In the future, a "Thermoelectric Ever-Charge Portable Charger" will play an important role in converting thermal energy to electricity via energy harvesting for wearable electronic products, biomedical industry, and AIoT and 5G industries to meet their power requirements.





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Smart glove with soft force sensors for virtual reality somatosensory equipment training

National Sun Yat-sen University

R&D UNIT Cheng-Tang Pan; Da-Huei Lee; Jih-Ching Chiu; Chung-Kun Yen; Shao-Yu Wang; Pei-Yuan Sun; Hao-Jan Li; Yong-Syuan Dai; Chia-Chun Chen; Chia-Huang Lin; Chou-Chuan Kuo; Wen Huang

Technical Introduction

The smart glove was made by soft force sensor with the multi-walled carbon nanotube cast in the mesh structure and combined with an interdigitated electrode together, then used AC/DC conversion and space calculation to establish the interactive virtual reality(VR) somatosensory system under the wireless. The recipient can achieve the same feedback as the demonstrator's behavior and skills in VR.

Scientific Breakthrough

The virtual reality (VR) training system is a multi-walled carbon nanotube (MWCNT) cast in a mesh structure and combined with the interdigitated electrode together to produce the soft piezoresistive sensor which is generated the difference of resistance by intertwined MWCNT. The sensor was embedded in the glove to wireless transmit hand power and posture to the VR to achieve the demonstrator.

Industrial Application

The smart glove in the virtual reality(VR) training system with an innovative sensor is low-cost, flexibility and high sensitivity. The wireless transmission was integrated VR and force feedback to let the trainees get the data of the demonstrators to improve the effectiveness of the training and providing an innovative development direction for the domestic education and training industry.

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

R&D UNIT **National Chung Cheng University** / Ching-Yuan Lin(Chief Executive Officer;CEO); De-Shin Liu(Professor chairman of AIM-HI); Zhang-Hua Fong(Professor president of CCU)

Technical Introduction

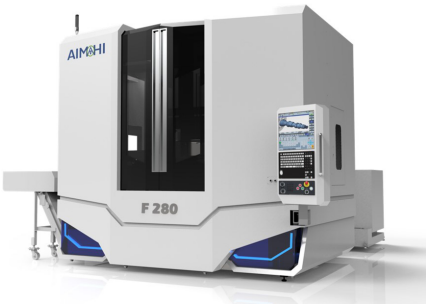
The special gear processing software was developed to calculate the cutting path. The CNC gear generator with high flexibility was utilized to process all kinds of special gear teeth and dress the gear precision by control feedback and compensation. Conversational human-machine interface has contributed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

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.



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

R&D UNIT National Chung Hsing University / Ying-Chih Lai; Yung-Chi Hsiao; Hsing-Mei Wu

Technical Introduction

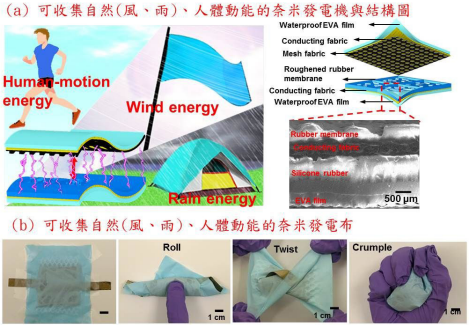
The first waterproof fabric-based multifunctional triboelectric nanogenerator that can produce electricity from natural tiny impacts (rains and winds) and body movements is presented. It can not only serve as a flexible, adaptive, wearable, and universal energy collector but also act as a self-powered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

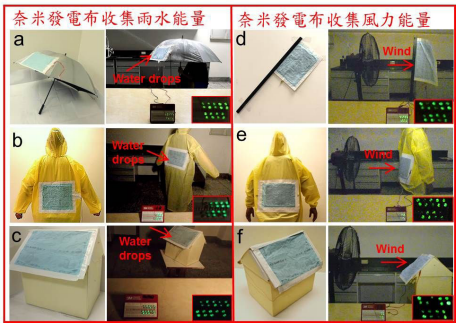
Scientific Breakthrough

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 Application

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.





Ultrasonic toolholder module

R&D UNIT National Chung Hsing University
Professor Michael Chen; Tony Wang

Technical Introduction

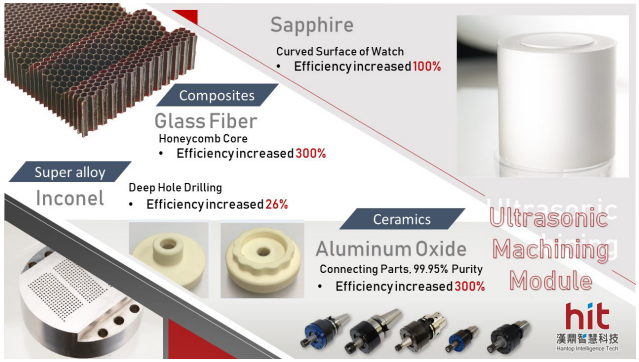
The ULTRASONIC technology and the Non-contact power transmission technology offers high quality and efficient machining for ceramic and other brittle materials. Depending on the workpiece requirements, our product allows higher feed and infeed, which increases machining efficiency for at least 30%, longer 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 vibration assisted machining leads to a reduction of the cutting forces by up to 40 %.

Industrial Application

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.



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Residual-glue-free biomimetic dry adhesives

R&D UNIT National University of Kaohsiung
Yi-Chang Chung; R & D team members from Research Center of Biomimetics and Medicare Technology

Technical Introduction

Biomimetic adhesive has some characteristics: no residual glue, anisotropic adhesion, easy to be peeled and stuck and repeated. Its adhesion could be adjusted depend on the application. The adhesive can be applied but not limited in wafer processing, movement of optoelectronic materials, 3C product assembly, daily-used fixation, and producing a protective film for attaching to an object surface.

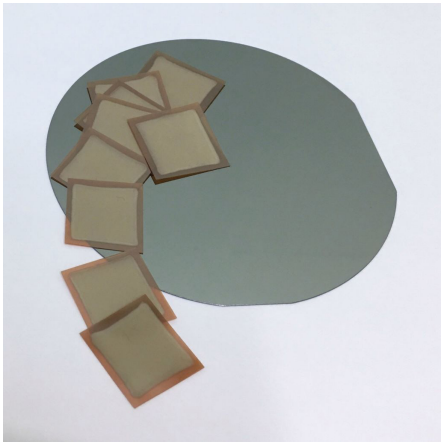
Scientific Breakthrough

Based on the subsidized project from the MOST of Taiwan, we employ some simulation techniques to find the design rules of adhesive materials. Furthermore, text mining is applied to summarize biomimetic adhesive information in publications to establish the related trend and goal, giving us a direction to confront special adhesion property under manufacturable consideration.

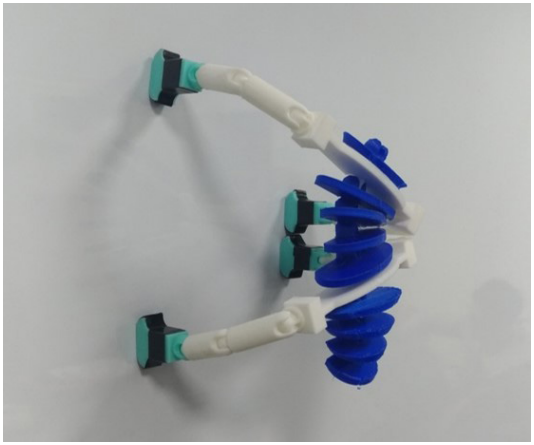
Industrial Application

The dry adhesive can be applied but not limited in wafer processing, movement of optoelectronic materials, 3C product assembly, daily-used fixation, and producing a protective film for attaching to an object surface, including optical glass, LCD panels, solar cells, semiconductor elements (for chips and packages), silicon wafers, metals, and so on.

Residual-glue-free adhesives designed to fix heavy weights of objects (e.g. cart)



High-temperature-durable adhesives with no residue left after peeling (for fixing, protection and transportation in hot process)



Residual-glue-free adhesives for climbing robot's movement

Materials Design Platform of Bio-inspired Lightweight Structures by Integrating Artificial Intelligence and Materials Genome Initiative

R&D UNIT National Tsing Hua University, National Taiwan University
Po-Yu Chen; Chuin-Shan Chen; Shu-Wei Chang; Shou-Yi Chang

Technical Introduction

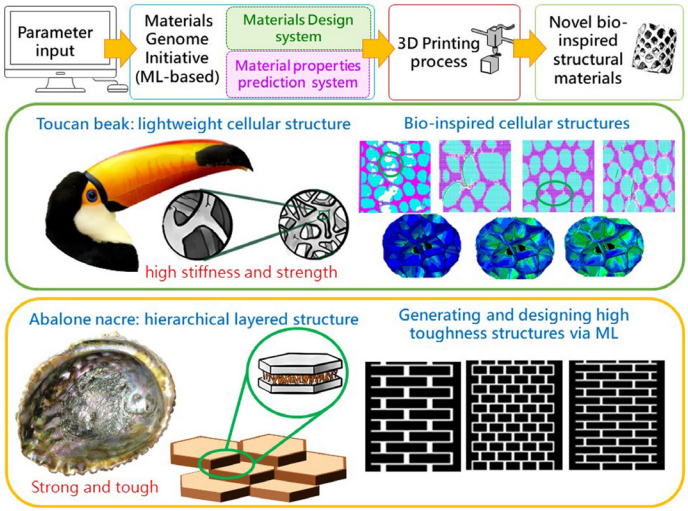
Through the study of structural biological material and the multiscale analysis and simulation, we construct an initiative integrated platform, which provides user-friendly experience, automatically generates designs of lightweight structure for the demands and offers various choices of materials or suggestions. This design platform contains great potential for engineering applications.

Scientific Breakthrough

"Biological materials", "Bio-inspired materials", "Multi-scale modeling", "Materials genome initiative platform", "data science and artificial intelligence" are integrated in this study for the first time, which make great breakthrough and impact on the design of bioinspired, lightweight structural materials and enlighten interdisciplinary research of science and engineering.

Industrial Application

Novel bio-inspired materials prediction and design systems can enhance the development of structural materials with superior mechanical performance and can be widely applied in the fields of aerospace, automobile, bicycle, intelligent mechanics, biomaterials and assistive devices.



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Technology of anthropomorphic robotic arm and intelligent grasping

R&D UNIT **National Tsing Hua University** / Distinguished Professor Jen-Yuan Chang's Group

Technical Introduction

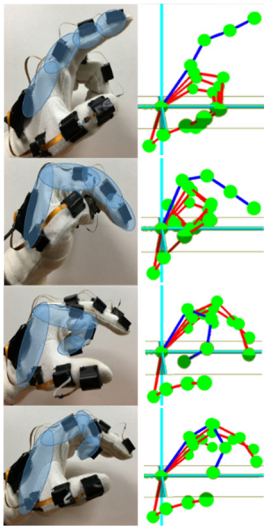
Through patented wearable sensor fusion technology, human 3D motions can be captured in real-time which allow 7-DOF robotic arm and dexterous robotic hand to perform anthropomorphic motion and grasping action. Integrated with eye-in-hand visual module, the adaptive gripper can intelligently decide optimal grasping strategy to ensure success grasping of arbitrary shape of objects in smart manufacturing applications.

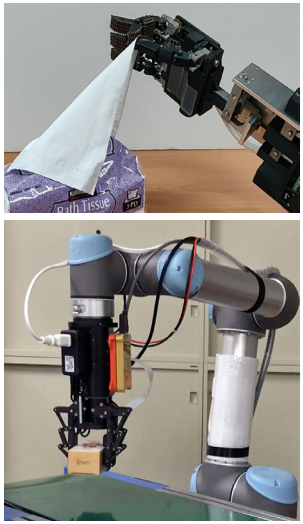
Scientific Breakthrough

1. Sensor fusion technology allows real-time capturing of human 3D motion.
2. Humanoid mechanical design with biomechanics allows mimicking human motion and anthropomorphic grasping by the bionic arm/hand.
3. Adaptive gripper design allows performing different grasping actions without change of adaptor.
4. Embedded vision module allows smart identification of shape and position of random objects for best grasping.

Industrial Application

1. Sensor fusion technology allows recording human motion, which can be implemented in manufacturing, sport, medical, and cultural fields.
2. The robotic arm/hand can be controlled to conduct anthropomorphic action, especially in hazardous environments where safety and manpower shortages are of concern.
3. The eye-in-hand adaptive gripper can identify object's shape and determine the best strategy for quick and accuracy grasping in manufacturing.





