2014 NARLabs Annual Report

National Applied Research Laboratories

Global Excellence, Local Impact

NARLabs
National Applied Research Laboratories

Commitment • Passion • Innovation

History

2003 **NARLabs established**

Six labs were founding members of NARLabs

- National Chip Implementation Center (CIC)
- National Center for High-performance Computing (NCHC)
- National Center for Research on Earthquake Engineering (NCREE)
- National Nano Device Laboratories (NDL)
- National Laboratory Animal Center (NLAC)
- National Space Organization (NSPO)

2005 **Two more labs joined NARLabs**

- Instrument Technology Research Center (ITRC)
- Science & Technology Policy Research and Information Center (STPI)

2008 **TORI established**

Taiwan Ocean Research Institute

2011 **TTFRI established**

Taiwan Typhoon and Flood Research Institute

Establish R&D Platforms | Support Academic Research | Promote Frontier Science and Technology | Foster High-tech Manpower

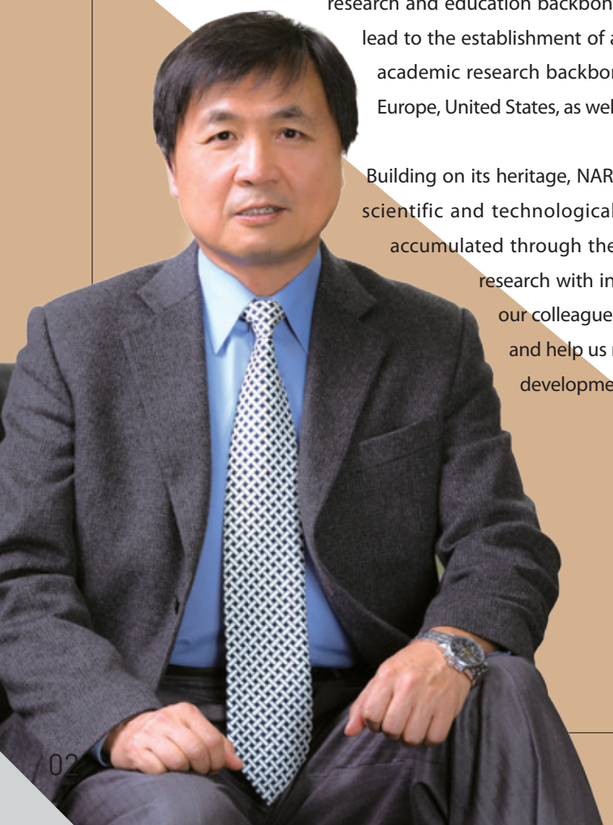
Contents

Message from the Chairperson

NARLabs was established almost 12 years ago. With a vision of pursuing global excellence and creating local impact, NARLabs has strived to establish cutting-edge research platforms, and has successfully developed innovative applications with local features in areas such as earth and environment, information and communications technology, biomedical technology, and science and technology policy. NARLabs has received much recognition in various aspects, including R&D, services, and talent training. Due to the high level of integration among the core technologies and facilities of NARLabs' ten laboratories, we are always prepared to help domestic industry, government, academia, and research organizations in bringing original and essential forward-looking technologies into existence. NARLabs also takes advantage of the R&D capabilities of industry, academia, and research organizations in order to assemble key intellectual property portfolios and transform R&D results into innovative industries.

During the past year, NARLabs' areas of focus included the FORMOSAT-5 optical remote sensing satellite program, which will support land planning and natural disaster assessment; the FORMOSAT-7 remote sensing satellite program, which will improve global weather observation capability; reconstruction of the marine research vessel capabilities; and the implementation of the oceanography research park project aimed at sustaining Taiwan's marine S&T research advantages and development. In the area of earthquake engineering R&D, the establishment of a second facility by the National Center for Research on Earthquake Engineering for modeling research on near-fault dislocation has bolstered Taiwan's role as an international center for earthquake engineering research. Furthermore, the planned move of the National Laboratory Animal Center to the National Biotechnology Research Park will better integrate the country's animal research resources and fully utilize the center's facilities. Acting in conjunction with government policy, the biomedical R&D technology service platform, established by NARLabs at Hsinchu Biomedical Science Park, will form the nucleus of a biomedical industry cluster, and promote Taiwan's brand image within the biomedical market. In the field of big data applications, NARLabs has joined forces with the Ministry of Education and Academia Sinica, to cooperatively implement a research and education backbone network bandwidth enhancement project that will ultimately lead to the establishment of an even higher quality, and higher bandwidth, of education and academic research backbone network, linking Taiwan with researchers in the Asia-Pacific, Europe, United States, as well as the rest of the world.

Building on its heritage, NARLabs looks forward to playing the role of a promoter of Taiwan's scientific and technological development, and will use the capabilities that have been accumulated through the provision of service to the academic sector, to link academic research with industrial applications. I hope that the continued dedication of all our colleagues will enable science and technology in Taiwan to advance further, and help us make even more contributions to society, economy, and industrial development.



Chairperson
Jyuo-Min Shyu

Message from the President

In conjunction with the efforts of the Ministry of Science and Technology (MOST) to advance national scientific and technological development, NARLabs has strived to accomplish its four major missions of establishing R&D platforms, supporting academic research, promoting forward-looking technologies, and training S&T talent. NARLabs has been the key provider of domestic S&T manpower and R&D platforms needed in an innovation economy, and has transformed academic research results into emerging industries, in order to make contributions to the people's well-being.

Reflecting on the past year, I have sought to emphasize the principle of creating value from innovation and have led NARLabs' colleagues to strengthen S&T innovation and to promote cooperation among industry, government, academia, and the research community, of which the results are showing progress. In the area of S&T innovation, important results have included the development of monolithic 3D ICs, genetic dart technology, a street building's seismic-resistance information network, a composite-material lightweight bridge, an underwater hyper-spectrometer, a rainfall research radar installation, the ocean bottom seismometers, an earth science database, a space-grade GPS navigation receiver, the Sounding Rockets -9 and -10, and 4G LTE patents, etc. Furthermore, in the area of R&D service platforms, NARLabs has provided services to approximately 16,000 users and the platform's services even reach 76,564 cases. Moreover, NARLabs has cooperated with the industry to help promote the establishment of an optical system R&D alliance, a medical instruments value-creation alliance, a sleep disorder risk assessment platform, and an earthquake early warning service, etc. NARLabs has further implemented MOST's "From IP to IPO (FITI)" program to encourage entrepreneurship as well as helped boost domestic companies amongst international competitors.

Looking ahead, NARLabs will continue to focus on promoting cooperation and fostering globalization. At a time when Taiwan's industries seek to further transform themselves, we will strive to make our contributions and seek to sustain the next wave of industrial development-Industry 4.0. NARLabs' R&D innovations will play key roles in such emerging areas as the Internet of Things (IoT), smart cities, environment changes, and new-generation communications, etc. In addition, we are also making efforts to ensure that NARLabs' outstanding R&D innovations and results obtain international recognition.

I look forward to continuing my commitment of working with my colleagues to strengthen our consensus and achieve maximum synergy, in keeping with our status as an independent organization. This year, the completion of history showcases of each research center, the groundbreaking of NCREE's second experimental facility, the opening of NLAC's southern surgical experimental platform, and the completion of TORI's headquarters, all signify that NARLabs is now achieving a new state of maturity in response to the needs of the future. This 2014 annual report honors the efforts of all NARLabs' colleagues by highlighting a few of our technological innovations and accomplishments. We hope that these achievements and contributions will invigorate Taiwan's spirit and inspire the confidence to flourish in the Year of the Sheep.

President
Ching-Hua Lo

Organization

Board of Directors & Supervisors

Chairperson	Jyuo-Min Shyu
Managing Director	Guan-Chung Chang, Chung-Liang Chien, Jing-Yang Jou, Yu Wang
Director	Mau-Chung Frank Chang, Bon-Chu Chung, J. Raynien Kwo, Chih-Yuan Lu, Kuo-Fong Ma, Huey-Jen Su, Hung-Duen Yang
Executive Supervisor	Wen-Ji Hwang
Supervisor	Der-Tsai Lee, Chein Tai

President Office

President	Ching-Hua Lo
Vice President	Tzi-Dar Chiueh, Jough-Tai Wang
Secretary General	Wen-Yen Chang
Chief Operating Officer	Peter J. Sher

Headquarters

	Director General
Human Resources Office	Chin-Ling Lin
Administration Office	Ying-Yun Lee
Planning & Evaluation Office	Ching-Ping Lu
Finance & Accounting Office	Tai-Ling Lian
Business Development Office	Ching-Yin Wang
Auditing Office	Nan-Hung Ting

Laboratories

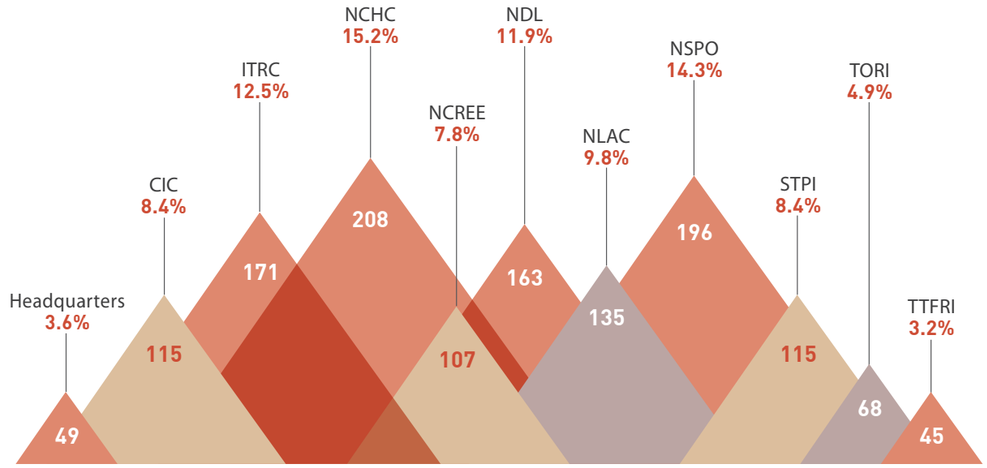
		Director General
National Chip Implementation Center	CIC	Liang-Hung Lu
Instrument Technology Research Center	ITRC	J. Andrew Yeh
National Center for High-performance Computing	NCHC	Ce-Kuen Shieh
National Center for Research on Earthquake Engineering	NCREE	Kuo-Chun Chang
National Nano Device Laboratories	NDL	Wen-Kuan Yeh
National Laboratory Animal Center	NLAC	Chun-Keung Yu
National Space Organization	NSPO	Guey-Shin Chang
Science & Technology Policy Research and Information Center	STPI	Yuh-Jzer Joung
Taiwan Ocean Research Institute	TORI	Hui-Ling Lin
Taiwan Typhoon and Flood Research Institute	TTFRI	Cheng-Shang Lee

