

## Office of Research & Development

### City-Data Through Real-Time Images

City real-time images offer huge business opportunities. OmniEyes Co. Ltd. founded by Professor Chun-Ting Chou, Department of Electrical Engineering, and Prof. Ai-Chun Pang and Sho-De Lin, Department of Computer Science & Information Engineering, applies fog computing for a comprehensive collection of city-data. Using cameras on buses, taxis, and other vehicles, they generate real-time city images delivering high commercial value.

**Prof. Chun-Ting Chou:** [chuntingchou@ntu.edu.tw](mailto:chuntingchou@ntu.edu.tw)

**Prof. Ai-Chun Pang:** [acpang@csie.ntu.edu.tw](mailto:acpang@csie.ntu.edu.tw)

**Prof. Shou-De Lin:** [sdlin@csie.ntu.edu.tw](mailto:sdlin@csie.ntu.edu.tw)

### Fighting Diseases With Healthy Cells

Through aging, our immune system loses its ability to recognize and destroy disease-causing pathogens. Professor Jih-Luh Tang, College of Medicine, developed a technology to separate, propagate, and store young immune cells and peripheral blood stem cells and established Retain Biotech Corp. as the first leading company in the field. The preserved healthy immune cells and tissue regenerating peripheral blood stem cells are a powerful tool to fight future diseases.

**Prof. Jih-Luh Tang:** [tangjh@ntu.edu.tw](mailto:tangjh@ntu.edu.tw)

### Use Microfluidics Technology to Detect Disease-Related Molecules in the Body

Extracellular vesicles are mainly composed of microvesicles and exosomes, which are encapsulated by nucleic acids and proteins. They are involved in tumorigenesis and other disease processes. In vitro diagnosis of exosomes is very difficult, because its size of 30-150nm is smaller than the wavelength of visible light. Professor Andrew Wo from NTU's Institute of Applied Mechanics developed a new technology to detect exosomes and established Reliance Biosciences Incorporated, which uses special microfluidics technology to recognize the progression of diseases as a reference for medical treatment.

**Prof. Andrew Wo:** [andrew@iam.ntu.edu.tw](mailto:andrew@iam.ntu.edu.tw)

## Office of International Affairs

### Promoting SDG Through International Collaboration Seed Funding

To strengthen cooperation with strategic partners and establish research partnerships with top universities worldwide NTU promotes the International Collaboration Seed Funding with 16 universities, including from the US, Canada, France, UK, Germany, Poland, Japan, South Korea, Singapore, Thailand, and Mainland China as preferred partners. Projects have to address at least one of the UN Sustainable Development Goals with higher priority given to SDG 3 "Good Health and Well-being," SDG1 "Sustainable Cities and Communities," and SDG13 "Climate Action."

### COVID-19 Special Visiting Student Program Ensures Continuous Education

Due to the pandemic, many Taiwanese students were unable to return to universities overseas and faced interruption to their studies. To protect their right to education, the OIA set up the "COVID-19 Special Visiting Student Program." Students from more than 80 overseas universities, including the Massachusetts Institute of Technology, Harvard University, and the London School of Economics, enrolled as visiting students. It is estimated that through this program, hundreds of students will study in relevant colleges in 2020/2021.

### Subsidies for Teaching in English Enhance International Learning Experience

To improve the learning experience of both international and local students, the Subsidies for Teaching in English were readjusted, including passing revised regulation and simplifying the application process. Subsidized courses include Foundation Courses and General Education Courses, Module Courses, and Intensive Courses by International Guest Lecturers. The subsidies encourage colleges and teachers to teach in English, to cultivate students to become future international talents.

## College of Life Science

### Big Data Mining for Drug Repurposing Against COVID-19

The current COVID-19 pandemic is an acute and rapidly developing global health crisis. To fight the novel coronavirus, we used big data mining for drug repurposing. We show that the repurposed drugs are effective against SARS-CoV-2 with the best inhibitory concentrations below 20 nM.