Beryllium-free multi-element copper alloy

R&D UNIT National Tsing Hua University
Che-Wei Tsai assistant professor and Jien-Wei Yeh distinguished professor

Technical Introduction

For the working places where have the risk of burning and explosion, non-sparking tools are important safety tools. They are made of hardest Cu-Be alloys. However, Be is very expensive and poisonous. To overcome this, we develop Be-free copper alloys which have high hardness for tools. In Taiwan, we have steel-tools industry. To have higher profit, it is promising to produce such Be-free non-sparking tools.

Scientific Breakthrough

Beryllium copper is unique in their highest strength and hardness. The alloy has been used as non-sparking tools for a long time. Although beryllium is poisonous and expensive, no suitable Cu alloys were developed for replacing them. Now, we have used the high-entropy alloy concept to develop beryllium-free medium entropy alloys which are cheap, hard and no sparking. We have got the patent from Taiwan.

Industrial Application

For the working places where have the risk of burning and explosion, such as mining tunnels, oil or gas tanks, powder production and explosive production, non-sparking tools are important safety tools. In Taiwan, we have steel-tools industry. To have higher profit, it is promising to produce such Be-free non-sparking tools.

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Preparation of biomimetic omniphobic porous membrane for application in membrane contactor

R&D UNIT National Taiwan University

Kuo-Lun Tung; Liang-Hsun Chen; Allen Huang; Yi-Rui Chen; Chien-Hua Chen; Chia-Chieh Ko

Technical Introduction

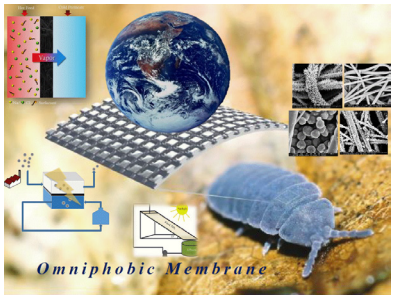
Inspired by the surface of the insect skin, a special nanostructure was grown on the membrane surface that is the key for omniphobic membrane which is able to treat low surface energy wastewater. The technique of omniphobic membrane combined with membrane contactors has the opportunity to become a trend in the future for water resources, carbon capture, valuable minerals recovery and high-purity drug crystallization.

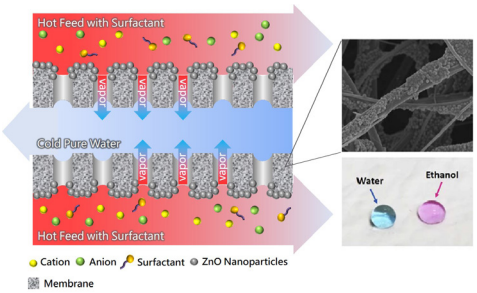
Scientific Breakthrough

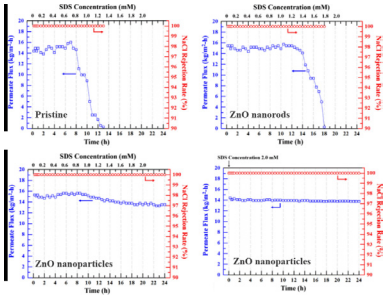
The omniphobic membranes fabricated via a facile approach (Chemical Bath Deposition, CBD) were presented. For DMCD, the membranes had the best ability to enhance wetting resistance, and the permeate water flux was maintained for 24 h using a 2.0 mM SDS solution as an initial feed. The re-entrant structures created by the nanoparticles enabled a non-wetting Cassie-Baxter state even for the feed with a very low surface tension.

Industrial Application

The successful development of omniphobic membranes will be possible to become a new bright for water resources, carbon capture, minerals recovery and high-purity drug crystallization. Furthermore, this will enable Taiwan to keep the key materials as well as process techniques and lay the foundation for the crucial technology to take root in Taiwan.





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Probabilistic Seismic Hazard Analysis (PSHA)、Epidemic-Type Aftershock Sequence (ETAS)

R&D UNIT

National Central University, Earthquake-Disaster & Risk Evaluation and Management Center (E-DREaM)

Kuo-Fong Ma (Director); Chung-Han Chan (Research Associate); Yu-Ju Wang (Research Associate); Ming-Che Hsieh (Associate Fellow); Yin-Tung Yen (Research Fellow); Yi-Wun Liao (Reseaerch Assistant)

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

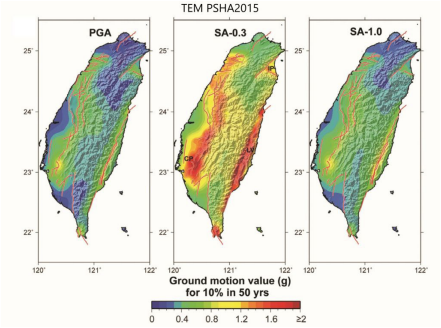
PSHA-2019 implementing a time-dependent factor through Brownian Passage Time model. Including possibility of earthquake on multiple-structure. The first seismic hazard map incorporating site condition in Taiwan.

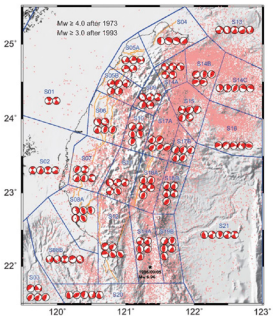
The ETAS model could be used to develop a real-time aftershock forecasting system and offer the possible effect of the aftershocks within 24 hours after the main shock.

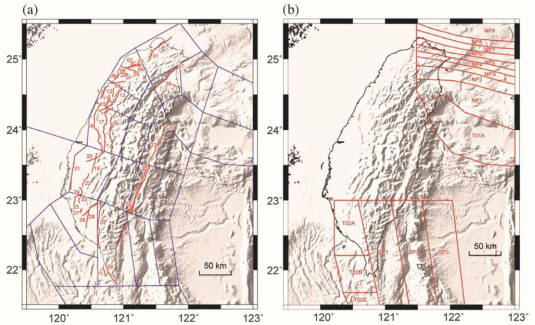
Industrial Application

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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Application of hybrid earthquake early warning system

R&D UNIT **National Center for Research on Earthquake Engineering**
Pei-yang Lin Research Fellow; Hung-Wei Chiang Assistant Researcher

Technical Introduction

NCREE combined on-site and regional EEW to provide the hybrid EEW for the industries. As results, the fast and accurate earthquake warning message can be provided to the industry with low cost (No cost for the EEW hardware, only the receiver and disaster reduction system). Industry can combine the Hybrid EEW with their existing service and provide one more disaster service to their customer.

Scientific Breakthrough

Detect the minor P-wave and predict PGA in 1~3s. The predict accuracy is up to 95%
It can provide 5~15s of warning time for the region with 30~100km epicenter distance.
No false alarm through the multiple backup sensor arrangement.
Reduce seismic loss by automatically disaster-reduction control (gas valve, door luck, train brake, excavation guild light, warning sound, elevator stop)

Industrial Application

Security industry: EEW warning, disaster reduction control, to reduce the seismic loss of the customers.
Smart home devices: EEW warning, disaster reduction control with the existing IOT devices.
Insurance: provide EEW, disaster prevention services to customers to reduce the seismic loss.
Telecommunications: provide EEW and extra disaster prevention services through the existing channel.

Broadband Ocean Bottom Seismometer (BBOBS)

R&D UNIT

Taiwan Ocean Research Institute, National Applied Research Laboratories
Institute of Earth Sciences, Academia Sinica
Institute of Undersea Technology, National Sun Yat-Sen University

Chau-Chang Wang; Ban-Yuan Kuo; Ching-Ren Lin; Po-Chi Chen; Jia-Pu Jang; Hsu-Kuang Chang; Hsin-Hung Chen; Fang-Cheng Li; Yu-Lin Sung

Technical Introduction

The Broadband Ocean Bottom Seismometer (BBOBS) is a marine instrument that collects natural earthquakes or artificial sound sources. BBOBS project has been leading by TORI, Academic Sinica, and National Sun Yat-Sen University from designing, testing to success. BBOBS have been deployed and recovered in several research cruises and obtained the great results. Features:

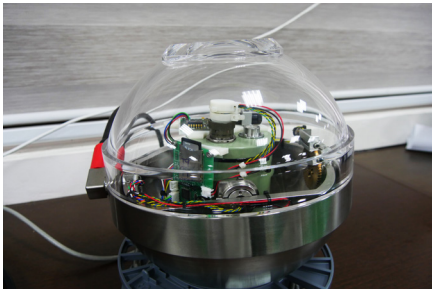
1. Application of a high reduction gearbox to design leveling device, with full 360° restoring leveling device, and 0.1° accuracy, will auto level from all possible orientations.
2. It is exceedingly light and portable with an ultralow power consumption for long term monitor seismic activities.
3. A full titanium sphere pressure housing ensures exceptional ruggedness and resistance, up to 6,000m depth.
4. Broadband refers to low frequency oscillation signals that can measure up to 120 seconds (1/120 Hz).

Scientific Breakthrough

Application of a high reduction gearbox to design leveling device, with full 360 degrees restoring and 0.1 degree accuracy, will auto-leveling from all possible orientations.

Industrial Application

The technology can be used in academic research to increases the observation area on the sea, and also used in marine resource exploration. The application targets research institutes and the marine energy industry.



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GIS Based 3D Flooding War Game Assistance Platform

R&D UNIT National Science and Technology Center for Disaster Reduction

Technical Introduction

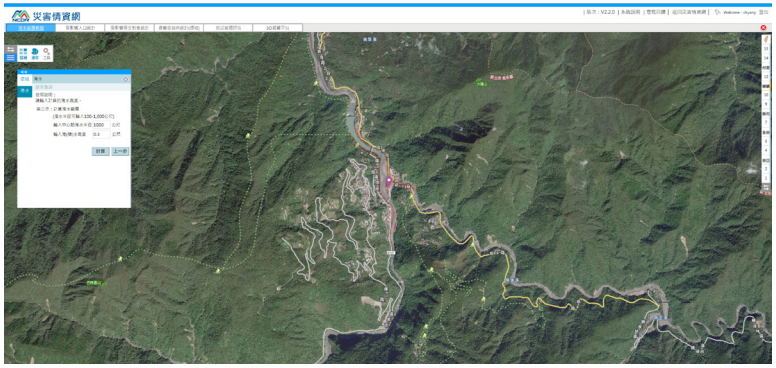
Flooding War Game Assistance Platform (FWGAP) is operated based on Disaster Response Decision Support System (DRDSS). DRDSS has been widely used at Central Emergency Operation Center (CEOC) over the years, it can overlay maps to provide imagines for decision makers and integrate spatial analysis tools to quickly identify emergency situation so that suitable countermeasures can be implemented during emergency operation.

Scientific Breakthrough

3D display technology can be applied to emergency operations, and improve decision accuracy for commanders. The flood-affected areas can be used as a base point for spatial analysis to identify near-by shelters, disaster relief resources, affected population, hospitals, elderly care centers, etc. It can also use 3D buildings and street view to provide emergency response personnel immersive experiences from virtual reality technology.

Industrial Application

The functional design of FWGAP in this study emphasizes simplification steps. The user completes the setting of flood location and flood depth. The system can automatically calculate the flooded area, the affected population, and the number of vulnerable people. When evacuating from affected area to designated evacuation shelters, how many evacuation shelters are nearby and how many people can be accommodated in the shelters are calculated for the users to identify actual situation. It will help decision maker to determine whether there are too many people in a certain shelter and if it requires to make a dispersion during emergency operation.



An Early Warning System for Flash Floods in Mountainous Areas

R&D UNIT **National Science and Technology Center for Disaster Reduction**

Technical Introduction

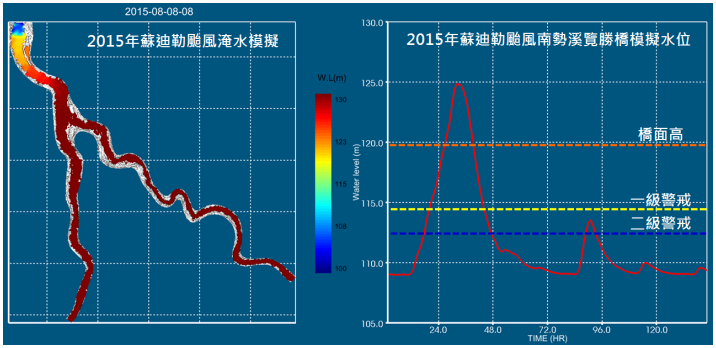
This study developed an operational forecasting system (OFS) through the integration of meteorological, hydrological and hydrodynamic models. Airborne light detection and ranging (LiDAR) data were used to generate a digital elevation model (DEM). The OFS employs high-density and high-accuracy airborne LiDAR DEM data to simulate rapid water level rises and flooding as a result of intense rainfall within relatively small watersheds. The water levels and flood extent derived from the OFS are in line with the measured and surveyed data. The OFS has been adopted by the National Science and Technology Center for Disaster Reduction (NCDR) for forecasting flash floods every six hours in a mountainous floodplain in Taiwan. The 1D and 2D visualization of the OFS is performed via the National Center for Atmospheric Research Command Language (NCL).