（Organization structure as of August 2015）

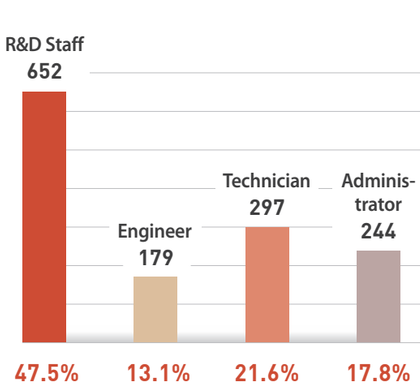
NARLabs

Human Resources

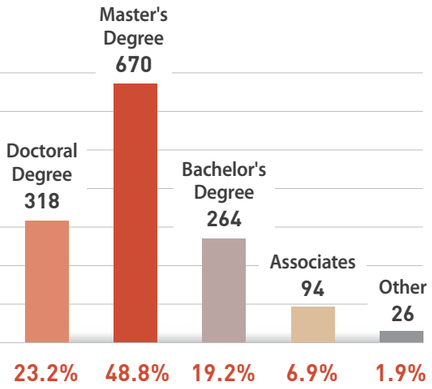
Number of Employees in Laboratories



Human Resources Profile



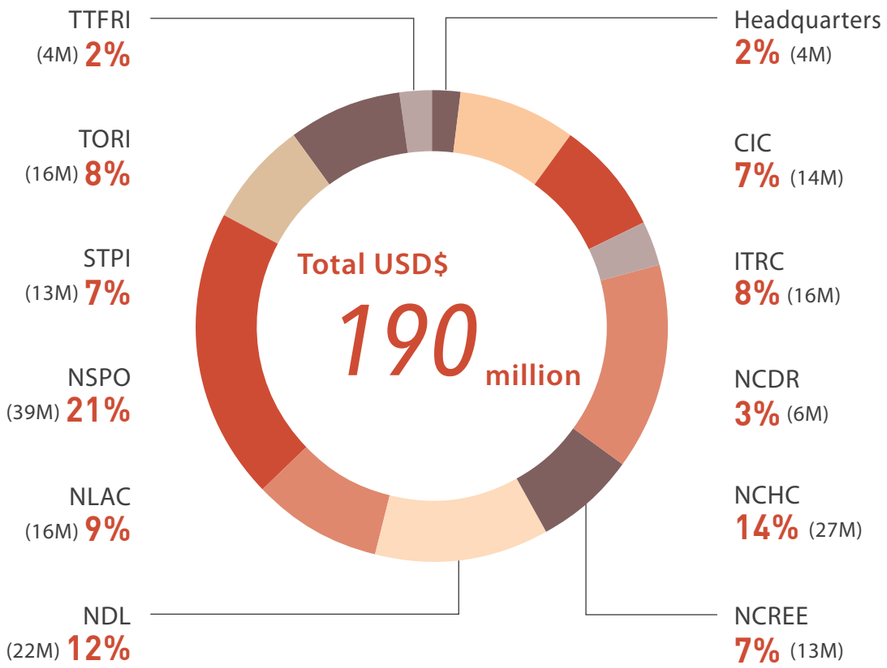
Education Level

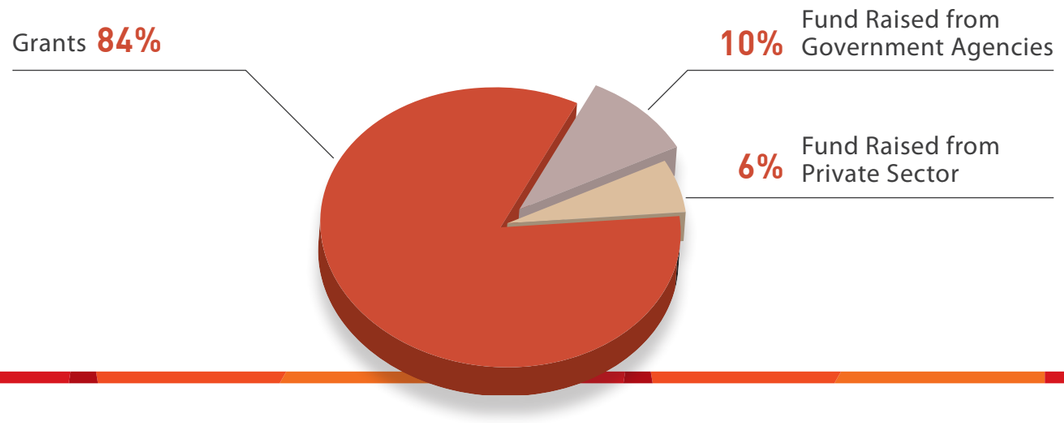


Number of Employees 1,372

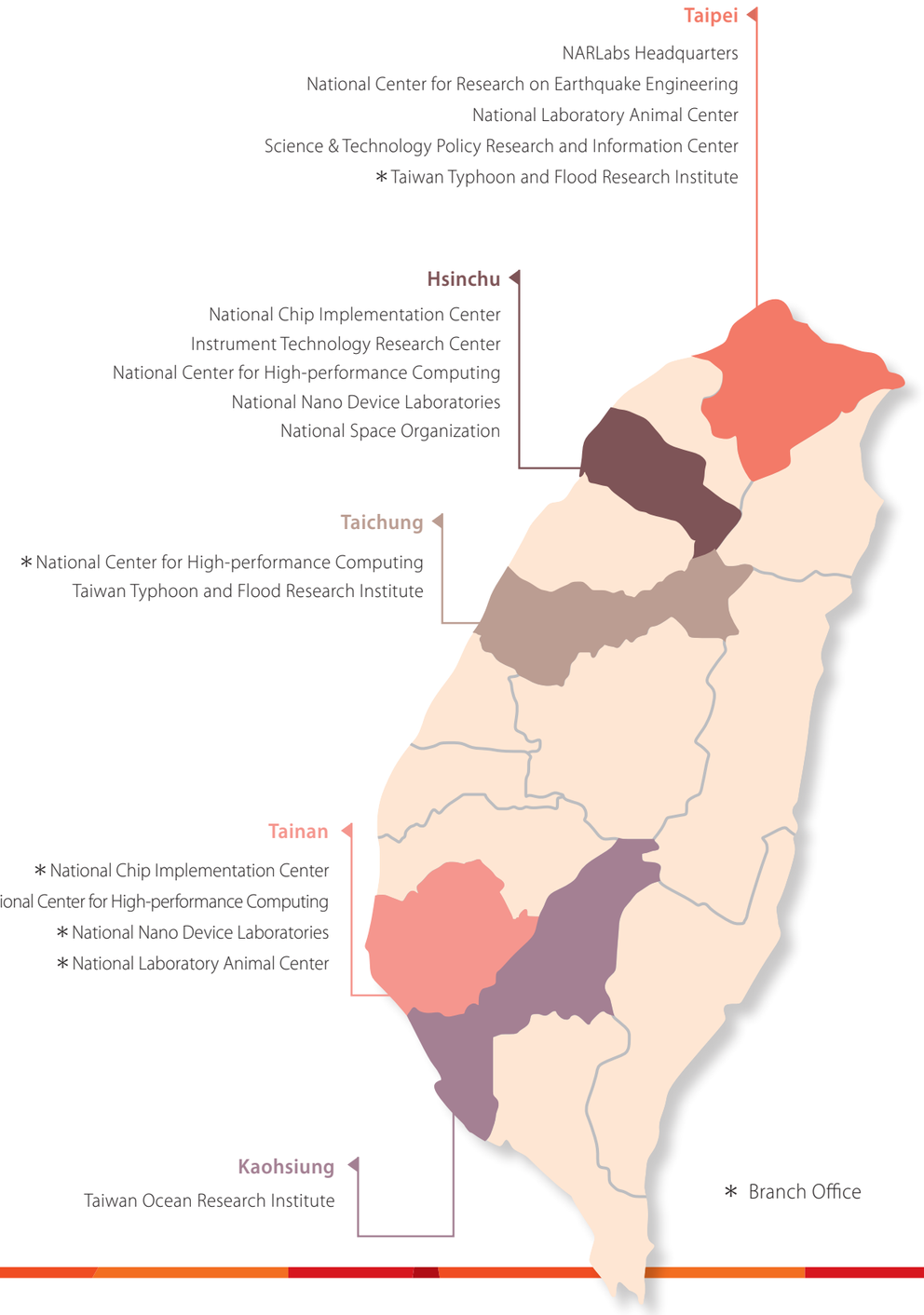
Financial Information

Revenue (FY 2014)





Location



R&D and Service Accomplishments

NARLabs is dedicated to creating cutting-edge scientific R&D platforms to facilitate application of academic research outcomes to industry, government and humanitarian causes. NARLabs plays an integral role in the development and establishment of technology and expensive, large-scale facilities that no single university can afford to maintain. These NARLabs platforms provide technical services for academic research, and help users leverage high-accuracy instruments, software modeling and analytical systems to conduct original and advanced researches.

Earth and Environment

Completion of Assembly and Testing of the FORMOSAT-5 Optical Remote Sensing Instrument

A pioneering CMOS-type high-resolution optical Remote Sensing Instrument

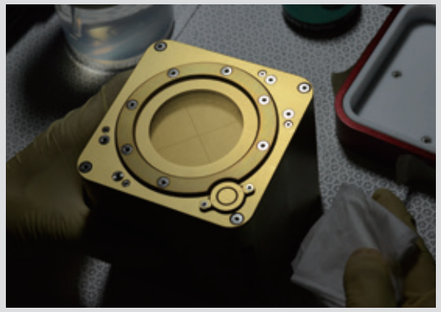
The National Space Organization's FORMOSAT-5 Optical Remote Sensing Instrument consists of three subsystems: the Telescope, Electronic Unit (EU), and the CMOS-type Focal Plane Assembly (FPA). The Telescope was completed and calibrated in 2014. The Electronic Unit employs high-capacity, high-density, stacked memory to reduce volume and weight, and has passed image compression ratio and system testing. The world's first CMOS-type FPA, which includes one panchromatic and four multispectral bands, has passed functional and reliability (lifetime) testing, and has been successfully integrated and tested with the Electronic Unit under thermal vacuum environment. The assembly and testing of the optical Remote Sensing Instrument is the final milestone of the FORMOSAT-5 program before finishing up all system level integration and test tasks.

National Space Organization

▶ Assembly of the FORMOSAT-5 optical Remote Sensing Instrument

The Ionospheric Probe with the World's Highest Sampling Resolution

Advancing the space scientific instrument development in Taiwan



▲ Advanced Ionospheric Probe

The Advanced Ionospheric Probe (AIP), an all-in-one scientific payload of the National Space Organization's FORMOSAT-5 satellite, will, for the first time, measure the characteristics of the ionospheric plasma, including composition, density, velocity, and temperature. In comparison with existing instruments, the AIP developed by National Central University has outstanding capability of a maximum sampling rate of 8,192 samples Hz to measure the fine structure of plasma irregularities, and an improvement of the spatial resolution from meter to centimeter. It is expected that AIP will yield major breakthroughs in the research of the characteristics of ionospheric plasma irregularities. This instrument has already passed a flight testing on the NSPO's sounding rocket 9 (SR-IX) and confirmed its design function integrity. The AIP will be launched with FORMOSAT-5 to carry out a space scientific mission.