**Prof. Hsueh-Fen Juan:** [yukijuan@ntu.edu.tw](mailto:yukijuan@ntu.edu.tw)

### HY5 Interacts With the Histone Deacetylase HDA15 to Regulate Photomorphogenesis

Photomorphogenesis is a critical plant developmental process. The transcription factor HY5 acts downstream of the photoreceptors to promote photomorphogenesis in Arabidopsis. We found that HY5 directly interacts with the histone deacetylase HDA15 and they act interdependently in the repression of hypocotyl cell elongation in photomorphogenesis. Our study revealed a key transcription regulatory node involved in plant photomorphogenesis.

**Prof. Ke-Qiang Wu:** [kewu@ntu.edu.tw](mailto:kewu@ntu.edu.tw)

### Ocean Litter May Never Drift Back to Land

Ocean litter has accumulated rapidly and is becoming a major environmental concern. We assessed litter dynamics by a backward- or forward-tracking model simulation considering both surface ocean currents and windage effects. A considerable proportion (from 0.5%–36.2% per month) of ocean litter is predicted to consistently spin and cycle in large swaths of the ocean, leading to ecological catastrophe.

**Prof. Chia-Ying Ko:** [cyko235@ntu.edu.tw](mailto:cyko235@ntu.edu.tw)

## Office of Academic Affairs

### Overseas Taiwanese Students Return to Taiwan due to the Pandemic

In response to the COVID-19 pandemic, NTU assists overseas Taiwanese students who are returning to Taiwan with the enrollment procedures. With a 2% increase in the university's enrollment quota, written or oral examination is used to enroll students who meet the admission standards of each department. For the first semester of the academic year, there are 49 additional spots for undergraduate students, 83 for master students and 30 for doctoral students.

**Prof. Shih-Torng Ding:** [ntudeanacademic@ntu.edu.tw](mailto:ntudeanacademic@ntu.edu.tw)

### Implement Measures to Protect Students' Rights and Interests During COVID-19

For students who are unable to come to school to attend class due to COVID-19, NTU provides flexible supplementary measures to guarantee the continuation of their education, such as reducing tuition, integrating NTU System resources to set up synchronous or asynchronous digital courses and adjusting scoring methods.

**Prof. Shih-Torng Ding:** [ntudeanacademic@ntu.edu.tw](mailto:ntudeanacademic@ntu.edu.tw)

### NTU Future Classroom 1.0 and 2.0

In response to the development of educational technology, NTU built the first Future Classroom in February 2020. In line with the IoT, BYOD, PBL trends, this classroom features advanced teaching equipment to create an environment for participatory learning. NTU will continue to build a 2.0 version as the model classroom to promote the idea of participatory learning.

**Prof. Chih-Kang Chiang:** [ckchiang@ntu.edu.tw](mailto:ckchiang@ntu.edu.tw)

## College of Electrical Engineering & Computer Science

### World-Leading AI Research

Wuzhen Institute ranks NTU the 37th in all universities working on AI of the world, the first in Asia. The Nature magazine recognizes Prof. Lin-Shan Lee as a star of East Asia for his speech recognition research. Prof. Chih-Jen Lin's LIBSVM has been downloaded 1,000,000+ times and received 40,000+ citations.

**Prof. Yung-Yu Chuang:** [cyy@csie.ntu.edu.tw](mailto:cyy@csie.ntu.edu.tw)

### Research of Semiconductor Technology Beyond 3nm-TSMC-NTU Research Center

The TSMC-NTU center focuses on novel devices, advanced interconnects, and 2D materials for the extension of Moore's law and next-generation semiconductor technology. Innovations on 3D transistors, 2D interconnect, and quantum computing have been demonstrated for impacts on artificial intelligence, internet of things, and big data to ensure Taiwan's leading position.