Scientific Breakthrough

The aim of the present study is to develop an operational forecasting system for flash floods in mountainous areas in Taiwan by integrating numerical meteorological, hydrological and hydrodynamic models and a visualization computer program.

Industrial Application

The technology can be widely used for dangerous waters in mountainous areas, and can provide suggestions related to mountainous tourism industry (such as hot springs and rafting). The technology can also be transferred to the industry of disaster prevention.



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Smart Evacuation Supporting System

R&D UNIT National Science and Technology Center for Disaster Reduction

Technical Introduction

Smart evacuation supporting system combines a series of disaster scenarios with data of shelters to facilitate evacuation operation. The tool applies integrated real-time data and algorithm analysis to produce automatic route planning and shelter suggestions for individuals during emergencies. The system can also provide real-time evacuation information through NCDR official LINE account platform to the public.

Scientific Breakthrough

The project applies integrated real-time data and algorithm analysis for automatic route planning and resources allocation during disaster response period.

Industrial Application

This tool can be provided to companies or agencies in the field of social media to develop other types of platforms which can help the public or the local governments for situation assessment of evacuation and shelters.


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Development of fruit tree industry monitoring technology based on multi-source image recognition technology

R&D UNIT **Taiwan Agricultural Research Institute Council of Agriculture, Executive Yuan** / Horng-Yuh Guo; Shu-Pei Chen; Yu-Wen Lin; Cheng-Ying Chou; Chi-Kuei Wang; Tsang-Sen Liu; Wei-Shen Lo; Po-Ting Liu; Yu-Fang Hsieh; Chung-Cheng Lee

Technical Introduction

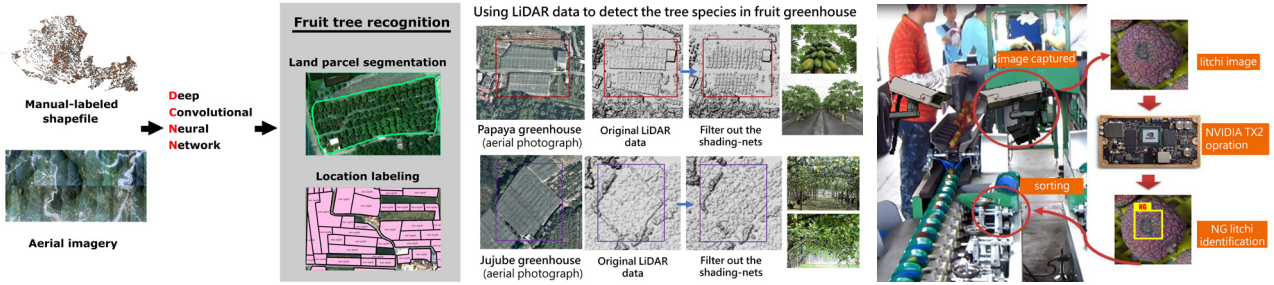
Integrating deep learning, 3D information analysis, hyperspectral analysis, computer vision analysis and the multi-source images to develop fruit quality monitoring techniques, including planting area monitoring, position monitoring, yield monitoring, harvesting time prediction, fruit maturity measurement, fruit quality testing, to achieve the goal of enhancing industrial value.

Scientific Breakthrough

Identification system applied to fruit trees classification can reach mean average precision of 0.85. Airborne LiDAR can penetrate the screen-house to obtain the fruit trees information inside.
Monitoring the production season and release yield prediction monthly.
Automatic fruit selection reduces human's screening, and hyperspectral technology is applied to measure fruit maturity.

Industrial Application

Agriculture and Food Agency: Interpret fruit trees and calculate area.
BAPHIQ: Apply height data for *Tessaratoma papillosa(Drury)*.
Agribusiness: Farm monitoring.
Council of Agriculture: Keep yield and price in balance by yield prediction.
Industry: We cooperated with Farmer's Association and two companies for automatic fruit selection and automatic interpretation of fruit maturity.



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The Application of Intelligent Agricultural Control System on Orchard

R&D UNIT

Tainan District Agricultural Research and Extension Station, Council Of Agriculture, Executive Yuan R.O.C. / Jung-Jui Cheng Director; Wei-Hsiang Lai Professor; Yueh-Min Huang Chair Professor; Ching-Ju Chen Project Assistant Professor; Ying-Cheng Chen Research Assistant; Tzu-Min Huang Research Assistant

Technical Introduction

This project integrated with industrial foresight technologies, including UAV, artificial intelligence and image recognition, to collect real-time images, apply algorithm in evaluation, link the technology of IOT (Internet of Things) and environment sensing, and use unmanned vehicle to conduct controlling work.

Scientific Breakthrough

The project develops intelligent agriculture system for slope orchard. From the ecology survey of litchi stink bugs, this project develops several pesticides for the prevention of litchi stink bug. This project also uses thermal image and route planning technology, to enhance the efficiency of using UAV. In the future, this project will consolidate aerial photography and 3D route planning to apply on slope areas.

Industrial Application

This project considers that currently labor shortage is the main difficulty. Also, the professional evaluation for pesticides is a problem. This project selects effective pesticides for farmers to reach to the goal of using pesticides concisely. This project concludes that developing UAV specifically focuses on slope area, plus spray pesticides via propeller, the efficiency of spray and distribution can be enhanced.

Analysis of Virual Capsid Structure of White Tail Disease for Shrimps

R&D UNIT **National Synchrotron Radiation Research Center**

Chun-Jung Chen Deputy Director; Nai-Chi Chen PostDoc; Yen-Chieh Huang Research Assistant

Technical Introduction

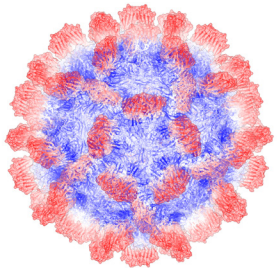
With the use of *E. coli* expression system, capsid protein assembly in vitro, X-ray protein crystallography and cryo-electron microscope, the T=3 capsid structure of white tail disease viruses for shrimps has been solved successfully, such that an entire model for viral capsid structure could provide a mechanism for viral capsid assembly and infection.

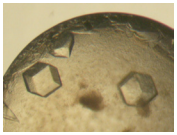
Scientific Breakthrough

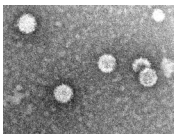
With the most advanced cryo-EM instrument, together with TLS, TPS of National Synchrotron Radiation Research Center and SPring-8 in Japan, T=3 shrimp nodavirus capsid structure with atomic resolution has been solved and its specific functions has been further investigated. Therefore, an entire model of viral capsid structure could provide a mechanism for viral capsid assembly and infection.

Industrial Application

The structural information for antiviral vaccine development will be obtained for the improvement of capacity and quality of shrimp products for the competitive advantage in the market. Moreover, with the different lengths of truncated protein and functional regions, a antigen-carrying platform can be developed through its ability of the viral capsid assembly to improve the immune response.







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Switch on a coming era to preservation of agricultural produce

R&D UNIT **Food Industry Research and Development Institute, Taiwan Banana Research Institute / Kaohsiung District Agricultural Research and Extension Station, Council of Agriculture, Executive Yuan**

Jinn-Tsyy Lai; Chiao-Ying Huang; Chia-Chen Hsu; Yu-Bin Chang; Chung-I Lin; Te-Sheng Lin; Yi-Jeng Chen; Min-Nan Tseng; Tai-Yuan Chen

Technical Introduction

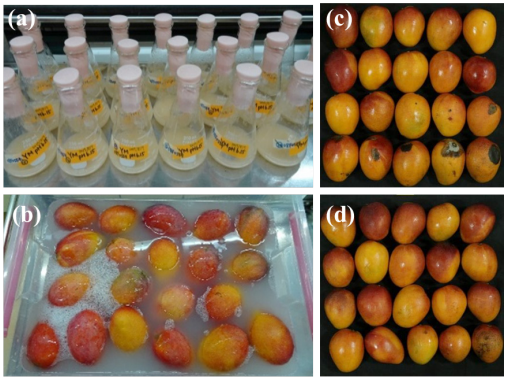
To develop a potential preservative from microorganisms, *Aureobasidium* was the positive candidates. In a laboratory scale, we introduced the *Aureobasidium* broth into a practical delivery chain to simulate the commercial process. For disease severity and banana degreening, the results indicated we 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* exhibited over 50% inhibition to the Anthracnose. For mango, the corresponding disease severity was lowered by 52% with the cell broths. The control rate of peel disease and crown disease of treated banana were 90% and 39%. Therefore, it is rather promising for development of natural biological agents instead of chemical preservatives and also presented a multi-effect performance.

Industrial Application

Aureobasidium 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 could easily combine with the current operation practice and expand the export capacity.



(a) Screening of *Aureobasidium* with antimicrobial activity (b) Mangos with soaking of *Aureobasidium* cell broth (c) Native mangos (d) Mangos with broth treatment

(a) Raw bananas (b) Raw bananas with cell broth treatment (c) Ripened bananas without cell broth treatment (d) Ripened bananas with cell broth treatment

Research and development of phytogenics for food animals/ Beneficial effect of Bidens pilosa on gut microflora and animal health

R&D UNIT **National Chung Hsing University** / Lee-tian Chang; Wen-ching Yang

Technical Introduction

We first reported that Bidens pilosa (BP), an edible and medicinal plant, suppress coccidiosis and gut bacterial infection as evidenced by increased survival rate, better performance, gut pathology and microbiota in chickens. In addition, combining with probiotics with anti-pathogenic bacteria activity and organic acids synthesis are used as novel natural growth promoters to replace antibiotic growth promoters.

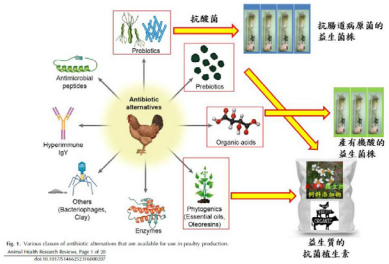
Scientific Breakthrough

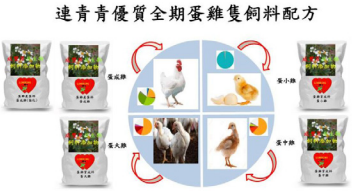
1. Natural anti-pathogenic phytogenics without drug-resistance
2. A natural growth promoter (NGP) that can replace the antibiotic growth promoter (AGP).

The above products account for 30% of the market for feed additives.

Industrial Application

Application potential：Safe and novel phytogenics and functional probiotic products against economic animal diseases caused by pathogenic protozoa and food-borne bacteria.
Application object: livestock economic animals
Application industry: feed additive industry, feed industry





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Non-GMO green revolution under climate change: The plant beneficial endophytic agent for total solution of abiotic and biotic stresses

R&D UNIT **National Chung Hsing University**

Professor Huang, Chieh-Chen; Associate Professor Hwang, Hau-Hsuan; Professor En-Pei Isabel Chiang

Technical Introduction

Our studies showed the endophyte Burkholderia 869T2 could help banana to stand against the Panama disease and improve growths of including pumpkin, cabbage, and other valuable crops. The 869T2 also helps plants to cope with salinity stress and can decrease dioxin bio-accumulations in plants. A specific metabolite of 869T2, PQQ was found to benefit host plant growth. The beneficial endophyte and the metabolite can be developed as an protective endophytic agent for total solution of abiotic and biotic stresses .

Scientific Breakthrough

The plant beneficial endophytic agent could directly regulate plant gene expressions and has shown a great potential to replace the GMO crops. We established core technologies to infect the endophyte into plants and to evaluate its activity inside plant host. This agent could enhance crops to cope withboth abiotic and biotic stresses. Our novel agrotechnology could enhance our international competitive advantage.

Industrial Application

The protective endophytic agent has been shown to enhance growths of several crops. This agent increases several plant anti-abiotic and biotic stresses abilities. Thus we designated this agent as "omnidirectionally protective agent". This agent affects various host plant gene expressions, improves plant growth, and increases anti-stress abilities of plants. It could be considered as a novel approach of breeding and achieve multi-functional purposes.