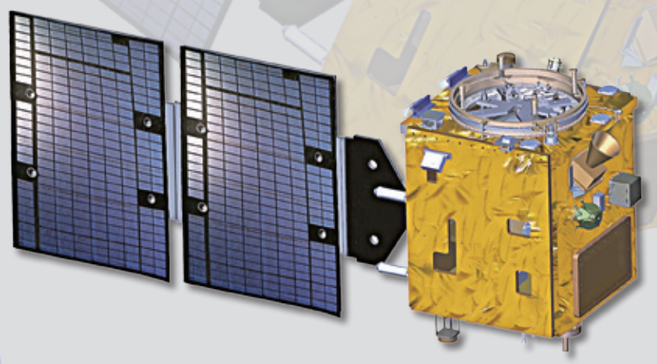
National Space Organization

FORMOSAT-7 NSPO-built Satellite Enters Detailed Design Phase

Development of NSPO-built 300-kg grade spacecraft bus heritable design platforms

The goals of the FORMOSAT-7 NSPO-built satellite project include: (a) To increase the overall reliability of the FORMOSAT-7 mission; (b) To serve as a verification platform for domestically made key spacecraft components; and (c) To become a standardized small spacecraft platform for future NSPO scientific missions. Through the completion of the Preliminary Design Review (PDR) in 2014, the design integrity of the spacecraft bus and the interfaces among spacecraft bus, launcher, and ground station have been preliminarily defined. Key domestically made spacecraft components include On Board Computer (OBC), Power Control Unit (PCU), Fiber Optic Gyroscope (FOG), GPS Receiver (GPSR), Reaction Control Subsystem Demonstration Module (RCS-DM), and satellite structure, all of which have completed detailed design and entered into the hardware manufacture and testing phase. Furthermore, NSPO is planning to develop a GNSS-Reflectometry scientific payload with support from domestic research institutes to fly with the FORMOSAT-7 NSPO-built satellite. The development of the scientific payload will kick off in 2015 and be completed in 2017.

National Space Organization



▶ The FORMOSAT-7 NSPO-built satellite

Development of a Spherical Grating for a Space-grade Hyper-spectrometer

The highest spectral resolution of gratings in the world

▲ The Space-Grade Spherical Grating

The National Space Organization and National Taiwan University of Science and Technology have jointly completed development of a spherical grating that comprises a key light-dispersive element in a space-grade hyper-spectrometer. This grating device has a wavelength range including visible light, near infrared, and short-wave infrared. The grating development project, the first of its kind in Taiwan, also facilitates the establishment of optical design simulation and aberration reduction optimization capabilities. The grating with a spectral resolution of less than 3 nm, is better than the current prevailing hyper-spectral resolution (NASA ~10 nm). In addition, even more importantly, the grating has an efficiency of as high as 70%, which is far better than that of existing gratings in the international market and highly competitive among international grating products. Apart from use in airborne/space-borne hyper-spectrometers, the grating also promises to have industrial applications, such as in optical communications and biomedical optoelectronics.

National Space Organization

Successful Launch of Sounding Rocket-10

Successfully performed six Ionosphere science payloads and spin control device verifications

The Sounding Rocket 10 (SR-10) of the National Space Organization was successfully launched from the Gio-Perng base in Pin-Tung at 11:10 AM on October 7, 2014. Its scientific missions are to perform the dynamic coupling measurements of the thermosphere and the ionosphere between 90 and 286 km in the upper atmosphere of southern Taiwan. In the SR-10 mission, there were six ionosphere science payloads and a spin control device, which were the first ones developed in Taiwan. The in-situ measurements of neutral particles, ions, electrons and magnetic data along the flight trajectory might be applied in validating the atmospheric data measured by FORMOSAT-3 and FORMOSAT-7 satellites. And the spin control device of SR-10 has accurately reduced the spin rates of the rocket which allowed adequate measurements of the scientific data.

National Space Organization

▶ Launch of SR-10 on October 7, 2014

FORMOSAT-2 10th Anniversary Conference

"Sentineling Taiwan and the World"-accomplishments of the FORMOSAT-2 after its first decade

The FORMOSAT-2 was successfully launched on May 21, 2004. After 10 years in operation, the FORMOSAT-2 has orbited more than 50,000 times around Earth, and has imaged a cumulative area roughly equivalent to 30,000 times the area of Taiwan, or approximately seven times the Earth's land area. In order to thank various partners for their support and assistance, NSPO held the "FORMOSAT-2 10th Anniversary Conference" on May 21, 2014. The heads of disaster relief organizations were invited to this event, along with domestic and foreign users and experts. Taking the opportunity of celebrating the FORMOSAT-2 10th Anniversary, NSPO also published an album gallery – "Under the Sky" which contains numerous collectable imageries taken by the FORMOSAT-2 satellite. And we present our blessings to FORMOSAT-2 for an extended continuation beyond the first decade, in guarding our beautiful home - Taiwan.

National Space Organization

1. FORMOSAT-2 10th Anniversary Conference
2. FORMOSAT-2 10th Anniversary Image Collections

Lightweight Composite Bridge for Emergency Disaster Relief

A powerful disaster relief tool providing fast access in emergencies

▲ A lightweight transportable emergency bridge made of composite materials

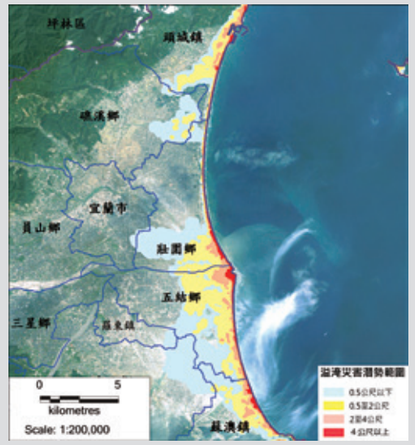
The flooding that occurred on August 8, 2009 caused the destruction of more than 100 bridges, which cut off numerous mountain communities from the outside world and prevented emergency disaster relief supplies and personnel from reaching these areas. In this type of situation, the "lightweight composite bridge for emergency disaster relief" can facilitate evacuation operations, enable the transport of foodstuffs to stricken areas, and minimize loss of life and property losses, and take advantage of the golden period for relief work.

By combining the advantages of composite materials with the structural features of an asymmetrical cable-stayed bridge, this technology overcomes the time restrictions imposed in the past by the use of temporary roadways and temporary steel bridges. In contrast, this transportable bridge can be assembled within 8 hours, and possesses the advantages of (1) quick assembly, (2) do-it-yourself use by residents, and (3) reusability.

National Center for Research on Earthquake Engineering

Establishment of a Tsunami Early Warning System and Disaster Scenario Database

Inundation's potential assessment and alert level



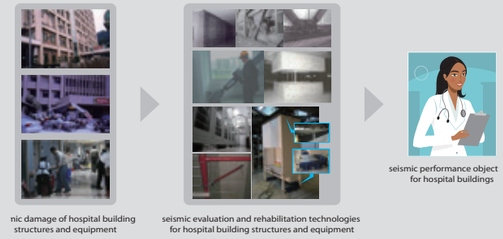
▲ Potential map of tsunami and inundation in coastal areas of Taiwan (the map shows the coast of Yilan County)

In light of the severe casualties and economic losses caused by the tsunami that occurred after earthquake Tohoku in Japan on March 11, 2011, NARLabs implemented the Project for the Establishment of a Tsunami Early Warning System and Disaster Scenario Database from 2011 to 2014. Apart from being able to provide tsunami inundation's potential maps for coastal cities and counties in order to facilitate the drafting of tsunami damage control plans, the system can provide information including maximum wave height, degree and area of inundation, and average water depth expected in relevant parts of Taiwan if a tsunami actually strikes. In addition, the system can also suggest alert levels for various towns, which will enable more efficient response and reduce deaths and injuries.

National Center for Research on Earthquake Engineering

Risk Evaluation and Reinforcement Guidelines for Hospital Buildings

Proper risk evaluation and rehabilitation of hospital buildings ensure medical functions after earthquakes



A designated hospital with responsibility for acute service must be able to provide emergency medical services after a major earthquake. However, from experience, hospitals require seismic performance improvements addressing both building structures and equipments if they are to provide emergency treatment and care to the large numbers of victims expected after an earthquake, as well as to avoid the problem of some hospitals in the disastrous zone needing to perform outside-care service, just like the case in the 921 earthquake which struck Taiwan on September 21, 1999.

The results of this study can provide the guidelines of seismic evaluation and rehabilitation for the Ministry of Health and Welfare, hospitals, and professional engineers. The guidelines integrate mature technologies of seismic evaluation and rehabilitation, and include advanced seismic performance improvement techniques for hospital buildings and critical equipments. NCREE has also conducted demonstrations to illustrate the proposed process of seismic evaluation and rehabilitation to achieve the seismic performance objectives for hospital buildings.

National Center for Research on Earthquake Engineering

Commemorating Ocean Researcher V; Looking Ahead to the Future

During her two years' operation supervised by the Taiwan Ocean Research Institute (TORI), NARLabs, *R/V Ocean Researcher V* began a new era of marine exploration in Taiwan. Since her first scientific voyage in February 2013, she has supported academic researches and participated in many energy-oriented explorations, completed numerous groundbreaking missions and amassed volumes of scientific data around Taiwan's coastal waters and territorial seas. Her milestone voyages, cover continental margins in the South China Sea, the James Shoal and surrounding reefs, Zheng-He Reefs and Spratly islands, where bathymetry and stratigraphy have been mapped. Investigations on detailed marine biodiversity ecosystem with extraordinary photo records have been conducted and core samples have been taken in areas of methane hydrate vents. The *R/V Ocean Researcher V* has successfully deployed the first Marine Weather Buoy near Itu Aba Island (Taiping Is.) and provided the most important monitoring capability at the southernmost territory. During her short commission, the vessel spent 417 days at sea, cruised a total of 95,723 kilometers and collected 26,242 GB of data. The longest voyage lasted for 23 days, cruising 9,081 kilometers.

When the *R/V Ocean Researcher V* was lost in an accident on October 10, 2014, Taiwan's oceanographic research capacity immediately suffered a severe blow. In order to quickly restore our marine research and exploration capabilities, the "*Ocean Researcher V* Incident Emergency Measures and Research Vessel Capability Reconstruction Plan" was initiated immediately and full-scale reviews of all research vessels were commenced. Accordingly, a new mission-oriented oceanographic research fleet with 5 various type/tonnage research vessels will be developed very shortly and operated with improved ship management systems similar to those of UNOLS in USA and JAMESTEC in Japan. With high expectation and commitment, TORI will strive to consolidate national marine science research and technologies to better serve the needs of government and academic researchers.