**Prof. Chee Wee Liu:** [cliu@ntu.edu.tw](mailto:cliu@ntu.edu.tw)

### Harmonic Generation Microscopy Provides Unprecedented Contrast and Resolution for Clinical Diagnosis

Harmonic generation microscopy, an NTU-patented technology, provides unprecedented contrast, penetration, and resolution inside human skin. Multiple clinical trials conducted at NTUH prove the superior performance of the system over the current clinical devices including OCT and reflection confocal microscopy for diagnosis and treatment assessment of skin diseases.

**Prof. Chi-Kuang Sun:** [sun@ntu.edu.tw](mailto:sun@ntu.edu.tw)

## College of Law

### The Development of Digital Technology and the Future of Law

Our research theme The Development of Digital Technology and the Future of Law is a joint project with Hamburg Law School emphasizing topics on important issues such as self-driving, financial technology, social media and democratic processes, digital communication and privacy, and artificial intelligence. Discussion derives from various aspects of jurisprudence, media law, commercial law, criminal law, evidence and procedural law.

**Prof. Jen-Guang Lin:** [andrewlin@ntu.edu.tw](mailto:andrewlin@ntu.edu.tw)

### Legal Integrity Safeguards for State Institutions and National Public Officials

Legal Integrity Safeguards for State Institutions and National Public Officials is a collaborative study with Radboud University and the University of Hong Kong, which implements a comprehensive discussion of the anti-corruption and clean government issues.

**Prof. Jen-Guang Lin:** [andrewlin@ntu.edu.tw](mailto:andrewlin@ntu.edu.tw)

### Comparative Law

Comparative Law has long been our law school's main research focus. More recently, our research trend emphasizes the possibility of regional legal integration, such as Civil Law or Contract Law in the developing East Asian countries and courts, comparative analysis of the similarities and differences in Taiwan, Japan, South Korea, and China.

**Prof. Jen-Guang Lin:** [andrewlin@ntu.edu.tw](mailto:andrewlin@ntu.edu.tw)

# Research Highlights at

# NTU

<https://oia.ntu.edu.tw/RHL>

Special Edition



國立臺灣大學  
National Taiwan University



COVID-19



SDGs



Social Impact



## College of Liberal Arts

### Striking a Balance Between Public Health and Data Privacy During the Pandemic

DxLab (Data Infrastructure Lab) at the Department of LIS has contributed to two cutting-edge projects that help combat COVID-19 while preserving users' privacy and control over personal data: decentralized contact tracing and health data logger. As the success of these projects depends not only on the advanced technology but also on users' trust, DxLab has sharpened expertise in data science & information design and created a unique user-centered front in collaboration with multi-disciplinary researchers, e.g. computer science, pharmaceutical companies, and startups.

**Prof. Wei Jeng:** [wjeng@ntu.edu.tw](mailto:wjeng@ntu.edu.tw)

### Combining Theatre Literature, Fieldwork, and Innovation

Prof. Ho-yi Lin has garnered wide acclaim in Theater Literature, Theater Genres, and Theater Arts. Her works are steeped in decades of theoretical investigation, fieldwork, and archival research. In addition to the pioneering book *A History of Taiwanese Theater*, her latest output *Taiwanese Improvisational Theater: Performing "Living Plays" in Gezixi* sets a new milestone in theater studies.

**Prof. Ho-yi Lin:** [lhy@ntu.edu.tw](mailto:lhy@ntu.edu.tw)

### Circulation of the Spherical Pattern: Starting From the Celadons of Goryeo and Song Dynasty

The spherical pattern has long been an intriguing topic in art history. This book traces its multiple origins and explains its cross-cultural implications. The Northern Song technical treatise Yingzao fashi connects the ball pattern on Goryeo celadons with the spherical pattern on Song wares. It may originate in the west, but was later confused with the Chinese coin pattern and integrated as the lion-and-ribbon-ball theme. In the end, the sinicized spherical pattern turned to influence both West Asia and Europe.