Fig. 1 Endophytes help plants to cope with biotic stress. Endophyte 869T2 assists banana to stand against Panama disease and improves their growth, the left side to the right side in this figure shows the experimental group, control group and negative control check respectively.

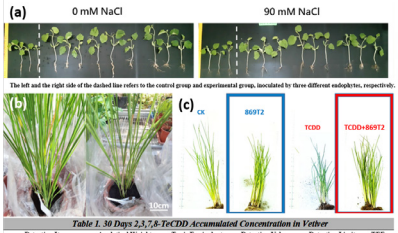


Table 1. 30 Days 2,3,7,8-TeCDD Accumulated Concentration in Vetiver

	Detecting Item	Analytical Weights	Toxic Equivalent	Detecting Value	Detecting Limit	TEF
CK	2,3,7,8-TeCDD	40.0068 g	pg WHO-TEQ/g	343.253	0.479	1
869T2	2,3,7,8-TeCDD	40.0034 g	pg WHO-TEQ/g	2.12257	0.089	1

CK: Vetiver inoculated with distilled deionized water / 869T2: Vetiver inoculated with *B. cenocepacia* 869T2

Toxic Equivalent Factor WHO-TEF (2005)
Upper and Lower Bound Lower Bound

Fig. 2 Endophytes help plants to cope with abiotic stress. (a) Types of endophyte improve the growth of melon and help them to cope with salinity stress. (b) (c) Endophyte 869T2 improves the growth of vetiver and to cope with dioxin abiotic stress. (Table.1) Endophyte 869T2 assists to decrease dioxin bio-accumulations in vetiver.

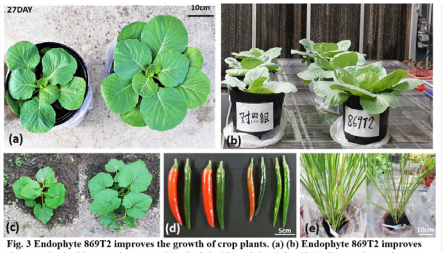


Fig. 3 Endophyte 869T2 improves the growth of crop plants. (a) (b) Endophyte 869T2 improves the growth of cabbage and (c) pumpkin, the left side and the right side in figures shows the control group and the experimental group respectively. (d) Endophyte 869T2 improves the growth of chilli pepper and (e) vetiver, the left side and the right side in figures shows the experimental group and the control group respectively.

The high temperature management and pre-warning and prevention of pests and diseases for beef tomato production

R&D UNIT **National Chung Hsing University**

Sheng Chung-The; Sung Yu; Tsai Ching-Chih; Tai Chen-Yang; Chen Wei-Cheng

Technical Introduction

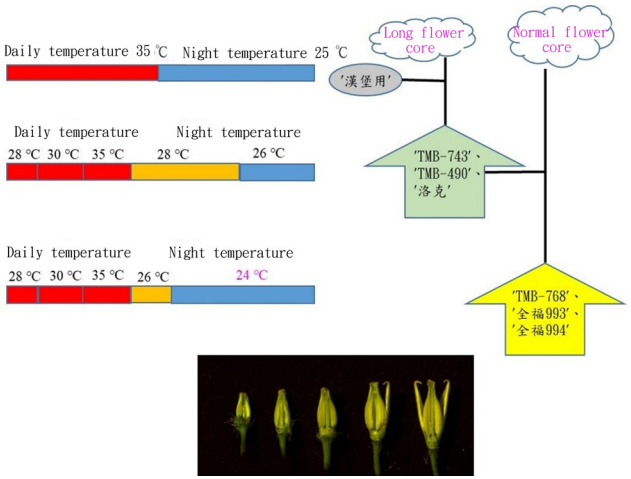
This technology multiple research to integrates the developed production system of the "smart integrated production system". Using AI to identify pests and diseases, and identify the high temperature resistant varieties, and developed Root temperature control system, and using IOT to establish Big data. An adopted robot will be used to assist spraying and harvesting in the future.

Scientific Breakthrough

To identify the temperature thresholds for the occurrence of long styles, it's can to help resist the thermal stress. Develop a root temperature control system, and reduce the heat stress hazard of crop. The IOT technology is used to connect the sensing and control subsystems, and develop the pest and disease early warning and AI control system, and a field robot will be developed.

Industrial Application

The establishment of intelligent technology service platform for domestic beef tomato production, farmers' agricultural enterprises can be helped to manage the production by platform. By analyzing possible pests and diseases, to establish an early warning system. The success of this project will help domestic agricultural enterprises, these will be the target market for the export.



Ice water host and temporary storage bucket

Ice bath in the growing room

control box

Touch human interface

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Consumables-free, remote, and rapid optical detection of plant pathogens--Dr. Lan

R&D UNIT **National Taiwan Normal University**

Jen-Jie Chieh; Yen-Hsiang Wang; Shien-Kuei Liaw; Wen-Chun Wei; Ming-Hsien Chiang

Technical Introduction

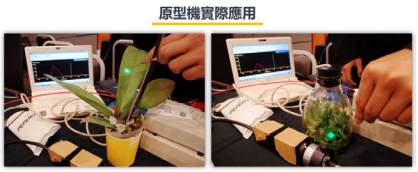
Based on the optical fluorescence of the plant, the technology distinguishes the difference of the main protein infected by virus from the normal ones with the feature light. The main difference of this technology is to omit the complicated and biochemical-material- consumption procedures. With the establishment of big data, the artificial intelligence algorithm identifies whether the implant is infected or not.

Scientific Breakthrough

The artificial intelligence algorithm based on the large data database of optical feature signal could achieve a simple, fast, economical, biochemical-consumable-free examination method. In addition, not only the disease examination but also the monitor of the plant growth could be achieved in the Internet of Things (IoT).

Industrial Application

Hand-held with a walk, and easily operation, such as farmers in the field for the large-scale inspection, the general people for the home inspection.
Non-contact, non-invasive, no requirement of the pre-treatment for the test substance.
The operator can be general people without special training.
The operation process is as rapid as only "3~5 seconds".



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

R&D UNIT **National Chiao Tung University**

Technical Introduction

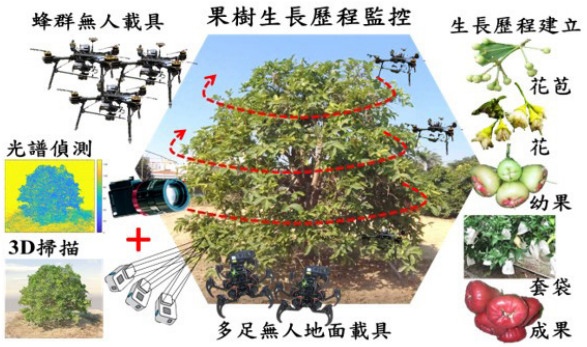
The core technology includes lightweight UAV, heterogeneous sensor integration, obstacle avoidance, group flight automatic flight control, RTK precision positioning system and fruit tree 3D stereo modeling technology. The UAV can be used for 3D scanning and spectral information collection. The information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

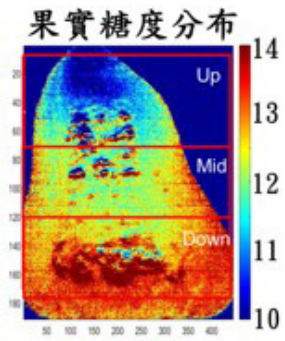
Scientific Breakthrough

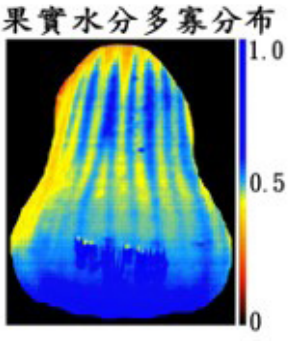
This project develops a group flying UAV modeling system, which can automatically collect 3D stereo information, and combine multi-spectral image to establish fruit tree growth process. The UAV can accurately shuttle between trees based on the RTK positioning and obstacle avoidance technology. Furthermore, the system can instantly and periodically provide 3D and spectral data for the growth process.

Industrial Application

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, 3D fruit tree growth process can be established.Through the spectrum analysis technology, fruit sweetness and moisture content can be classified for screening and grading.







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

R&D UNIT **National Chiao Tung University**

Technical Introduction

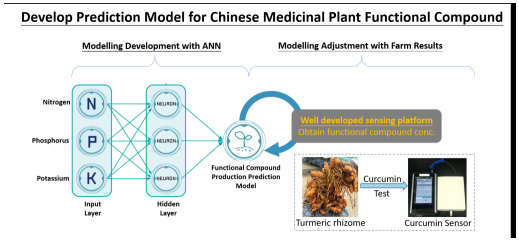
In agriculture, soil nutrients affect the production of functional compound in plants. The team has integrated agricultural systems including: "Soil Microorganisms Prediction System" and "Chinese Medicinal Functional Compound Prediction A.I. System" in a smart agricultural platform called the AgriTalk. With AgriTalk platform, we tell the functional compound content in plants in real time to provide a comprehensive management in farm production.

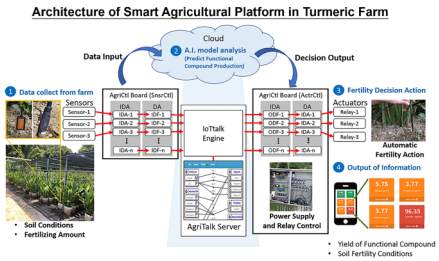
Scientific Breakthrough

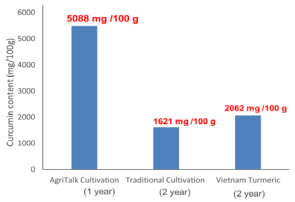
The different between the "Chinese Medicinal Functional Compound Prediction A.I. System" and recent systems is that we go beyond quantity prediction and focus on predicting functional compound production inside the crops during cultivation and tell the farmers instantly to improve crop management efficiency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

Industrial Application

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.







METHOD FOR LOWERING CANNIBALISM RATE IN FISH AND COMPOSITION

National Cheng Kung University

R&D UNIT Distinguished Professor Tzong-Yueh Chen; Associate Professor Yi-Min Chen; Chair Professor Jo-Shu Chang; Associate Research Fellow Chun-Yen Chen; Postdoctoral Research Fellow Yu-Han Chang

Technical Introduction

This technique used algae-a natural raw ingredient as novel functional aquafeed additives, as replacement for fish meal in nutrition sources, a fish oil replacement in the feed, an algae strain contains unsaturated fatty acid can change level of serotonin and blood cortisol in fish brain, decrease their cannibalism rate. This technique can reduce feed production cost and increase harvesting rate.

Scientific Breakthrough

Scientific breakthroughs in this technique are algae strain FSP-E can increase weight gain of fishes compare to plant protein, and substituted 20% of animal protein in feed, algae strain MS-C1 and SU-9 can completely replace fish oil as attractant in feed, algae strain BL10 can change the brain serotonin and blood cortisol concentration, and lower 10% cannibalism rate in fishes.

Industrial Application

This technique using algae protein and attractant to replace animal raw materials can lower feed costs, and unsaturated fatty acid in the algae reduce cannibalism rate in fishes, increase 23% of fish farmers income. This technique has entered trial mass production stage, with adjusting different parameters, it can link up to production line to produce multiple functional natural feed.

Chlorella vulgaris FSP-E

C. sorokiniana MS-C1 & SU-9

Aurantiochytrium mangrovei BL10

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Intelligent Image Recognition and Analysis System for Small-sized Insect Pest

R&D UNIT **National Taiwan University**

Professor Ta-Te Lin; Lin-Ya Chiu phD student; Chen-Yi Lu research assistant

Technical Introduction

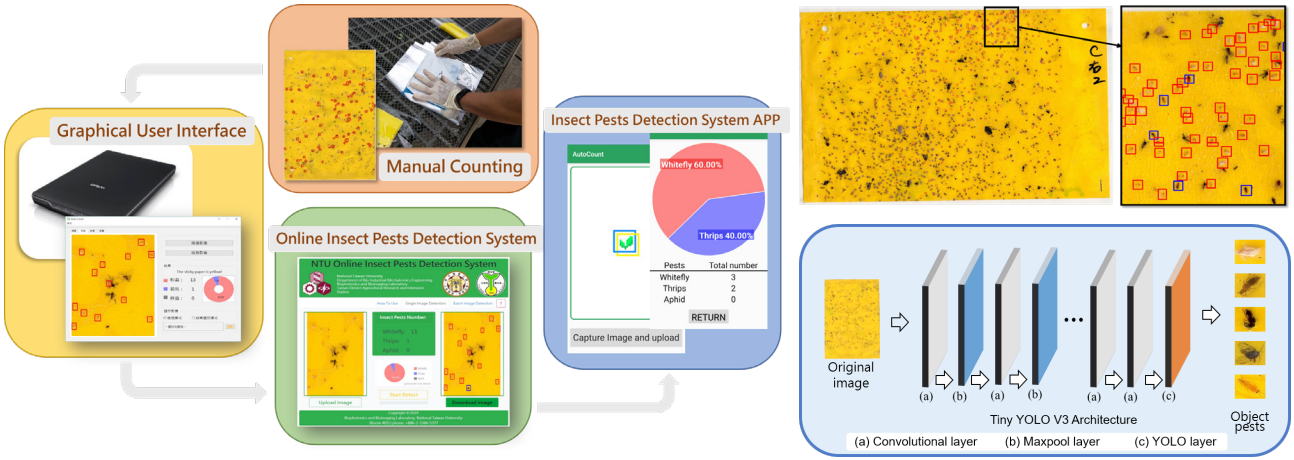
This study built an automatic insect pest image identification system based on tiny Yolov3 deep learning model. By optimizing the tiny Yolov3 detection model, images of insect pests on scanned sticky paper can be automatically identified. The system achieves a testing accuracy of 93% and 90% for whiteflies and thrips respectively.