Taiwan Ocean Research Institute

Use of a Lidar Wind Profiler to Perform Wind Field Measurements

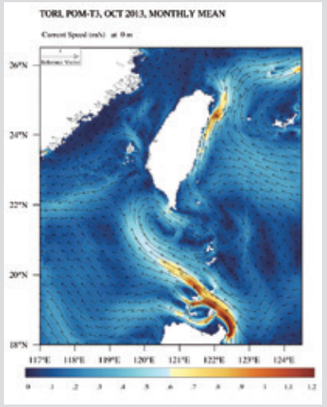
Lidar offers a powerful new tool for wind field research. Easy to deploy and flexible to use, lidar wind profilers have been successfully analyzed the wind field structure of typhoons

TORI studies marine and coastal wind fields using the Lidar wind profiler, WINDCUBE V2. The system applies the principle of Doppler frequency shift of laser pulses to perform high-resolution measurements at 12 heights. Three-dimensional wind structures are observed, giving horizontal wind speed, wind direction, and vertical velocity up to a height of 290 m. The Lidar is easy to set up and performs effectively with the function like moveable mast. The profiler has been employed to investigate wind characteristics over the sea and the coastal region. Besides, the wind speed distribution in the rotor swept range of wind turbines to evaluate power output curve will be studied and analyzed. Particularly, the typhoon winds have been successfully measured this year. The data obtained are very useful to interpret surface wind patterns. This will give a better understanding of the impact to our environments and the wind force on the structures.

Taiwan Ocean Research Institute

Ocean Radar Observation and Ocean Prediction Modeling-Taiwan Ocean Prediction System (TOPS)

TOPS makes effective use of computing power to compensate for marine observations and gain a better understanding of the characteristics and changes of the waters around Taiwan



▲ Simulation of a storm surge and tsunami in the waters around Taiwan

Taiwan Ocean Prediction System (TOPS) has relied on the state-of-the-art computing efficiency and the theoretical basis consisting of hydrodynamics and oceanography to gradually develop ocean numerical modeling technology. The well-verified numerical model can extend the spatial and temporal characteristics of data from observation points and compensate for insufficient ocean observations, which makes it a powerful tool for analyzing changes in the global characteristics of the sea. TOPS provides forecasts for currents, waves, storm surge, and tsunami in the waters around Taiwan. The development of the marine data value-added technology can also be employed to maximize the value of ocean forecasting data for marine environmental conservation, emergency rescue, economic development, recreation, academic research and disaster prevention.

Taiwan Ocean Research Institute

Ocean Radar Observation and Ocean Prediction Modeling-Taiwan Ocean Radar Observation System: TOROS

Realizing innovations through expansion of the coverage area, improvement of observation quality, enhancement of the value of observation systems, and active support for citizen applications

The Taiwan Ocean Observing System (TOROS) deployed by TORI provides surface current maps hourly for a large sea area in all weather. This is a modernized marine environment monitoring system for exclusive economic zone (EEZ) of developed country. This project began in 2009, and 15 individual systems have been completed thus far. It is expected that the establishment of a new monitoring system at Northeast coast of Taiwan in early 2015 will preliminarily achieve the goal of complete observation of surface currents surrounding Taiwan.

In 2014, the TOROS team made efforts on the improvement of data quality and promotion of applications. After enhancing signal stability, correctness, and applicability, the data output rate of 15 monitoring stations around Taiwan had been increased to more than 80%, and the surface current observation area had been expanded to over 124,896 square kilometers, which is equivalent to 3.47 times the area of Taiwan and 8% larger than before the improvement works. Besides, the TOROS team has engaged in numerous discussions with Kenting National Park, the Coast Guard Administration, and local ocean recreation operators, and has revised the information presentation methods of ocean weather in order to improve the System`s user interface applications.

Taiwan Ocean Research Institute

New Trends in Integrated Marine Geology and Marine Geophysics Research

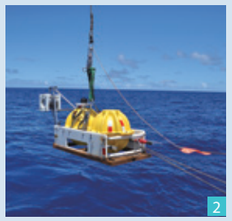
Establishing crustal cross-sectional surveying and mapping technology-diagnosing and sectioning marine geological disasters in the waters around Taiwan

Like a CAT scan of the human body, marine geophysical technique can snapshot perspective images of the earth. Besides by using the resulting images to study the evolution of the earth, scientists can also study crustal "anomalies" such as slope instability, submarine landslides, catastrophic earthquakes and fossil fuels distribution. However, different scientists may interpret facts concerning the same research topic in different ways. When it occurs, the best solution is to perform sampling or drilling and verify theories through geophysical exploration. To meet this need, the Taiwan Ocean Research Institute (TORI) has established an ocean bottom seismometer network, a long-offset multi-channel seismic system, and a 20 meters long-core sampler and analysis capabilities. TORI is using these three major diagnostic and sectioning technique to establish a crustal cross-sectional imaging and analysis capability from shallow to deep. The results will provide guidance for marine disaster prevention and mitigation policies.

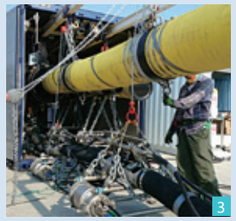
Taiwan Ocean Research Institute

1. Marine deposit sampling equipment: pistons/gravity core sampler.
2. "Yardbird" broadband undersea seismometer.
3. Container-type vibration source buoy array and air guns for the long-offset multi-channel seismic system.

1



2



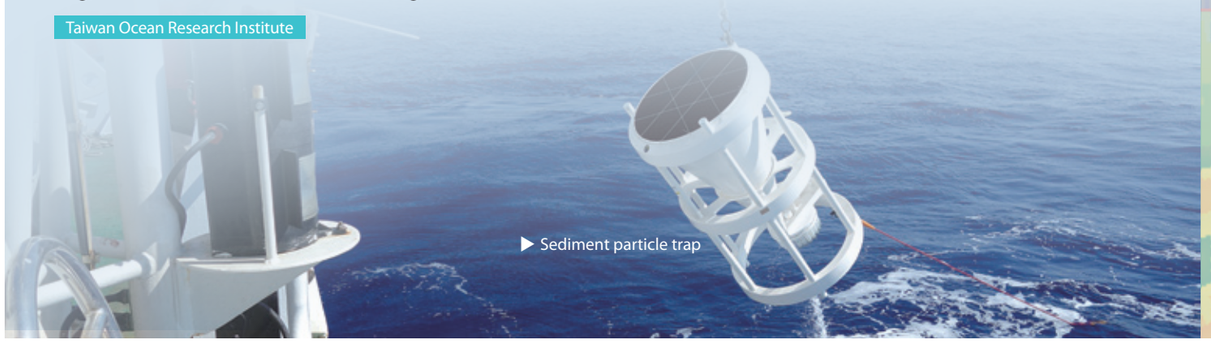
3

A Bottom-moored Sediment Trap Platform

Collecting sinking particles in bathypelagic zone to understand time series variation of marine environment

Taiwan oceanographic community has limited amount of observational data on and below the bathypelagic zone. These information, however, are fundamental to our knowledge of many ocean issues. TORI has resumed the deployment of bottom-moored sediment traps and current meters at 2000 and 3500 meters depths in the South East Asia Time-Series Station since September 2013. It not only records physical oceanographic information but also collects sinking particles into collection bottles at each depth on a preprogrammed schedule. These sinking particles are composed of organic matter, dead creatures, tiny shells, atmospheric deposition and terrigenous substances. Analyzing their fluxes of mass, organic C and N, opal, Al, P, trace elements, isotopes, pollutants, etc. might reveal the effects of climate change and human activities on the health of marine environment.

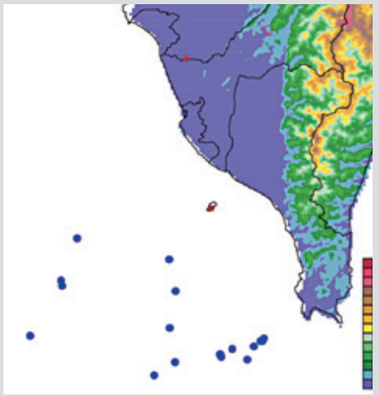
Taiwan Ocean Research Institute



▶ Sediment particle trap

Establishment of an Integrated Observational Network of the Atmosphere and Hydrology for Southwesterly Monsoon

Establishment of a joint observation team for the preliminary observation experiment of heavy rainfall associated with southwesterly monsoon



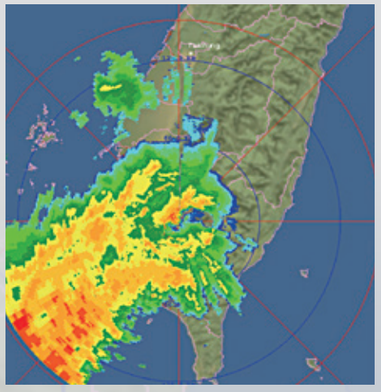
▲ Locations of intensive observational stations over land (red) and ship-borne soundings (blue) during the experiment.

Facing the challenges of global warming and climate change, the need for intensive meteorological observations is growing. To address this problem, the Taiwan Typhoon and Flood Research Institute (TTFRI) teamed up with other research units to establish a joint observation team, which serves for integrating resources for intensive observational experiment as well as enhancing students' abilities in observation. The preliminary observational experiment of heavy rainfall was conducted in southwestern Taiwan from May 26 to June 13 in 2014. During this period, three sets of intensive observations were conducted in which the soundings were released 4 times a day at given time and location. The intensive observations and data collected in this experiment provide a better understanding of how environmental characteristics affect the southwesterly monsoon as well as the characteristics of mesoscale convective systems.

Taiwan Typhoon and Flood Research Institute

Research Radar for Observing Precipitation over Mountainous Areas

Improvement of precipitation estimation over mountainous areas will enhance Taiwan's natural disaster early warning ability



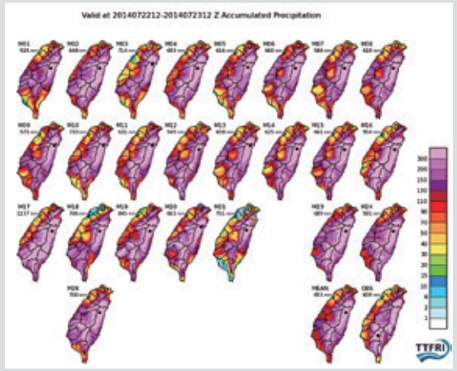
▲ Radar reflectivity of outer rain bands during Typhoon Fung-Wong in Sep. 2014

The Taiwan Typhoon and Flood Research Institute (TTFRI) installed an advanced dual polarization Doppler research radar in Shanlin District, Kaohsiung city which improves precipitation estimate for about 15% compared with the traditional one. The system also helps to detect the development of precipitation systems in mountainous areas over Tainan, Kaohsiung and Pingtung regions. The local precipitation mechanism can be better studied and heavy rainfall prediction in mountain areas can be further improved. In the future, transmitting the real-time radar observation data to Central Weather Bureau can be served as important guidelines for disaster prevention and mitigation efforts. Mechanisms of orographic precipitation can be better studied and catastrophic weather systems can be better understood using the radar data.