**Prof. Ming-liang Hsieh:** [mlhsieh@ntu.edu.tw](mailto:mlhsieh@ntu.edu.tw)

Ming-liang Hsieh, "Circulation of the 'Spherical Pattern': A Discussion Starting from Goryeo Celadons and Song Dynasty Spherical Patterns", *The National Palace Museum Research Quarterly* 36:4

## College of Science

### Discovering Giant Nonlinearity in Silicon Nanostructures

Optical nonlinearity is key to next-generation active Si photonics. We demonstrated Si nano-resonators amplify photothermal nonlinearity of silicon by at least three orders, with unusually rapid nanosecond response, via anapole or Mie-resonance enhanced absorption. This giant/fast nonlinearity enables 90% reversible/repeatable all-optical-modulation at GHz, and novel 40-nm super-resolution imaging of silicon.

**Prof. Shi-Wei Chu:** [swchu@phys.ntu.edu.tw](mailto:swchu@phys.ntu.edu.tw)

### Overcoming the Energy Gap Law in Near-Infrared OLEDs by Exciton–Vibration Decoupling

The near-infrared organic molecule emission is hindered by significant heat loss (non-radiation) due to vibration motions. Here we show that exciton delocalization could suppress these processes, realized by the corresponding high performance organic light emitting diode (OLED) operated at 930 nm. The results also confirm that such enhancements are applicable to other well-aligned molecular solids.

**Prof. Pi-Tai Chou:** [chop@ntu.edu.tw](mailto:chop@ntu.edu.tw)

### Truncated Age Structure and Warming Temperature Drive Marine Fishes Into Uneven Spatial Distribution, Weakening Their Sustainability

Populations distribute evenly in space when its age diversity is high and the temperature is normal. As age diversity is decreasing and the temperature is warming, populations will gradually become unevenly distributed in space. Decreasing abundance might also drive populations into an uneven spatial distribution, but the relationship could differ among species.

**Prof. Chih-hao Hsieh:** [chsieh@ntu.edu.tw](mailto:chsieh@ntu.edu.tw)

## College of Social Sciences

### Successful Prevention of COVID-19 Outbreak at Elderly Care Institutions in Taiwan

In April 2020, LSE researchers published an analysis of 7 official national data, including Australia, Singapore, Belgium, Canada, France, Ireland and Norway, and COVID-19-linked deaths of care home residents ranged from 14% to 64%. At the same time, Taiwan boasted its zero case of cluster infection in the total of 62,651 beds at 1091 care institutions.

**Prof. Peishan Yang:** [peishan@ntu.edu.tw](mailto:peishan@ntu.edu.tw)

### Reopening Colleges and Universities During COVID-19: Experiences From Taiwan

Rapid initial containment of COVID-19 infections made Taiwan one of the few countries where schools could function normally. To ensure the safety of students and staff, Taiwan's Ministry of Education established general guidelines for college campuses. Creation of a task force at each university based on the guidelines helped secure the initial success to a great extent.

**Prof. Chiung-tao Shen:** [acshen@ntu.edu.tw](mailto:acshen@ntu.edu.tw)

### Resurgence of Authoritarianism (SDG 16 "Peace, Justice, and Strong Institutions")

The worldwide resurgence of authoritarianism has posed serious threats to fundamental human rights. Our research examines the political logic of authoritarian rule and the possibility of establishing more accountable and transparent institutions. Specifically, our focus is to explore institutional settings that serve as countervailing forces to protect the rule of law.

**Prof. Chelsea C. Chou:** [chelseachou@ntu.edu.tw](mailto:chelseachou@ntu.edu.tw)

## College of Medicine

### Proteogenomics Landscape of Lung Cancer in Never-Smokers

The high number of East Asian lung cancer in never-smokers presented an opportunity for Drs. Pan-Chyr Yang, Yu-Ju Chen and colleagues from National Taiwan University and Academia Sinica to establish the proteogenomics landscape and delineate its mechanisms. The works were published in "Cell".