Scientific Breakthrough

Compared to traditional insect pest identification methods using image processing, based on deep neural networks, this research can yield a better detection accuracy and efficiency. Through implementing the tiny Yolov3 algorithm, we can finish the detection of a scanned sticky paper image within 14.21 second, outperforming works using Faster-RCNN with a detection time of more than ten minutes.

Industrial Application

The most common way to prevent the outbreaks of insect pests is through sticky paper traps. Traditionally, identification of pests was done by manual inspection. Through implementing this insect pest identification system, the efficiency of insect pest management can be drastically improved. Moreover, the risk of exporting infested crops can be reduced, which can help our product gain more reputation in international markets.

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Space Technology

Panchromatic CMOS TDI Image Sensor Design for Remote Sensing Satellite

R&D UNIT **Taiwan Semiconductor Research Institute, National Applied Research Laboratories** / Da-Chiang Chang

Technical Introduction

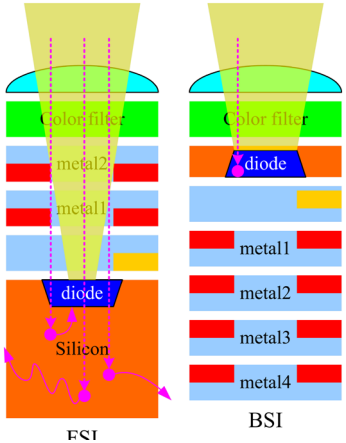
This project developed a CMOS Image Sensor (CIS) for the 2nd generation remote sensing satellite, and its main achievement is to improve the ground resolution (also known as the Ground Sampling Distance, GSD) from 2 meters to sub-meter. The 12-cm large size chip of CMOS image sensor is implemented using Back-Side Illumination (BSI) CIS technology with mask stitching technology and utilizing the CMOS Time Delay Integration (CMOS TDI) technology in this design.

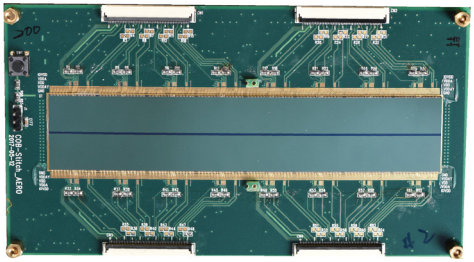
Scientific Breakthrough

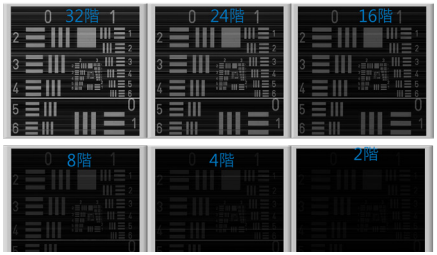
Taiwan Semiconductor Research Institute (TSRI) completed a large size CMOS image sensor chip by independent development. The BSI CIS technology is used to obtain higher sensitivity of light and the TDI technology is also introduced to increase the SNR effectively. In order to implement a 12-cm large size sensor chip, the chip stitching technology is used to accomplish the interconnection between chips in the same wafer directly. The interface for the data transmission is implemented by a LVDS TX/RX with the data rate of hundreds of Mbps.

Industrial Application

In addition to collecting geographic information through remote sensing satellite, this image sensor technology can be applied to any image sensor of remote sensing payload, such as unmanned aerial vehicle and space telescope. And it will be useful to provide high resolution image data for disaster prevention, ecological investigation, environment protection and space observation.







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Method of Top-of-Atmosphere Reflectance-Based Spatiotemporal Image Fusion Using Aerosol Optical Depth

R&D UNIT **National Central University** / Tang-Huang Lin; Chih-Yuan Huang; Hsuan-Chi Ho

Technical Introduction

The proposed TOA-STFM is a spatiotemporal image fusion technology that can preserve top-of-atmosphere (TOA) reflectance. By fusing high spatial (Landsat-8 and SPOT-6) and high temporal resolution (Himawari-8) images, the fused 10-minute- and 6~30-meter-resolution images can solve the problem of existing air quality monitoring techniques and effectively capture the dynamic changes of air quality in near-real-time.

Scientific Breakthrough

1. The TOA-STFM is the first work that overcomes the limitation of existing remote sensing spatio-temporal image fusion methods in preserving atmospheric information for AOD retrievals (10-minute- and 6~30-meter-resolution).
2. Construct the aerosol optical depth (AOD) retrieval model with only 2% to 8% relative error by using high spato-temporal-resolution fused images.

Industrial Application

The TOA-STFM has two advantages for industrial applications. First, large scale, accurate, and stable air quality information can be applied to multidisciplinary industries in providing nearly real-time air pollution and weather change. Second, this technology can be applied in environmental protection agencies or satellite image processing companies, including National Space Organization, SpaceX, Chung Hsing Surveying, LIDAR Technology, Spot Image in France, etc.

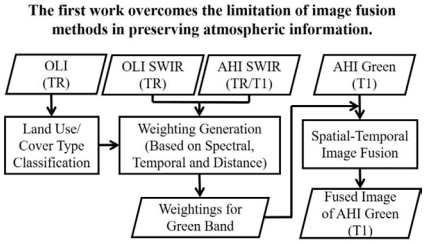


Figure 1. The flowchart of the STARFM-AP (Spatial and Temporal Adaptive Reflectance Fusion Model-Aerosol Property) approach.

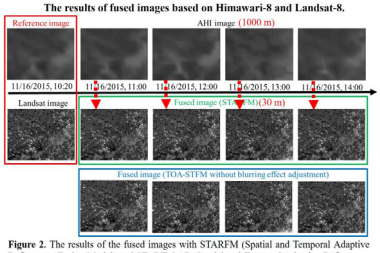


Figure 2. The results of the fused images with STARFM (Spatial and Temporal Adaptive Reflectance Fusion Model) and STARFM-AP (Spatial and Temporal Adaptive Reflectance Fusion Model-Aerosol Property) at 1100, 1200, 1300, and 1400 hours (local time) on 16/11/2015.

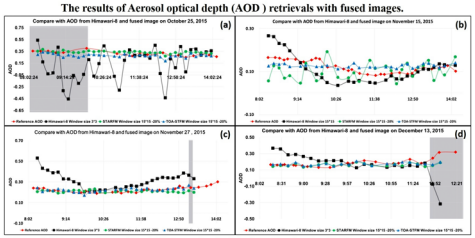


Figure 3. The comparisons of the AOD (aerosol optical depth) retrievals using the Himawari-8 AHI image (black squares) and the STARFM (green circles) and STARFM-AP (blue triangles) fused image with ground-based measurement (red diamonds) on (a) 25/10/2015, (b) 15/11/2015, (c) 27/11/2015 and (d) 13/12/2015. Grey regions indicate the time periods that have cloud and shadow effects (visually-identified).

Compact Ionospheric Probe

R&D UNIT **National Central University** / Chi-Kuang Chao

Technical Introduction

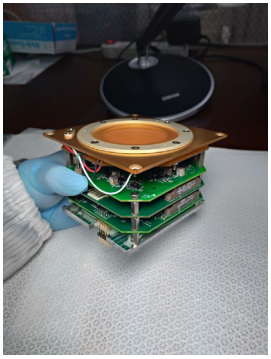
Compact Ionospheric Probe (CIP) is an all-in-one plasma sensor to optimizely install on CubeSat platform with sampling rate up to 1,024 S/s to measure ionospheric plasma concentrations, velocities, and temperatures over a wide range of spatial scales in a time-sharing way.

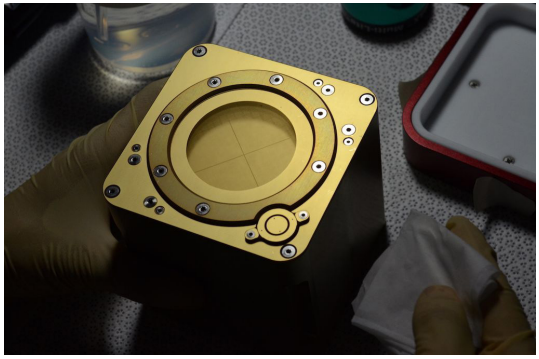
Scientific Breakthrough

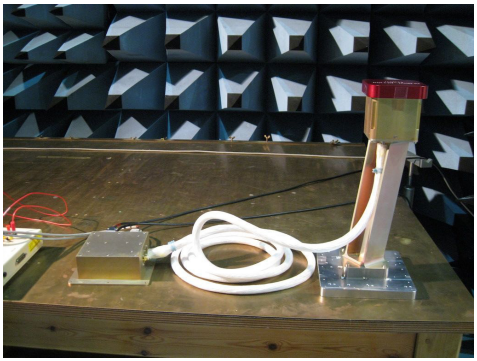
CIP is the finest science payload (400 g and 0.7 U) to in-situ measure ionospheric plasma density irregularities. It is capable of measuring complete properties of ionospheric plasma and monitoring plasma irregularities to cause space communication and navigation outage. It will be installed on the INSPIRESat-series CubeSats (like INSPIRESat-1, INSPIRESat-2/IDEASSat, INSPIRESat-4/ARCADE, INSPIRESat-6/SCION-X, etc.) and has been verified on FORMOSAT-5 satellite.

Industrial Application

Ionospheric plasma density irregularities cause disruption of global communication satellite network (SpaceX, OneWeb, Telesat, Amazon) and navigation outage of autopilot cars (Tesla and Google) and airplanes (Boeing and Airbus). It is definitely important to deploy CIP constellation to monitor global communication and navigation security.







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Development of a metallic ion thruster using magnetron e-beam bombardments

R&D UNIT **National Cheng Kung University** / Po-Yu Chang Assistant Professor

Technical Introduction

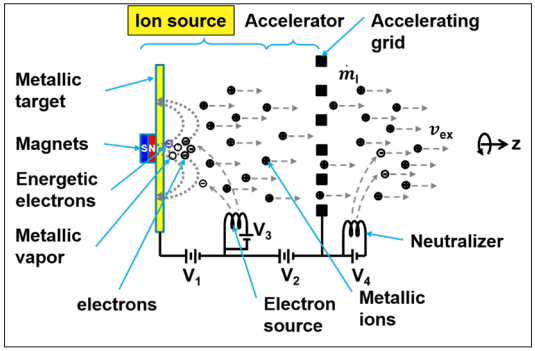
The ion thruster uses metallic ions as the propellant. By using the concept of electron-beam physical vapor deposition processing, a zinc target is bombarded, heated, evaporated, and ionized by magnetron e-beam bombardments. Zinc ions are accelerated by an electric field and thus provides thrusts.

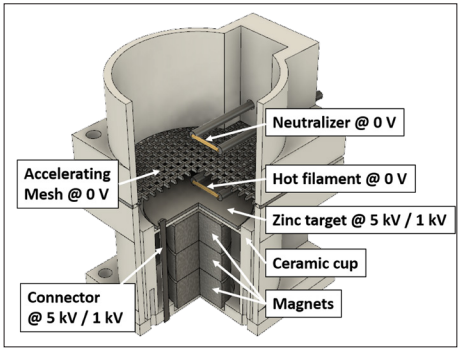
Scientific Breakthrough

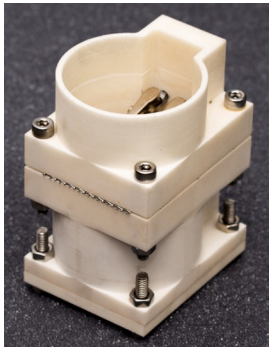
The metallic propellant used in an ion thruster is the innovation in this project. It solves the problem of the global shortage of xenon which is commonly used in electric propulsions. In the metallic ion thruster, zinc is heated, evaporated, and ionized by magnetron e-beam bombardments. Zinc ions are accelerated by an electric potential and thus provides thrusts.