Taiwan Typhoon and Flood Research Institute

Establishment of the Ensemble Experiment Platform in Supporting Typhoon-induced Flooding Early Warning and Response

Enhancing accuracy of typhoon track prediction as well as heavy rainfall regions



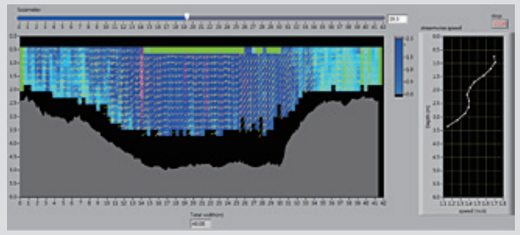
▲ Observed 24-hour precipitation (OBS) and averaged ensemble precipitation (MEAN) for Typhoon Matmo predicted by the Taiwan Quantitative Precipitation Ensemble forecast Experiment (TAPEX) with the model initialization time at 20:00 of July 22, 2014; precipitation for individual member is also presented.

The Taiwan Typhoon and Flood Research Institute (TTFRI) has teamed up with other relevant agencies and academic researchers to develop the Taiwan Quantitative Precipitation Ensemble forecast Experiment (TAPEX) using computing resources provided by the National Center for High-Performance Computing (NCHC). The results in 2014 showed that the ensemble averaged typhoon tracks is useful in prediction. In addition, the ensemble experiment was successful in capturing heavy rainfall areas such as northern Hualien County, Yilan County, and the mountains of southern and central Taiwan, when Typhoon Matmo passed over Taiwan. Ensemble members were also successful in predicting the geographical extent of heavy rainfall along the south coast of Taiwan during August 2014. Data from the TAPEX platform is also used by many official agencies for early warning and disaster responses, such as the Office for Emergency Management, Executive Yuan; National Science and Technology Center for Disaster Reduction; Central Weather Bureau; Water Resources Agency, MOEA; Taiwan Water and Soil Conservation Bureau; and Directorate General of Highways.

Taiwan Typhoon and Flood Research Institute

Development of Techniques for Non-contact Flow Observation

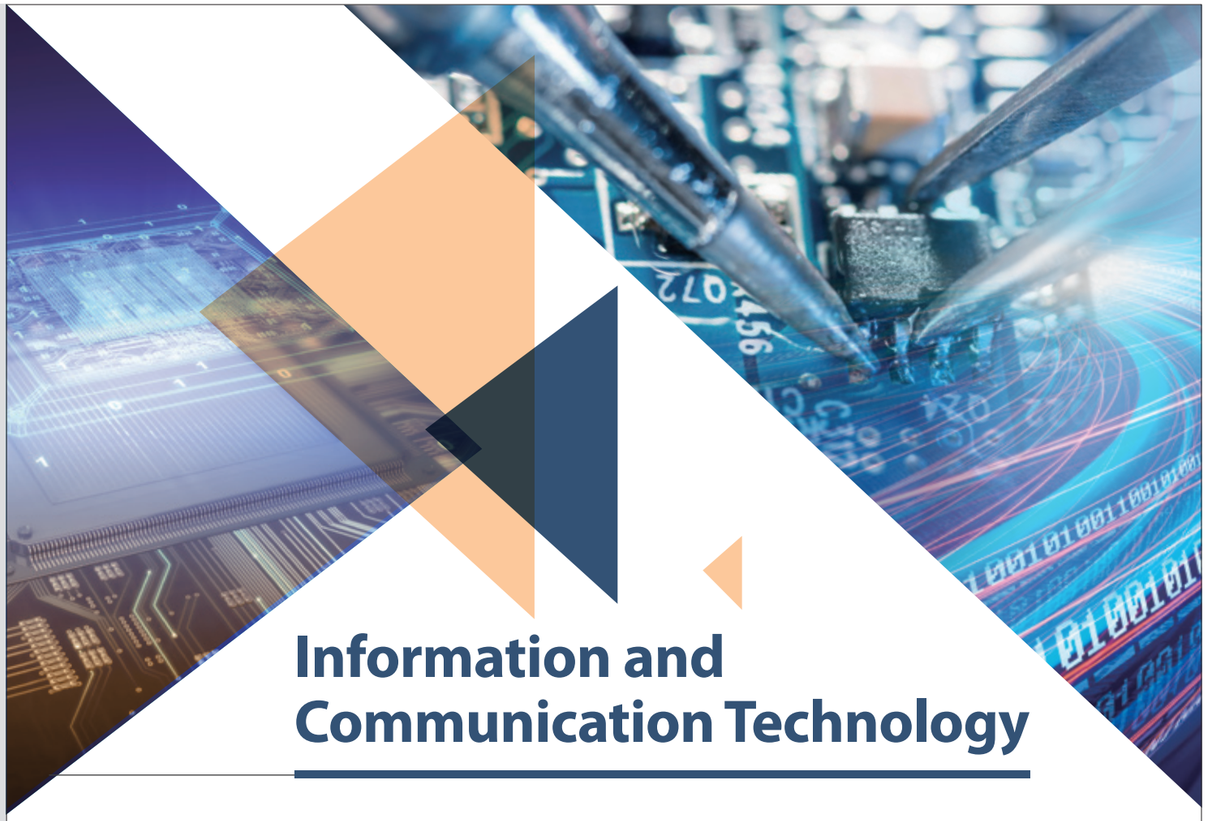
Real-time estimation of river cross section and discharge



▲ ADCP River Flow Analyzer (ARFA) on the ADCP post-processing GUI

The Taiwan Typhoon and Flood Research Institute (TTFRI) uses acoustic Doppler velocity profilers (ADCPs) to observe the river flow velocity and the cross section information during non-heavy rainfall days. The observed data are then used in conjunction with entropy theory to obtain the relationship among the surface flow velocity, cross section, and flow rate. Finally, the real-time estimation of cross section and flow during typhoons and torrential rain events can be obtained from the relationship and surface flow velocity measured by surface velocity radar (SVR) on site. TTFRI has also developed a proprietary ADCP River Flow Analyzer (ARFA) with a graphical user interface. This software can automatically process the signals from ADCP and increase observation efficiency. The software is promoted at an ADCP workshop. It enables hydrological engineers to conveniently perform flow observations and monitor the river regime.

Taiwan Typhoon and Flood Research Institute



Information and Communication Technology

Self-powered Technology for Internet of Things Chips

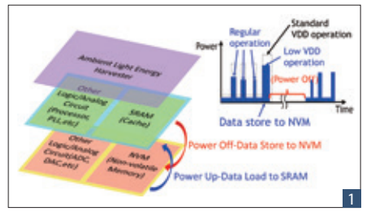
Development of key monolithic 3D-IC technologies and applications

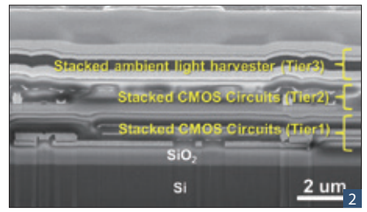
Technology related to the Internet of Things (IoT) has been continually developed and prevalently used, with the IoT Chips required for various application scenarios being suitably produced. The National Nano Device Laboratories (NDL) applied a low-cost, three-dimensional heterogeneous integration technique and successfully integrated low power consumption epi-like transistors, low operation voltage memory devices with, and silicon thin film ambient-light energy harvesters for an integration technique that combines self-power and ambient light energy in IoT Chips applications. This technique enables collecting various types of ambient light energy and applying energy storage devices (such as batteries or capacitors) to prolonging the charge cycle of an IoT wafer. The NDL offers this manufacturing-technique platform to IC designers for developing system-on-chip for integrated sensors and self-powered devices that can be applied to IoT and wearable devices.

National Nano Device Laboratories

1. Designing monolithic 3D-ICs with low power consumption logic circuits, non-volatile memory, and ambient light energy harvesting technology

2. A monolithic 3D-IC with ambient light energy harvesting technology under an electron microscope





Applications of Sub-10 nm 2D Electronic Channel Materials to 3D FETs

From planar to 3D, and from 3D to 2D

Today's advanced semiconductor production technology has already made the leap from planar elements to three-dimensional elements with varied gate structures. In order to keep up with the steadily-shrinking dimensions forecast by Moore's Law, the sub-10 nm elements of the future will inevitably incorporate materials with even faster channels. After successfully developing "double-fin FinFETs" in 2013, the Nano Device Laboratory (NDL) recently incorporated novel high-speed 2D electronic materials in 3D field effect transistors (FETs). NDL's newly developed mixed-layer channel transistors produced from molybdenum disulfide on a silicon substrate are the first elements of their kind to achieve N-type/P-type complementary symmetrical operation in low-voltage operation, and they pave the way for the production of 2D N-type elements with driver currents in excess of 25%.

National Nano Device Laboratories

A Si-based IR Photodetector

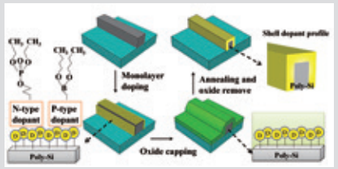
Overcoming the inherent inability of silicon-based materials to detect the infrared radiation used in communications

National Nano Device Laboratories (NDL) joined forces with the Graduate Institute of Materials Science, National Taiwan University in using NDL's 6" process to develop a low-cost Si-based infrared photodetector that is compatible with current CMOS standard processes. This result completely overcomes the difficulty of using silicon in long-wavelength optical communication, and also avoids the high cost and complex processes entailed by III-V family elements. The team's research has successfully produced relevant elements using a pure silicon process for the first time in Taiwan. Compared with the efforts of other research teams worldwide, the project team has succeeded in enhancing conversion efficiency by a factor of several hundred to create Taiwan's new industry. Relevant R&D results have been published in the prominent international journal Nature Communications.

National Nano Device Laboratories

Novel Junction-less Field-effect Transistors

Helping chip manufacturers produce even smaller electronic elements



▲ Use of super shallow doping technology involving molecular self-assembly to produce novel junction-less FETs

Junction-less transistors use the simple concept of resistance with one gate to control the density of carriers. Since this type of structure is still easy to produce at even a nanometer scale, the transistors will be less expensive to manufacture. However, as their size continues to shrink, junction-less transistors still face challenges, such as random dopant fluctuation and the short channel effect. NDL has developed a junction-less transistor with a novel structure by achieving an ultra-shallow dopant profile, which ensures that dopants are distributed solely on the channel surface. This design concept ensures that the flow of carriers is concentrated in the outer shell channel, which can eliminate random dopnt fluctuation problems and short channel effects.