**Prof. Pan-Chyr Yang's Group:** [pcyang@ntu.edu.tw](mailto:pcyang@ntu.edu.tw)

### A Dual-Component Sympathetic Nerve Niche Regulates Hair Stem Cells

Hair follicle stem cells respond to systemic cues through sympathetic nerves. This is achieved by a dual-component niche with sympathetic nerves signaling to hair follicle stem cells by forming synapse-like structures and arrector pili muscle providing anchorage to sympathetic nerves. Their development is instructed by signals initiated from hair follicles.

**Prof. Sung-Jan Lin's Group:** [drsjin@ntu.edu.tw](mailto:drsjin@ntu.edu.tw)

### Osimertinib in Patients With Epidermal Growth Factor Receptor Mutation-Positive Non-Small-Cell Lung Cancer and Leptomeningeal Metastases: The Bloom Study

160mg osimertinib (double standard dose) was given to EGFR mutant patients with leptomeningeal metastasis in an international multicenter study. Cerebral spinal fluid tumor cell clearance was confirmed in 11/40 patients. Patients achieved good progression free and overall survival time. This treatment is accepted as standard in many cancer treatment guidelines. This study was published by James Chih-Hsin Yang et. al. from the Graduate Institute of Oncology at National Taiwan University.

**Prof. James Chih-Hsin Yang's Group:** [chihyang@ntu.edu.tw](mailto:chihyang@ntu.edu.tw)

## College of Engineering

### Research and Talent Cultivation of Offshore Wind Energy

To promote offshore wind energy in Taiwan for SDGs, Prof. Mao-Hsiung Chiang and his research team have been involved in the National Energy Program-II, responsible as the principal investigator of the Offshore Wind Power and Marine Energy Focus Center and project executor since 2014. Research projects contain "Smart Offshore Wind Farm Supervision and Management System", "Offshore Wind Operation and Maintenance AI Data Base", "Pilot Floating Kuroshio Turbine Design", etc. Besides, NTU's offshore wind energy program has been developed for talent cultivation of offshore wind energy in Taiwan.

**Prof. Mao-Hsiung Chiang:** [mhchiang@ntu.edu.tw](mailto:mhchiang@ntu.edu.tw)

### The Era of New Collaborations: Timebanking for Community Practices

Our project challenges the individualistic concepts of time by investigating time-based currency to experiment with Taiwanese communities' capacities for technology-based timebanking. Our transdisciplinary team integrates community building professionals and AI-Blockchain experts. Together, we work with both urban and rural high school students as well as social housing residents. Through hands-on prototype testing, we aim to publish platforms and apps fitting the Taiwanese local cultures.

**Prof. Shenglin Elijah Chang:** [shenglin@g.ntu.edu.tw](mailto:shenglin@g.ntu.edu.tw)

### Design of Enzyme-Less Hybridization Chain Reaction Probe Set for SARS-CoV-2

HCR reactions toward cDNA of SARS-CoV-2, targeting N1/N2/N3 loci on SARS-CoV-2 N genes and human RNase P, have been proposed and demonstrated to provide an isothermal amplification screening tool for the prevention of on-going pandemics. Please check Int. J. Mol. Sci. 2020, 21, 3216 & <http://hcrd.plasmonicon.com/index> for details.

**Prof. Chii-Wann Lin:** [cwlinx@ntu.edu.tw](mailto:cwlinx@ntu.edu.tw)

## College of Bio-Resources & Agriculture

### Revealing the Viral Entry Determinant of Feline Coronavirus for Facilitating the Developments of Vaccine and Therapeutics

Feline coronavirus infection causes the deadly feline infectious peritonitis (FIP), which is a serious problem urgently to be solved. Our interdisciplinary team constructed the atomic model with post-translational glycosylation using cryogenic electron microscopy and mass spectrometry, and predicted the receptor binding domain providing for future vaccine and antiviral drug designs.