Industrial Application

The space era is coming. Thrusters are needed to maintain orbits of satellites, changing orbits of satellites, controls of satellite attitude, and exploration of deep space. Therefore, the metallic ion thruster using magnetron e-beam bombardments can be widely used in the space industry.







Modularized and Throttleable Hydrogen Peroxide Hybrid Rocket Engine with Direct-Drive Vector Control Technology

R&D UNIT **National Chiao Tung University** / Jong-Shinn Wu Distinguished Professor

Technical Introduction

Modularized and Throttleable Hydrogen Peroxide Hybrid Rocket Engine with Direct-Drive Thrust Vector Control Technology.

Scientific Breakthrough

We use liquid hydrogen peroxide water as oxidants and solid plastics as fuel for hybrid rocket engines. The characteristic of combustion is like candles, which is safe, easy to save and not prone to explosion. Around 90% of the injection flow of hydrogen peroxide water are used to control the engine thrust which is a simple and low cost system that the engine vacuum specific impulse is over 300 seconds.

Industrial Application

Satellite launch vehicle and In-space propulsion system

Contact Feng-Tai Hwang / 03-5784208 #7340 / fthwang@nspo.narl.org.tw

Research on Photo-ignition Mechanism and process of Nano-particles by Flash Lamp and its Application as an Ignitor for Aerospace Propulsion

R&D UNIT **National Cheng Kung University** / Yei-Chin Chao Chair Professor

Technical Introduction

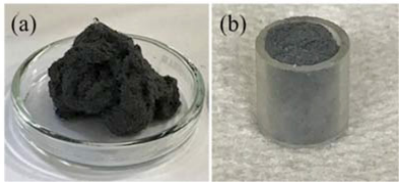
The objective of this study is to develop a high energetic ignition powder which combines the features of nano-aluminum (nAl) powder and Nitrocellulose (NC) and Ammonium perchlorate (AP). The study covers from the deployment of the igniter using above three materials, the research of the ignition mechanism and the application in engineering field.

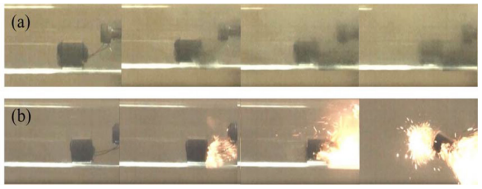
Scientific Breakthrough

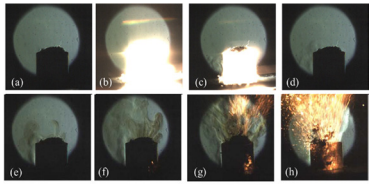
The aluminum powder under nano-scale has the heating effect of the electric dipole by flash light, which can increase the local temperature over 800 degrees of Celsius. The mixture with suitable oxidant and fuel can make it possible as a remote flash igniter, which can be used to the ignition of the solid fuel rocket in the future.

Industrial Application

This system can replace the traditional igniter and can be used as the igniter of the rocket in the future.







Advanced Retrievable Unmanned Space Vehicle as an Integrated Space Science and Technology Verification Platform – Power Mobilized CubeSat for Missions

R&D UNIT **National Cheng Kung University** / Yei-Chin Chao Chair Professor

Technical Introduction

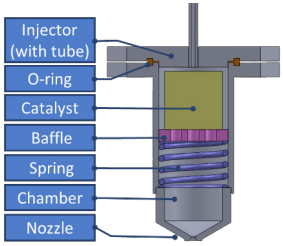
A prototype propulsion control system for CubeSat is designed. For the demonstration and preliminary dynamic verification of the system on earth we use four thrusters to perform the yaw and pitch control and each thruster provides a thrust of 600mN. The result shows that the propulsion and control system both have good performance.

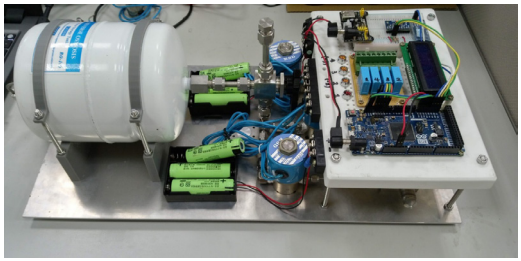
Scientific Breakthrough

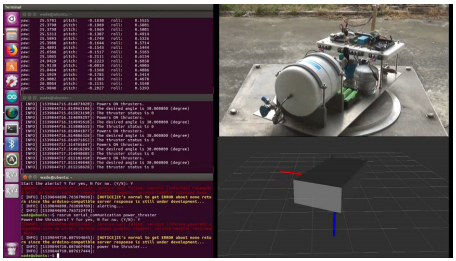
The main idea of the current study is to design a HTP monopropellant propulsion attitude control system, RCS, for large CubeSat. The experimental results show that this system was successfully operated and demonstrated several verification control.

Industrial Application

This system can be applied to cubic satellites and become a satellite propulsion subsystem or module.







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Ultrahigh Bit-rate Lightweight X-band Communication System

R&D UNIT **National Space Organization** / Ming-Hwang Shie Research Fellow

Technical Introduction

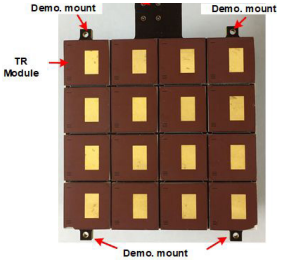
This technique is based on Ultrahigh Bit-rate Lightweight X-band Transceiver. Combining the satellite, user's cell phones, and the transceiver mentioned, we proposed a multi-user two-way communication system with extremely high bit-rate.

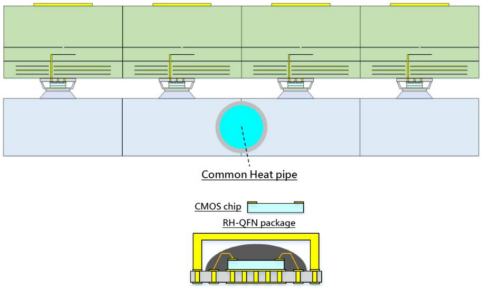
Scientific Breakthrough

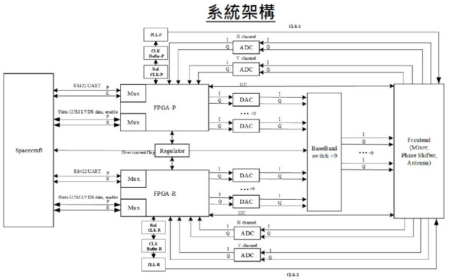
Hybrid (analog/digital) Phased Array Structure: Every module has merely one set of DAC and PA. Because the reducing of DACs and PAs, the total power consumption is reduced.
SMD Patch Antenna Array: we substitute patch antenna array for traditional big parabolic antenna for flattening and minimizing the system. We package the antenna into SMD component for easily soldering and total weight reducing.

Industrial Application

Terrestrial cell antennas and networks can be damaged by natural disasters. Satellite communication system can avoid this problem and be useful during natural disasters. Besides, remote areas or undeveloped land require satellite communication system most. It can help researchers, offshore fishing and geochemical exploration a lot.





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GaN Based High-frequency High-efficiency Converter

R&D UNIT **National Central University**

Yue-ming Hsin、Jen-Inn Chyi、Hsien-Chin Chiu、Hao-Chung Kuo、Chin Hsia、Yu-Chen Liu、Huang-Jen Chiu

Technical Introduction

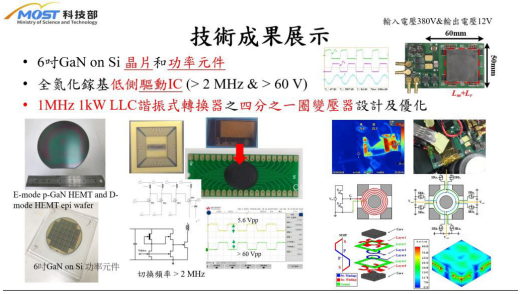
A high power converter application built with GaN HEMT was presented. The technical aspects are developed from 6-inch wafers to converter applications, covering the optimization of 6-inch GaN epitaxial layers. The process and device model of the 6-inch GaN E/D-mode component was established. Low-side GaN HEMT logic gates (> 2MHz) for integrated circuit were designed. Finally, The high-frequency and high power density LLC resonant converter is completed.

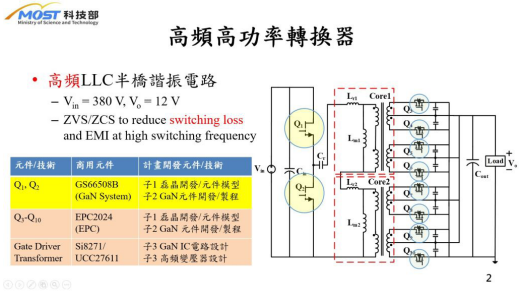
Scientific Breakthrough

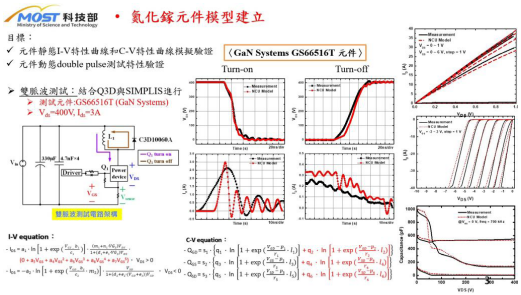
The high power converter system constructed with wide bandgap (GaN HEMT) is currently tested to 1.5 MHz/1000 W with a power density of 38 W/cm3 and a conversion efficiency of 97%. The technology starts from the 6-inch wafer to the system application including the optimization of 6-inch GaN epitaxy. E/D-mode HEMT fabrication, and Low-side GaN HEMT logic gate (> 2MHz) for integrated circuit design.

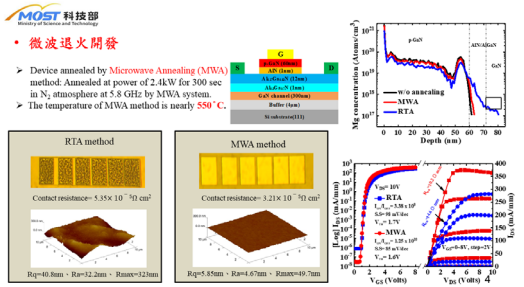
Industrial Application

Industrial applicability can be applied by the most upstream epitaxial technology, the midstream process technology and component model, and the final converter/converter circuit (transformer). It is in line with Taiwan's semiconductor industry's additional GaN options in Silicon.









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Platform for SiC Power System on a Chip

R&D UNIT
National Chiao Tung University / Bing-Yue Tsui
National Tsing Hua University / Chih-Fang Huang
National Taiwan University /Kung-Yen Lee

Technical Introduction

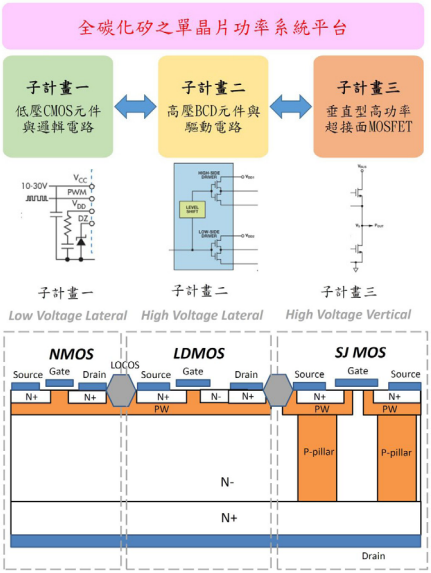
Develop a SiC single-chip power system platform across processes, devices, and circuits to breakthrough the temperature and power constraints of Si applications. The research includes low-voltage CMOS logic circuits, high-voltage driver circuits, and vertical super-junction MOSFETs. All specifications exceed existing technology. The results can be applied to energy networks, rail transit, electric vehicles, data center, aerospace, defense and other fields.

Scientific Breakthrough

The single-chip power system platform will provide SiC low-voltage logic IC technology which is superior to existing international technology; provide various lateral high-voltage devices to implement SiC driving circuit which has not been realized; and demonstrate 600 V ~3.3 kV super junction SiC MOSFET which has not been commercialized. All of these are leading technology in the world.