National Nano Device Laboratories

MorSensor Wireless Sensor Building Blocks

Like playing with building blocks, users can easily and quickly assemble the MorSensor blocks to build sensing systems with different functions, which will accelerate the innovation process

▲ MorSensor wireless sensor building blocks

▲ A posture sensing system made from sensor building blocks

The MorSensor wireless sensor building blocks consist of modular sensing blocks that can be assembled to form integrated sensing platforms with a multilayer structure. The MorSensor building blocks can be used to combine various types of sensors, which can be used in conjunction with cell phone or PC apps to demonstrate sensor applications. Appropriate MorSensor building block configuration can be employed to incorporate sensors in various types of sporting equipment, clothing, or accessories, and the versatile building blocks can also be attached to surfaces made of different materials. The CIC's wireless sensor building block system platform provides academic sensing element development teams with a reference platform that can quickly be used for system integration and system demonstration.

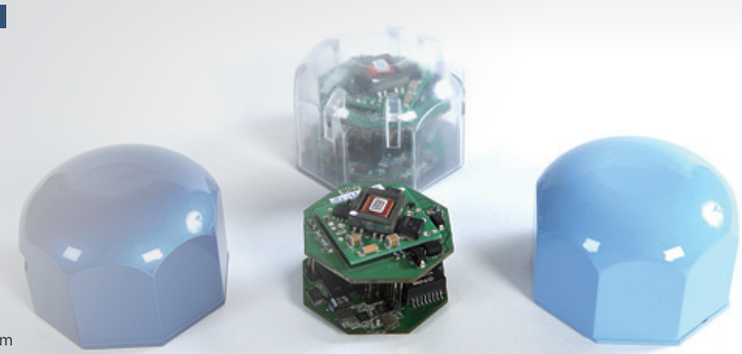
National Chip Implementation Center

Bridge Structural Safety Sensing Node System

Real-time sensing of bridge safety can protect the public and reduce property losses

The Chip Implementation Center has recently begun implementation of a disaster prevention bridge safety monitoring system R&D project in conjunction with the Executive Yuan's "Science and Technology Development and Implementation Program for Strengthening Disaster Prevention." This project, which is being conducted in a demonstration area along the Zhuoshui River, has completed the design, development, and production of a bridge structural safety sensing node system, including a bridge body sensing node system and an underwater sensing node system. The underwater sensing node system comprises a power module and core module; the system's control work station relies on a POE switch with its own power source to access data from the underwater sensing node system. Testing and verification of the sensing node system has also been completed, and it was installed on the Zhuoshui River Bridge at the end of 2014 to perform real-time monitoring.

National Chip Implementation Center



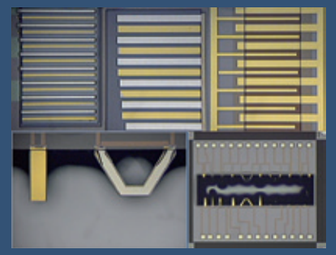
▶ The underwater sensing node system

Multi-option 0.35 μm CMOS MEMS

A high-performance platform that can integrate motion, environmental, and biomedical sensing applications

The Chip Implementation Center has developed a 0.35μm complementary metal oxidation semiconductor micro-electromechanical system (CMOS MEMS) process platform able to facilitate the integration of semiconductor circuit design, micro-electromechanical sensor structure, gold and platinum electrode materials. The platform can enable more sensing functions in a single chip to realize future "Internet of Things" applications.

National Chip Implementation Center



▲ A high-performance platform that can integrate motion, environmental, and biomedical sensing applications, and can be used in future "Internet of Things" and intelligent living products.

0.18 μm CMOS MEMS

Effectively reducing the production cost of CMOS sensing system chips and R&D development time

Taking advantage of Taiwan's semiconductor supply chains, the Chip Implementation Center has developed a 0.18 μm CMOS MEMS technology, and has now successfully integrated a triaxial accelerometer in an ordinary IC chip. With advantages including low cost and tiny dimensions, this chip technology can help academic researchers and companies to develop single-chip sensing applications. This advance will lend new energy to Taiwan's ICT industry and help make wearable/IOT devices a reality.

National Chip Implementation Center

A High-resolution Automatic Optical Inspection System for Wafer-form and Chip-form LEDs

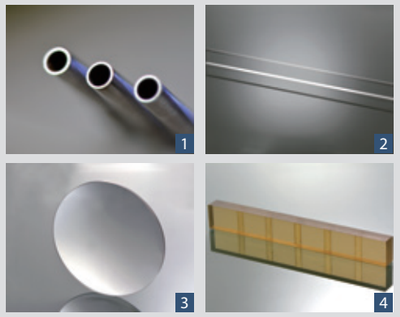
A new powerful inspection tool for Taiwan's semiconductor industry

Demand for automated inspection equipment able to boost QC and production performance, while cutting costs, has kept pace with the continuing miniaturization of semiconductor products. This optical defect inspection platform and technology developed at ITRC possesses the high-resolution inspection and measurement capabilities needed by the semiconductor industry, and offers spatial resolution (1.83μm) and field of view (4.2 x 2.8 mm) better than similar inspection systems currently on the market (3~5μm resolution), while also providing superior precision and lower cost. The inspection system can be used to check the surface of either wafer-form or chip-form LED for electrode defects and edge defects, etc. ITRC is currently continuing to improve its prototype system, and expects the system to be able to complete defect inspection of a 4" LED wafer within 20 min. in the future. By replacing the current manual inspection methods, the system will boost the competitiveness of Taiwan's LED industry.

Instrument Technology Research Center

Breakthroughs in the Autonomous Manufacturing of Optical Elements for Semiconductor Equipment

ITRC develops customized optical systems and elements for semiconductor process equipment



1. Elevation pins (length: 120 mm, end diameter: 4.5 mm)
2. The quartz light guide rod (size: 447×34×14 mm)
3. The i-line glass lens (size: 152 mm)
4. The Zerodur reference mirror (shape accuracy/flatness ≤ λ/10 @ 632.8 nm)

The Instrument Technology Research Center (ITRC) has developed new optical elements needed in wafer positioning platforms for semiconductor lithography equipment. These elements meet accurate positioning requirements and overcome the problem of deformation when optical elements are subject to heat. The Zerodur reference mirror and i-line glass lens completed at ITRC can be used in measurements involving precision positioning platforms in semiconductor equipment and in the illumination and projection lens system for semiconductor lithography equipment. ITRC has also completed an elevation pin with surface roughness of less than 30 nm for use in wafer transport devices. This pin has passed verification by semiconductor process equipment manufacturers, and ITRC continues to provide small batch production service. In addition, ITRC has accomplished development of a quartz light guide rod that boosts the current rectangular quartz rod production capacity from 250 mm to 450 mm. These quartz light guide rods will be used in a lithography illumination system developed in-house. The foregoing four R&D results all involve key precision optical elements used in semiconductor process equipment, and will increase opportunities for the manufacture of localized semiconductor equipment in Taiwan.

Instrument Technology Research Center

ITRC's Hyperspectral Imaging Technology Wins International Renown

Taiwan-Australia collaboration for marine testing: The first trial of an underwater hyperspectral imager in Australia

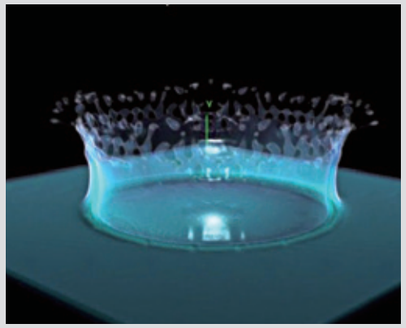
▲ Underwater hyperspectral imager results presentation conference

The hyperspectral imaging instrument technology developed at the Instrument Technology Research Center (ITRC) is unrivalled in the world. This year, with funding from the South Australian Premier's Foundation, ITRC joined forces with National Cheng Kung University and the Australian Water Quality Centre to use the underwater hyperspectral imager developed at ITRC in performing monitoring and management of the underwater environment. In May of 2015, ITRC was invited to participate in an undersea ceremony at Saint Vincent Bay, South Australia, where the first trial of the underwater hyperspectral imager in Australia was performed. A successful case of domestic scientific diplomacy, the project received coverage on Australian TV, and was also the subject of a press conference after the team returned to Taiwan. The R&D team has obtained further funding from Australia, and plans to conduct an underwater seagrass observation project in the future as part of its plans to apply this technology to the detection and assessment of environmental changes, and monitoring of restoration work.

Instrument Technology Research Center

3D Special Effects Simulation and Cloud Rendering

Enhanced cloud browsing and developed accelerated special effects algorithms



▲ New technology results of Render Farm; GPU-accelerated milkcrown simulation

The upgrading of the National Center for High-Performance Computing's (NCHC) Render Farm allows remote users to directly browse and manipulate complex 3D software operating procedures on the Render Farm's graphic processing unit (GPU) computing nodes via a prototype cloud desktop system, which shortens users' animation processes. Furthermore, the NCHC completed the GPU-accelerated milkcrown simulation technology that accelerated simulation performance of the splashing water droplets, formed when a falling drop hits the water surface, from 3.2 to 5.5 times better than the simulation performance done by CPUs. This technology was selected for presentation at the 2014 SIGGRAPH Asia, which attracted nearly 6,000 attendees. In the future, the technology will be applied to the production of visual special effects involving splashing water.

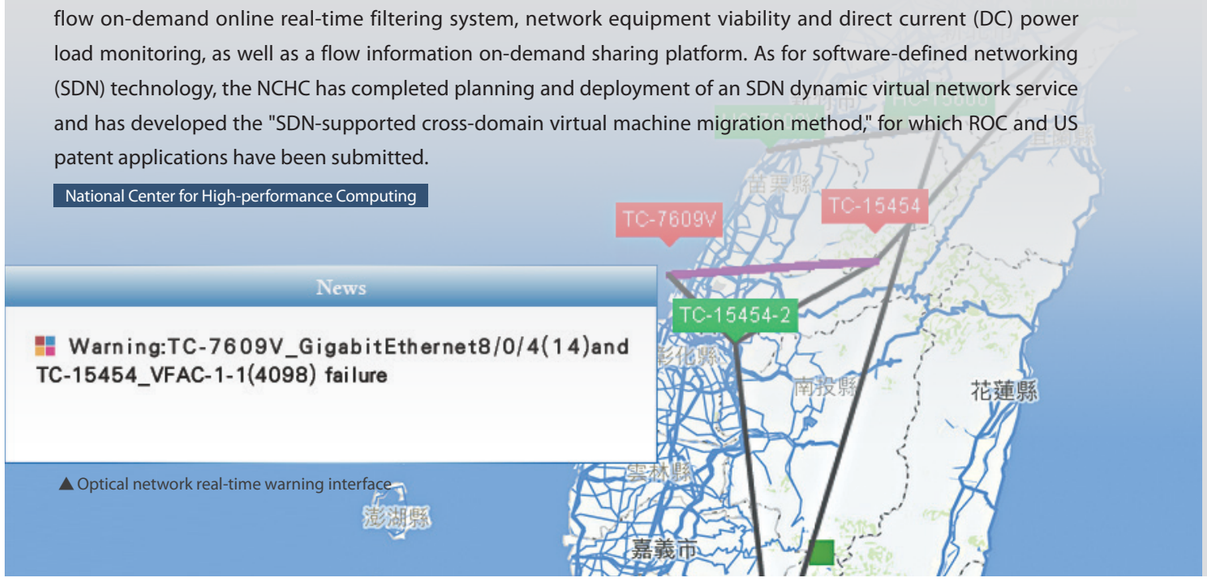
National Center for High-performance Computing

TWAREN Management and SDN Technology

Added seven new functions and one platform; continuing development of various network management functions to ensure high network availability

National Center for High-Performance Computing (NCHC) operates the Taiwan Advanced Research and Education Network (TWAREN) and develops relevant network management methods and technologies in order to ensure high network availability. In 2014, the NCHC added seven new network management functions and one platform in TWAREN, including log quantitative trend statistics, flow trend charts, network one-way packet loss monitoring, domestic and foreign router monitoring and positioning, optical network real-time warning system, network flow on-demand online real-time filtering system, network equipment viability and direct current (DC) power load monitoring, as well as a flow information on-demand sharing platform. As for software-defined networking (SDN) technology, the NCHC has completed planning and deployment of an SDN dynamic virtual network service and has developed the "SDN-supported cross-domain virtual machine migration method," for which ROC and US patent applications have been submitted.