**Assoc. Prof. Hui-Wen Chang:** [huiwenchang@ntu.edu.tw](mailto:huiwenchang@ntu.edu.tw)

### An Innovative Iot/WSN-Based Agricultural Monitoring Platform.

Distinguished Prof. Joe-Air Jiang has engaged in the integration of Wireless Sensor Networks (WSNs) and Internet of Things (IoT) and utilized the modularization of core technologies to design long-distant wireless field monitoring systems and develop innovative monitoring platforms suitable for a variety of monitoring targets in different agricultural areas. The intelligent platform has been successfully applied to pest monitoring, honey bee colony monitoring, greenhouse monitoring, and natural enemy production.

**Prof. Joe-Air Jiang:** [jajiang@ntu.edu.tw](mailto:jajiang@ntu.edu.tw)

### Green Technology for Realizing Waste-to-Resource Towards a Circular Economy

This work was supported by the Einstein Project, Ministry of Science and Technology to develop energy-efficient technologies to convert inorganic or bio-wastes into green materials, such as calcium carbonate and construction materials. The associated environmental benefits were evaluated from a life-cycle approach to estimate the global CO<sub>2</sub> mitigation potential.

**Asst. Prof. Shu-Yuan Pan:** [sypan@ntu.edu.tw](mailto:sypan@ntu.edu.tw)

## College of Management

### Board Structure, Director Expertise, and Advisory Role of Outside Directors

We investigate how a shock to corporate demand for experienced directors affects U.S. firms' board structure and board advisory role. Firms appoint more outside directors with China-related experience after the grant. They realize higher returns and better post-deal operating performance, particularly when these directors reside in the U.S. The appointment of directors with China experience is also greeted more positively by the stock market and they gain more board seats after the grant.

**Prof. Yan-Shing Chen:** [yanshing@ntu.edu.tw](mailto:yanshing@ntu.edu.tw)

### Board Networks and Corporate Innovation

This paper studies whether board connectedness affects corporate innovation. Well-connected boards have positive effect on innovation activities and quality. The effect is stronger when firms have higher demand for advising or face more severe agency problems. Firms with greater needs for external finance benefit more from board connections with bankers.

**Prof. Ching-Hung Chang:** [chinghungc@ntu.edu.tw](mailto:chinghungc@ntu.edu.tw)

### Higher-Order Omega: a Performance Index With a Decision-Theoretic Foundation

This paper proposes a new performance index referred to as the N<sup>th</sup>-order Omega that includes the well-known Omega as a special case. The index is established by adopting an approach that is free of a utility functional form or/and distributional assumptions. The index is monotonic with respect to N<sup>th</sup>-degree stochastic dominance and offers a complete ordering on gambles.

**Prof. Larry Y. Tzeng:** [tzeng@ntu.edu.tw](mailto:tzeng@ntu.edu.tw)

## College of Public Health

### The Discovery on Particulate Matter (PM) and Precision Prevention for Colorectal Cancer

A cascade of causal effects of PM<sub>2.5</sub> on a continuous spectrum of carcinogenesis of colorectal cancer was first corroborated, including the short-term effect on inflammatory process and the role of initiator and promoter for multistep carcinogenesis. The precision public health intervention can be designed by different levels of PM<sub>2.5</sub> exposure.

**Prof. Chang-Chuan Chan:** [ccchan@ntu.edu.tw](mailto:ccchan@ntu.edu.tw)

### Smart Exercise Modifies Obesity-Causing Genes

The novel study design on gene and types of exercise associated with obesity provides a discovery and insight that genetic effects on obesity measures can be decreased to various extents by performing different kinds of exercise. The benefits of regular physical exercise are more impactful among eighteen kinds of exercises.

**A. P. Wan-Yi Lin:** [linwy@ntu.edu.tw](mailto:linwy@ntu.edu.tw)

### Precision Population Health for Longer Life Expectancy Through Integrated Public Health Interventions

Precision population health provides a new avenue for enhancing life expectancy in the domain of public health. A systematic framework for integrating public health interventions including environmental pollution control, life style modification, and awareness of early detection and treatment, was developed to demonstrate the improvement of life expectancy by seven years.

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