Industrial Application

The project develops 600 V to 3.3 kV super junction (SJ) MOSFETs, which are widely used in electric vehicles, smart grids, rail transportation and other fields. The SJ structure can greatly reduce the on-resistance and thus power loss. The SJ MOSFETs will be integrated with the full-SiC driving circuits and logic circuits to maximize the material advantages of SiC. These technologies would trigger a new economic industry.



High-Security IC Test Technology with Dynamic Keys

R&D UNIT **National Cheng Kung University** / Kuen-Jong Lee; Ching-An Liu; Zheng-Yao Lu

Technical Introduction

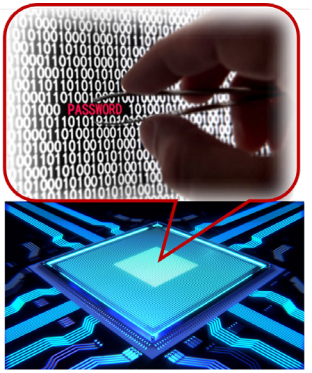
We proposed a dynamic-key secure DFT (Design for Testability) structure that can generate the keys dynamically and defend scan-based and memory attacks without decreasing the system performance and the testability. Analysis results show that our method can achieve a very high security level and the security level will not decrease no matter how many times the attacker guesses due to the dynamic characteristic of our method.

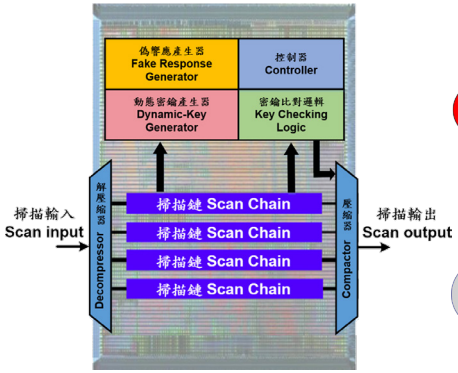
Scientific Breakthrough

1. Using the dynamic key and maintaining a high security level.
2. Generating the fake response to mislead the attacker.
3. Hidding the secure design by embedding the key pin into the scan input pins.
4. Do not need to share the test key with testers within the IC supply chain.

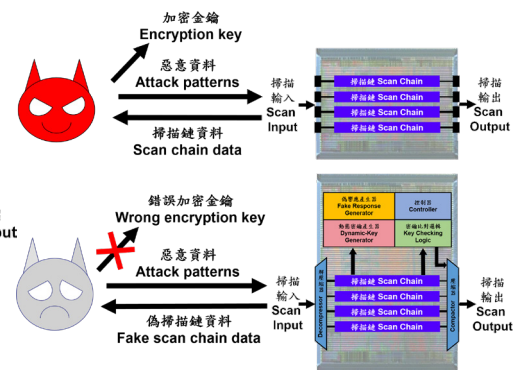
Industrial Application

This technology can be widely used in the IC test architecture of products such as communication, automotive, home appliances, medical, consumer electronics, etc. And maintain the in-field testability and high security.





High-Security IC Test Technology with Dynamic Keys



Scan-Based Side-Channel Attack and Defense

Contact Ling-Lan Hsieh / 06-2761804 / hll67@mail.ncku.edu.tw

A Secure IoT Communication Technique with Ultra Low Power Wake-Up Scheme

R&D UNIT **National Cheng Kung University** / Professor Hui-Tang Lin; Professor Kuang-Wei Cheng

Technical Introduction

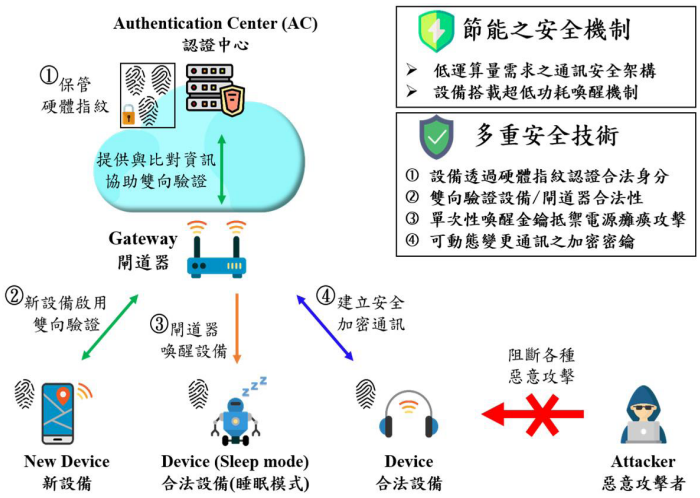
Security and power consumption are two challenges faced by IoT. This solution uses the hardware fingerprint (called Physical Unclonable Function) created by the IC manufacturing process and a wake-up receiver with the one-time wake-up code to provide an integrated solution to the issues. It results in rigorous identity authentication, secure communication, and significant energy reduction for IoT.

Scientific Breakthrough

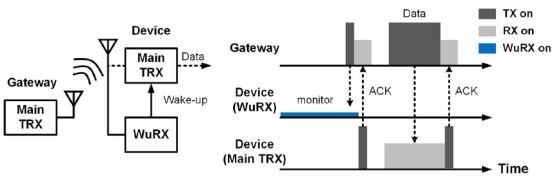
The use of hardware fingerprint strengthens IoT security by avoiding security issues to which traditional approaches are vulnerable. The wake-up receiver applies the envelope detection with frequency/phase discriminator and the high quality factor inductor to reduce energy consumption by up to 1000 times. This solution enables highly secure communication and ultra-low power consumption for IoT.

Industrial Application

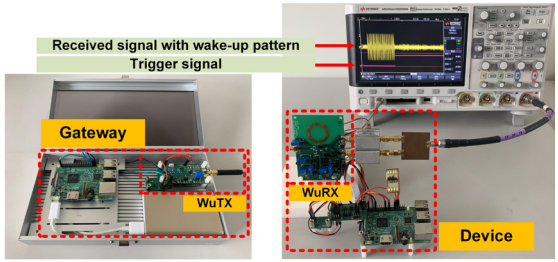
This solution could be widely applied to the ever-growing number of IoT systems. With its multiple modes, the wake-up receiver could be easily integrated into existing products to strengthen security, significantly reduce power consumption, and prolong device operation time. This would increase people's confidence in using the IoT devices, which would in turn promote the IoT industry tremendously.



圖一、具多重安全與節能機制之智慧物聯網系統架構圖



圖二、具備喚醒機制之無線收發機架構與操作示意圖



圖三、理論驗證與量測架構圖

Lead-free piezoelectric acceleration sensing system capable of monitoring unmanned vehicle behavior.

R&D UNIT **National Cheng Kung University**

Sheng-Yuan Chu; Soon-Jyh Chang; Lih-Yih Chiou; Cheng-Ying Li; Rui-Tong Weng; Sheng-Kai Lin

Technical Introduction

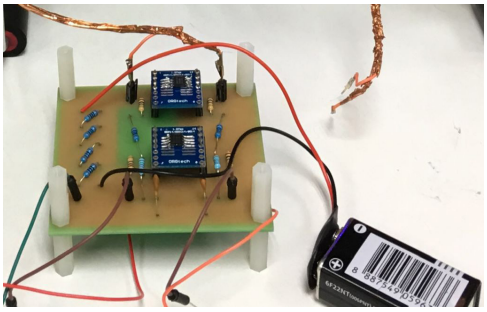
We develop ZnO:Li films as lead-free piezoelectric materials and successfully develop lead-free piezoelectric MEMS accelerometers through MEMS process technology. The charges generated by the accelerometer are converted into a voltage signal and then transfered to the digital code from the SAR ADC.

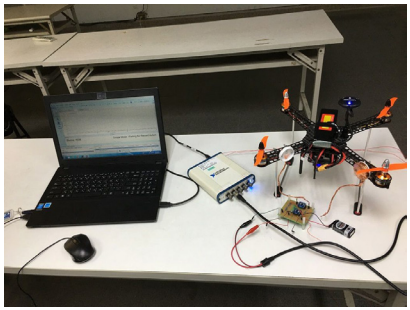
Scientific Breakthrough

The lead-free piezoelectric material ZnO:Li(LZO) films developed by our team have a piezoelectric characteristic d_{33} = 22.85 pm/V, which is the world's leading value. The contribution of present work is to design and manufacture of lead-free piezoelectric accelerometers with wide frequency and high sensitivity for unmanned vehicles and smart machine applications.

Industrial Application

MEMS sensors are not only suitable for popular used in large number of consumer electronics industries, but also suitable for Internet of Things sensing applications in the future. MEMS sensors including inertial sensors are currently the largest in the market . They are widely used, such as industrial 4.0, IoT underlying sensing components, vehicle networking and human sensing applications.





Contact Cheng-Ying Li / 06-2757575 #62400 #1391 / tcob866lon@gmail.com

Energy Efficient and High Performance Neural Network Accelerator / Real-time Full-HD Image Semantic Segmentation and Object Detection Technology

R&D UNIT **National Tsing Hua University** / Professor: Youn-Long Lin
Project Manager: Jian-Wen Chen; Chao-Yang Kao; Huang-Chih Kuo; Chiung-Liang Lin

Technical Introduction

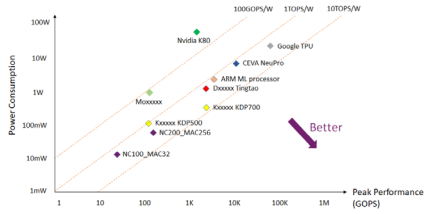
- Low-power deep learning accelerator integrates neural network design / training, model compression and accelerator design. It uses a small amount of computation and memory footprint to realize high performance on the edge device.
- The image semantic segmentation technology can reach 80 frames per second @1024*2048 on NVIDIA Tesla V100 to meet real-time requirements.

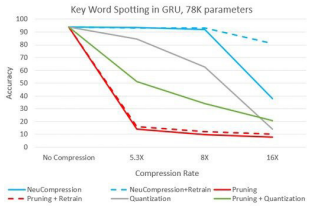
Scientific Breakthrough

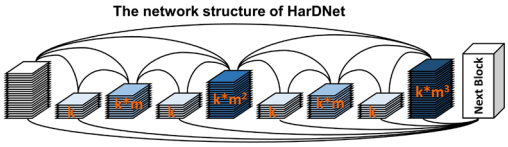
1. An AI engine that accelerates multi-layer fusion neural networks (each layer can be DNN, RNN, GRU or LSTM)
2. Parameterized number of neurons for input/hidden/output layers
3. Smart model compression achieving 2 to 16 times compression ratio
4. Configurable decimal point position for input, weight/bias and output of each layer
5. 8 to 256 Configurable MACs
6. Easy to use SDK

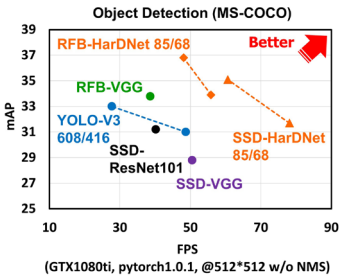
Industrial Application

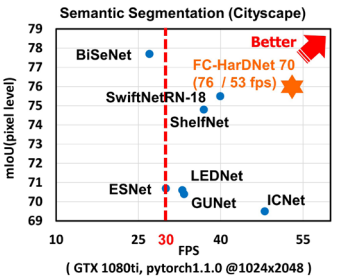
- Low-power deep learning accelerator can be widely used in IC design, communications, transportation, home appliances, consumer electronics, e-health etc. related industry.
- The image semantic segmentation and object detection technology can be used in autonomous driving, medical diagnosis, security surveillance, human-computer-interface, etc.