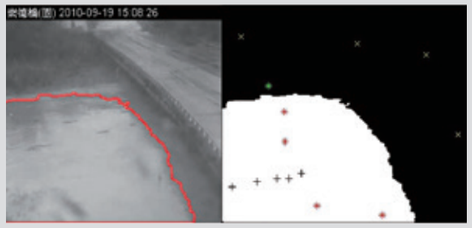
National Center for High-performance Computing



▲ Optical network real-time warning interface

Big Data Image Recognition and Analysis Technology

Facilitating big data image processing and analysis



▲ Facilitating big data image processing and analysis

The National Center for High-Performance Computing (NCHC) has developed the big data image recognition technology which can monitor the water level on rivers, bridges, and reservoirs. At present, the NCHC cooperated with the Water Resources Agency, MOEA in the development of a system that can simultaneously process over 200 monitoring images. This technology can be applied to inspection of rebar with an accuracy of 99%. The technology can further be used to estimate the number of people in dense crowds.

National Center for High-performance Computing

Biomedical Database and Analysis Platform

Fruit fly brain neural database

▲ New molecular marker for liver cell tumors-the gene DUNQU1, found by using this platform

The National Center for High-Performance Computing (NCHC) integrated its facilities in the development of a fruit fly brain neural gene database and the next-generation sequencing data platform. These systems facilitate scientists to extract phenotype-linked groups of genes with biological significance or find key biological pathways and disease-causing mechanisms from huge bodies of data.

National Center for High-performance Computing

Earth Science Observation Knowledgebase

Taiwan's first peta-scale earth science database

The National Center for High-Performance Computing (NCHC) developed Taiwan's first peta-scale earth science database, Earth Science Observation Knowledgebase (ESOK). It contains observation results extending from space and the atmosphere to the sea and the interior of the earth. In conjunction with high-performance computing and big data analysis technologies, ESOK offers integrated database services. Data are currently accumulated into ESOK at a rate of 100 TB annually, and it can process more than 18,000 high-frequency data items per second. Through the NCHC's integration measures, the database enables users to make diachronic, cross-field, cross-space, and cross-event queries. In addition to assisting in natural disaster management, the database also facilitates environmental and ecological sustainability research.

National Center for High-performance Computing

Disaster Information Management Platform

Providing integrated disaster prevention and relief information

The National Center for High-Performance Computing (NCHC) integrated satellite data, near-shore data, and disaster prevention and relief databases for local communities. The NCHC completed the integration of flood module in 2014. The platform provides topography browsing through areas of interest as well as overlaying satellite images of different years to view the changes for loss assessment.

National Center for High-performance Computing

3D Printing Cloud Service Platform

The NCHC integrated resources and tools to provide scanning and software services for 3D printing

▲ The NCHC's 3D scanning service uses scanners to produce three-dimensional numerical models.

3D printing has become a new design-oriented production method and opens up tremendous room for imagination. The National Center for High-Performance Computing (NCHC) established a 3D printing cloud service platform integrating relevant resources and tools to provide scanning and software services for 3D printing. Users can run modeling software, query image libraries, and download tools and resources directly from the website. It benefits users in many fields, such as of national defense, machinery manufacturing, consumer goods, cultural creativity, and medical industry.

National Center for High-performance Computing

Collections of 4G-LTE Standard-essential Patents

More than 6,000 SEPs could snapshot worldwide leading companies' tech portfolio

Evolved Universal Terrestrial Radio Access (EUTRA), known as the Long Term Evolution technology, brings cellular communication to the fourth generation (4G) era, and at the same time 4G LTE is also a critical infrastructure for Internet of Things (IoT), mobile cloud services, and next generation of mobile technologies. Companies worldwide have been actively participating in 4G LTE R&D activities. To catch up to the leading companies, based on the gathering of worldwide patents analysis, Taiwan's companies need to develop plans for accelerated R&D activities, keep innovating and even proposing the "standard-essential patent" (SEP). In the "Research Project on Telecommunications Industry Patent Trend and Patent Litigation Analysis," which has been conducted under the commission of the Intellectual Property Office, MOEA, STPI has accumulated more than 6,000 4G-LTE SEPs. Dozens of experts and scientists read the patents, summarized technical focus, tagged the types of usage, performance, and tech features, and also disclosed what the corresponding 3GPP technical specifications are. More project details can be accessed for free at https://tiponet.tipo.gov.tw.

Science & Technology Policy Research and Information Center

Biomedical Technology

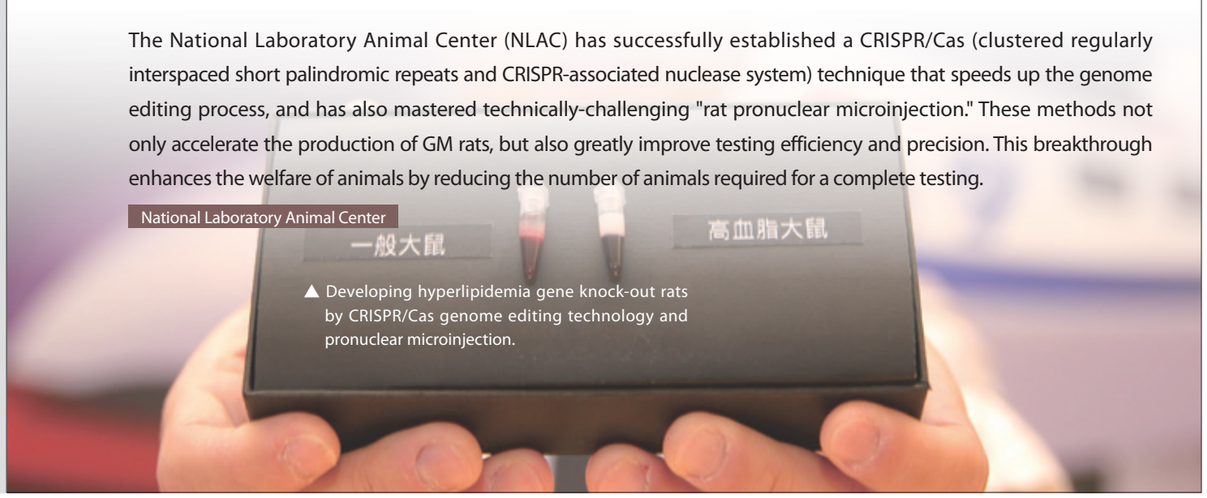
CRISPR/Cas Genome Editing Technique Accelerates Drug Development

Developing genetically modified rodents in one-tenth time and at one-fifth cost

Fast genetically-modified (GM) rodent production and shortened preclinical testing process are important for new drug development. Rats are the most commonly used animal in preclinical testing, but technical bottlenecks prevented the development of GM rats in the past, forcing researchers to conduct testing with GM mice.

The National Laboratory Animal Center (NLAC) has successfully established a CRISPR/Cas (clustered regularly interspaced short palindromic repeats and CRISPR-associated nuclease system) technique that speeds up the genome editing process, and has also mastered technically-challenging "rat pronuclear microinjection." These methods not only accelerate the production of GM rats, but also greatly improve testing efficiency and precision. This breakthrough enhances the welfare of animals by reducing the number of animals required for a complete testing.

National Laboratory Animal Center



▲ Developing hyperlipidemia gene knock-out rats by CRISPR/Cas genome editing technology and pronuclear microinjection.

Aged Mice-A Powerful Tool for Degenerative Disease Researches

Naturally aged mice for degenerative disease treatment development

The aging and elderly populations are growing worldwide. The progressive loss of body functions often lead to degenerative diseases, which make researchers pay more attention on geriatric medicine. Many degenerative processes in mice are similar to those in human; therefore, aging mice are excellent models for research. Naturally aged C57BL/6JNarl mice, aged 12-24 months, from NLAC can be used in geriatric medicine, anti-aging and degenerative disease researches. NLAC has established an aged mouse database to fulfill the demand of aging research.

National Laboratory Animal Center

Eight Surgically Induced Disease Animal Models

Animal models used in preclinical drug testing shorten the pathway from researches to the industrialized stage

NLAC has established surgically-induced animal models to cover four major areas: reproduction, urinary metabolism, the endocrine system, and immunity. The procedures include castration, vasectomy, ovariectomy, ovariectomy & hysterectomy, unilateral nephrectomy, 5/6 nephrectomy, adrenalectomy, and splenectomy. NLAC provides qualified, reliable animal models for preclinical drug efficacy testing. The service reduces the cost of animal experiment and the risk of getting undesired outcomes in the clinical trials of Taiwan.

National Laboratory Animal Center

An "Impossible" Mission on the Development of Gene Targeted Mouse

The high-quality mouse embryonic stem cells and blastocyst injected hosts increases Taiwan's international recognition

NLAC joined the International Mouse Phenotyping Consortium (IMPC) due to its high-efficiency genetic modification ability. In 2015, NLAC received an international "impossible" mission - to develop 20 gene targeted mice that are urgently needed, but with great technical challenges. NLAC isolated embryonic stem cells from C57BL/6N mouse strain, and used albino mice as hosts to develop green fluorescent expression by blastocyst injection. Consequently, gene targeted mice may be identified by the fluorescent expression, shortening the selective breeding process and reducing the number of animal use. The "impossible" mission completed by NLAC enhances Taiwan's international status.

National Laboratory Animal Center

▲ Albino mice with green fluorescent protein (GFP) expression enables rapid selection, accelerates gene targeted mouse development.

Science and Technology Policy

Strengthening "National Profiles of Human Resources in Science and Technology" Services

Sustained attention to PhD-related issues by developing a high-level human resources database and in-depth analysis services for industry, government, academia, and research organizations

The "National Platform on Human Resources in Science and Technology" (NPHRST) has been dedicated to periodically collecting Taiwan's PhD holders' data regarding their education background and career pathway accessible to the public on various websites. In 2014, STPI launched the "Annual Survey of Earned Doctorates in NPHRST" with regard to PhD holders' career issues, striking a chord among the stakeholders. In the future, NPHRST will keep on providing the statistical information and science policy analysis to high-level decision-makers in domestic industry, government, and academia.