Neuromorphic Intelligent Visual System for Low-Power Edge Devices

R&D UNIT **National Tsing Hua University**

Kea-Tiong Tang; Chih-Cheng Hsieh; Chung-Chuang Lo; Ren-Shuo Liu; Meng-Fan Chang; Hsin Chen; Min Sun

Technical Introduction

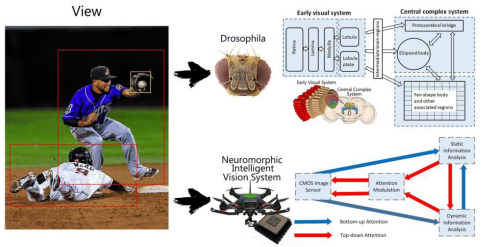
1. Low-Power Processing-in-sensor CMOS Image Sensor
2. In-memory Computing Technology that can Realize Neuromorphic Architecture
3. Implementation of Low-Power and Low-Latency Deep Learning Chip based on Neuromorphic Intelligence
4. Development of Neuromorphic Chip based on The Fruit Fly Visual and Spatial Sensory Systems
5. Hardware-Software Co-Design for Neuromorphic AI Chips

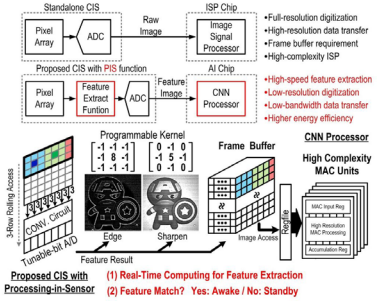
Scientific Breakthrough

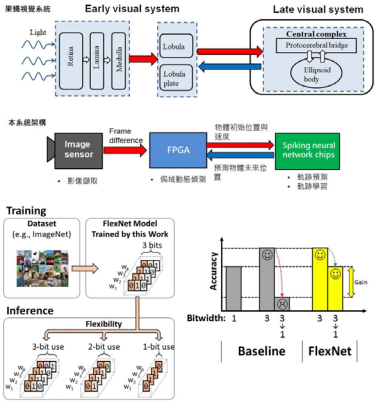
1. The computational CMOS image sensor (C2IS) with array-parallel computing can perform always-on feature extraction.
2. Multi-precision computing in SRAM increases the DNN accuracy and performance.
3. Based on real NN to design a low power object tracking neuromorphic chip with learning rule.
4. FlexNet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

Industrial Application

Our technologies cover a wide spectrum of low-power edge devices including neural models, software optimization, and hardware performance. The models developed by our team can be used in various low-power applications, including acceleration of AI on mobile phones, unmanned vehicle identification and obstacle avoidance, industrial automation, smart home, AI toys, intelligent surveillance, interactive robots, etc. The potential of these technologies can go beyond imagination!







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Development and Integration of MEMS environment sensors towards smart and more-than-Moore era

R&D UNIT

National Tsing Hua University / Weileun Fang NTHU Chair Professor; Sheng-Shian Li Professor; Yu-Lin Wang Professor; Cheng-Hao Ko Associate Professor; Chitsung Hong Ph.D.; Sheng-Kai Yeh Ph.D. student; Chien-Hao Weng Ph.D. student; Shin-Li Wang Ph.D. student; Pen-Sheng Lin Master student; Yung-Chian Lin Master student; Cheng-Chun Chang Master student; Yu-Chen Chen Master student

Technical Introduction

The environmental information is very important to the human life, the proposed technologies of Environment Sensing Hub including:

1. Air sensing hub: temperature sensor, humidity sensor, pressure sensor, infrared sensor, noise sensor (microphone), PM 2.5 sensor
2. Water sensing hub: heavy metal ion sensor, spectrochip

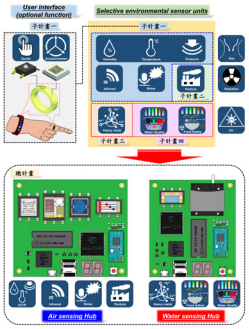
Scientific Breakthrough

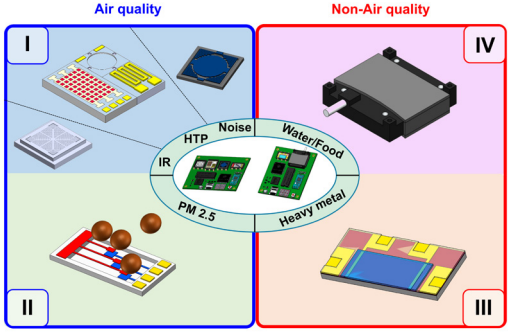
Air sensing hub: The autonomous development technology of the H/T/P sensors which could be implemented by the CMOS-MEMS processes sensors can be established; the novel PM 2.5 sensor has the benefits of compact size and high resolution.

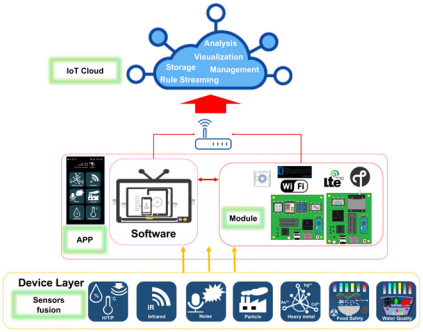
Water sensing hub: Novel ISHEMT sensor has high sensitivity to detect the heavy metal ion in water; novel spectrochip has the mass-fabrication capability and compact sensing system.

Industrial Application

Different using situations can be fitted by selecting the different required environmental sensors in our proposed environment sensing hub. By the integration of the distinct analyzed information and the comparison of the data by different users/conditions, it can be further utilized in Smart-X fields; hence, the air/water qualities can be monitored to improve the quality of human life.







Advanced magnetic randon access memory technology toward low-power-consumption, high frequency, and field-free spin-orbit torque

R&D UNIT **National Tsing Hua University** / Lai, Chih-Huang; Yang, Bo-Yuan; Lin, Po-Hung

Technical Introduction

Spin-orbit torque (SOT)-based MRAM is regarded as the core component for next generation, featuring low-power-consumption, high frequency, and non-invasive characteristics. Benefitted by the field-free nature, SOT-MRAM will be sizable to be one of the high density memory technologies.

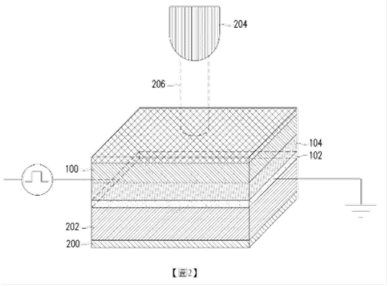
Scientific Breakthrough

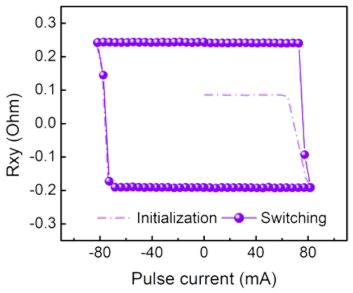
Using ferromagnet/antiferromagnet exchange coupling to achieve 1. high thermal stability, 2. field-free SOT switching, 3. magnetic multilevels for AI, neuro-computing, and machine learning applications.

Industrial Application

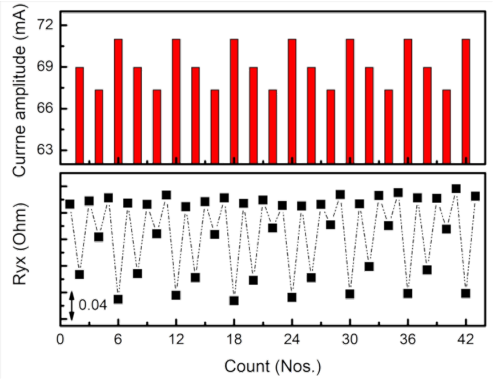
For the purpose of low-power consumption, intelligent, and novel sensing, spintronics-based MRAM definitely plays an important role. SOT-MRAM is technologically potential to replace the STT-MRAM because of its writing mechanism, which promotes spintronics-based MRAM to low-power consumption, hgih frequency, and non-volatile characteristics.

1. Sot驅動磁矩翻轉





2. 多重磁態性質



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Baseball finger force sensing and wireless transmission device with time-series big data analysis system

R&D UNIT **Yuan Ze University** / Huang-Chia Shih and Hung-Hsuan Ku

Technical Introduction

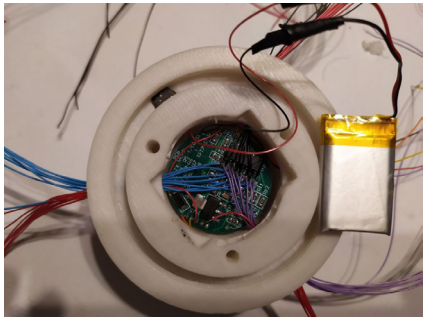
This pressure-detection smart baseball obtains applied force, dynamic and inertial features of pitcher during pitching. Through the connection between wireless module and terminal, sensor data will be transferred and provides vibration as a pitching signal. In addition the precise adjustment is achievable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

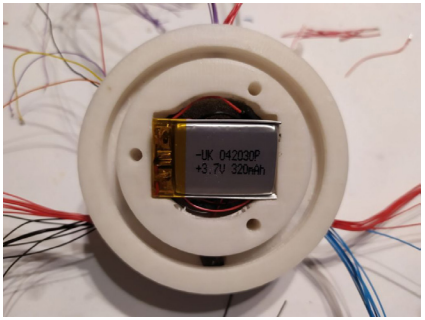
Scientific Breakthrough

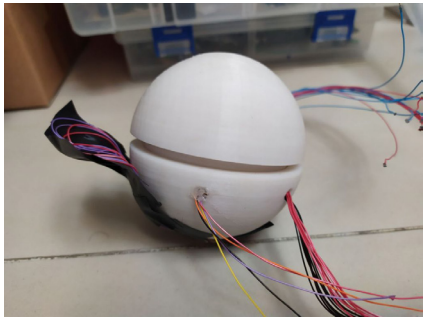
Due to the underdeveloped 3D pressure detection technology and difficulties in baseball pressure sensor installation, the available equipment for measuring finger pressure is rare in local and foreign market. This technology can instantly capture finger pressure while analyzing pitcher's control of the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

Industrial Application

The main business opportunity of this technology is its customizability. Through big data analysis and customized training from professional coach, sensor 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 AI, IoT and sports data analysis.







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A Sport Training System and Devices

R&D UNIT National Taiwan University of Sport
JyhHow Huang; JiangHun Wu; Ren Der Jean; BinJu Lee; RenHow Wang; SiJu Lee

Technical Introduction

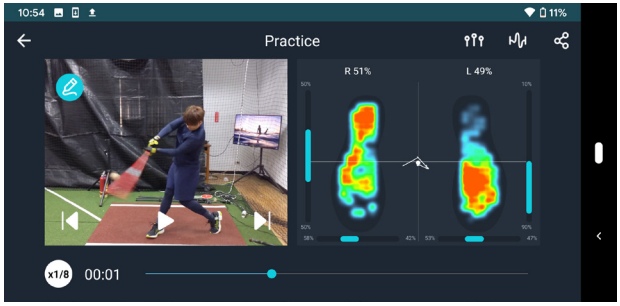
Our system uses wireless insole in the shoes to measure foot plantar pressure of athletes. Machine learning and AI is used to identify flaws in users's pitch/swing and the training will recommend proper drills accordingly.

Scientific Breakthrough

Current wireless insole foot planar 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 planar pressure and video simultaneously. Our system analyzes their swing and use AI to find proper drills to help the users to improve.

Industrial Application

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.



Next Precision Weightlifting Platform

R&D UNIT **University of Taipei** / Pao-Hung Chung; Shun-Hwa Wei, Wei-Hua Ho; Ching-Ting Hsu

Technical Introduction

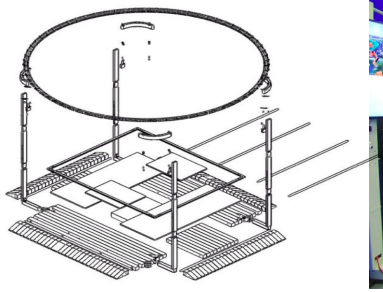
The main purpose of this invention is to provide a training system with the surrounding photographing unit, the display unit, and a force platform. The system can immediately capture the motion of the user from various angles, and measure the force of the user from both legs, in order to provide the useful biofeedback information to coaches and athletes.

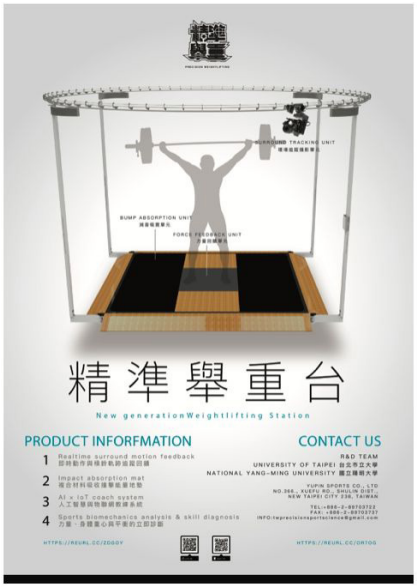
Scientific Breakthrough

This device is to monitor various weightlifting movements in a non-contact manner, such as the surrounding photographing unit, the display unit, and a force platform. The AI technical feedback can also provide the risk factor to the coaches and athletes from injury. Moreover, the high shock and noise absorption mats can protect athletes from the impact.

Industrial Application

The next generation of precision weightlifting training platform can provide the innovative technology to Taiwan manufactories in weightlifting equipments, such as motion capture, force feedback, and high shock and noise absorption mats.





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