Science & Technology Policy Research and Information Center

The STPI Research Portal

Gathering sources of knowledge and innovation

The Research Portal is a major channel for presenting research of STPI, one of the most important science & technology (S&T) policy think tanks in Taiwan. By presenting perspectives on critical S&T policy issues, the Portal aims to offer high-quality content services to all citizens concerned with S&T policy and development. The Portal also provides value-added information containing key terms to help readers absorb background knowledge and link relevant online resources. The Portal will continue to expand its services, with the vision of enhancing citizens' knowledge and awareness of S&T trends, and helping the government to promote S&T affairs.

Science & Technology Policy Research and Information Center

Patent Information Services-Building a Bridge between S&T and Industry

Using subtle clues to find opportunities for S&T and industrial development

Based on patent information, The Science & Technology Policy Research and Information Center (STPI) is capable of monitoring the technology development tracks and regional patent portfolio to understand the trends and competition states in different industries and technologies. Through a systematical and structural data compilation, the statistics of patent information can be additionally interpreted beyond the technology boundaries. The solid achievements of 2013 include: the macro trend analysis of patent issue, the fundamental S&T capability of industries, patent analyses in specific topics, such as Solar-cell battery, Multimedia Broadcast Multicast Services (MBMS), Intelligent wearable devices, litigation strategies in selected U.S. patent litigation cases, wireless communication standard version in 3GPP Beyond 4G, and so forth. There are also more than 28,600 subscribers of iKnow (innovation Knowledge) website and accumulated 920 patent information reports till 2014.

Science & Technology Policy Research and Information Center

International Conference on Science and Technology Entrepreneurship Policy and Regulation

Important think tanks and experts from Taiwan and abroad were invited to advise on Taiwan's S&T policy environment of innovation

To review the obstacles and restrictions on Taiwan's present entrepreneurship policy, regulation, and entrepreneurial environment, STPI, NARLabs, George Washington University (USA) and the University of Ottawa (Canada) together organized the "2014 International Conference on Science and Technology Entrepreneurship Policy and Regulation". The conference concluded with the following suggestions: creating an ecosystem of innovation and entrepreneurship, deregulating under certain regulations so that college and university professors can participate in start-up businesses while avoiding conflict of interest, and establishing a legal framework with no barriers to innovation. All these suggestions contribute to the formulation of policies on science, technology, and innovation in Taiwan.

Science & Technology Policy Research and Information Center

A Demand-oriented Foresight Method

Establishment of scientific research topic selection processes and mechanisms

The Science & Technology Policy Research and Information Center (STPI) relies on observation and analysis of trends in the external environment to implement demand-oriented forward-looking analysis aimed at uncovering future S&T development trends and directions in important fields. STPI also relies on expert opinions and evidence-based data analysis to help government agencies establish mechanisms and processes for the selection of emerging S&T topics. This year, STPI has helped the Ministry of Science and Technology to uncover global academic development focal points and future research hotspots in the areas of electronics, computers, and communications, electrical machinery, and chemicals & materials. STPI's preliminary recommended focal points include wide band gap semiconductors, sensors, and high value-added technologies for use of non-grain biomass resources. These focal areas of scientific research possess great potential application value for Taiwan's industries during the coming three to eight years.

Science & Technology Policy Research and Information Center

Innovation Ecosystem Research and Planning

Assisting innovation policy drafting and mechanism planning; providing important decision-making references and support

In line with its mission of promoting research and development concerning innovation ecosystem operation and industry-academia collaboration innovation, assisting the governance of S&T development, and drafting innovation policies as well as planning of relevant mechanisms, STPI accomplished the following major achievements in 2014: (1) Implementation of projects commissioned by MOST, such as "Planning and Implementation of Measures to Strengthen Industry-Academia Collaboration and Innovation in Science Park"; (2) Provision of significant research insights in nearly 10 crucial issues to support MOST for policy recommendations (including special project reports at the Executive Yuan Council Meetings), etc.

Science & Technology Policy Research and Information Center

▲ Hosting the "Science Park Innovation Development Brainstorming Conference" (April 2014)

▲ STPI, NARLabs invited a delegation including MOST Vice Minister Ter-Shing Chen (5th from right) to visit the Zhongguancun Science Park in Beijing, and take a photo with Director Hong Guo (4th from left) of the Zhongguancun Science Park. (November 2014)

Leading Industrial-academic Collaboration

Working in conjunction with the Ministry of Science and Technology's nationwide S&T development, NARLabs serves as a provider of technological manpower and R&D platforms needed for the innovation economy. NARLabs helps connect upstream R&D results with downstream applications and guide industrial/academic collaboration. From innovation to value creation, NARLabs strives to accelerate the development of value-added applications of R&D platforms and increase the integration of Taiwan's S&T and industry value chain.

NARLabs Signs Strategic Alliance MOU with the Entrepreneur Club

Promoting industrial upgrading and creating new opportunities for industry-academia research cooperation

▲ President Ching-Hua Lo of NARLabs (7th from left) turns on the lights at the signing ceremony together with former Chairman Kuo-Chou Tsai of the Entrepreneur Club (7th from right) and other distinguished guests.

If Taiwan's economy is to continue to advance, apart from further developing high-tech industries, the upgrading of traditional industries is also extremely important. In order to assist in the promotion of industrial development, NARLabs signed a strategic alliance MOU with the Entrepreneur Club on March 1, 2014. This agreement calls for inter-domain and inter-industry cooperation between NARLabs with its cutting-edge science and technology and the Entrepreneur Club with its entrepreneurial resources. It is hoped that the agreement will promote communications among industry, academia, and research organizations, which will foster new opportunities for industrial development. A total of roughly 270 guests attended this solemn and highly successful event, including important figures from the Office of the President, Legislative Yuan, Taichung City Government, and universities in central Taiwan. The new-formed strategic alliance will provide industry access to NARLabs' R&D platforms and services, and enable NARLabs to help industries form innovative clusters. Industrial cooperation is a key driver of technological innovation, and NARLabs hopes that the strategic alliance can effectively bring about the further transformation of industry. Both parties look forward to striving to enhance Taiwan's economic strength in the future.

Mining Deposits of Scientific Innovation-Promoting Technological Entrepreneurship in Taiwan!

160 teams participate in training, establish 28 start-up companies, and raise over NT$73 million in funding from domestic and overseas sources

▲ The winners of NT$2 million in startup funds-together with Science and Technology Minister Simon Chang, President Wu Cheng-Ching of China Bills Finance, and President Shih of Stan's Foundation, 2013.

The "From IP to IPO" program is an incubation project using entrepreneurial resources to help academic research teams to support on technological startups, and it is expected that the program will renew the vigor of Taiwan's industries. Starting in March 2013, the program has brought about the issuance of 853 startup proposals and provided training to 675 would-be entrepreneurs. The program has called on a number of heavyweight figures including Silicon Valley venture capitalists and prominent corporate managers to provide insider guidance and help the teams gain marketing, legal, and fund-raising knowledge through in-depth lectures and training workshops. The program also provides startup funds to help the intrepid teams to make progress toward realizing their dreams, and eventually create a fertile startup ecology growing in the rich soil of science and technology.

Fruitful Achievements of Industry-academia Research Strategic Alliances Promise to Yield Trillion NT Dollar Production Value for Taiwan

Some of the most notable achievements of cooperation between NARLabs and industry, academia, and research organizations during the year included the "NARLabs Medical Instruments Value Creation Alliance", which provides the integrated medical instrument's services, the "Sleep Disorder Risk Assessment Platform" developed by NCHC and Horien Itl. Co., and the "Earthquake Early Warning Service" promoted by NCREE and Taiwan SECOM. These milestones show that NARLabs' efforts to derive value creation from technological innovation are bearing fruit.

1. Distinguished guests at the press conference for the inauguration of the "NARLabs Medical Instruments Value Creation Alliance" included Legislator Pi-Han Chen, Legislator Chih-Chieh Hsu, Minister without Portfolio Tze-Chun Tu, and Li-Teh Chen, deputy director of the Council of Agriculture.
2. NARLabs is cooperating with Taiwan SECOM to promote an earthquake early warning service. From left to right: Director General Kuo-Chen Chang of NCREE, NARLabs; Chief Operating Officer Peter J. Sher of NARLabs; NARLabs President Ching-Hua Lo; Senior Vice President Frank Lin of Taiwan SECOM; General Manager Jung-Kuei Lee of Taiwan SECOM; and General Manager Hsing-Kuo Chou of Taiwan SECOM
3. NARLabs President Ching-Hua Lo (left) is shown with President Kuo-Chou Tsai of Ginko International (right) at the signing ceremony between NARLabs and Horien International.

NARLabs Elite Presentation Opens the Door to Increase Industrial-academic Collaboration

Entrepreneur Club members and academic specialists bear witness to NARLabs' achievements

Planned and arranged by STPI, TTFRI, and NARLabs' headquarter, the 1st NARLabs Elite Presentation was held on June 10, 2014 at NCHC International Conference Room in Taichung. In addition to traditional research results contest among NARLabs' centers, members of the Entrepreneur Club and academic specialists were invited to attend this event. Furthermore, two outstanding entrepreneurs-President Enid H. C. Tsai of Hiwin Technologies Corp. and Vice CEO Charlie Ho of Horien International Co., Ltd. shared the perspectives of industry, and also witnessed the unveiling ceremony of NARLabs' Industry Liason Office. This event was attended by 156 persons from NARLabs, university and industry. NLAC, NDL and NCREE received the top three awards respectively in this event.

ITRC's Optical System R&D Consortium Achieves Win-win Outcome for Industry and Universities

ITRC fosters 3 successful industry-academia collaboration cases in 2014

After establishing the Optical System Integration R&D Consortium in 2013, this year the Instrument Technology Research Center (ITRC) successfully collaborated with National Yunlin University of Science and Technology and M&R Nano Technology to implement the project "Development of an I-line Narrow Band Pass Filter Applied to Lithography Equipment for MEMS Process," teamed up with Chungho Memorial attached to Kaohsiung Medical University, and the medical equipment companies Taiwan Surgical Corporation and Lumos Technology, to develop the "Controlling Mechanism and Imaging Module of 5.9mm Micro Transnasal Endoscopy"; and also collaborated with Epistar Corp. and National Central University's Thin Film Technology Center to develop "Development of High-temperature plasma enhanced atomic layer deposition system applied to UV LED." ITRC is integrating its in-house resources with the capabilities of the industrial and academic sectors to promote the development of future industrial technologies and create tangible win-win outcomes.

New Industry-academia Research Alliance Forged at the 2014 BioTaiwan Exhibition

Bio ICT lays the groundwork for Taiwan's next biotech "diamond" industry

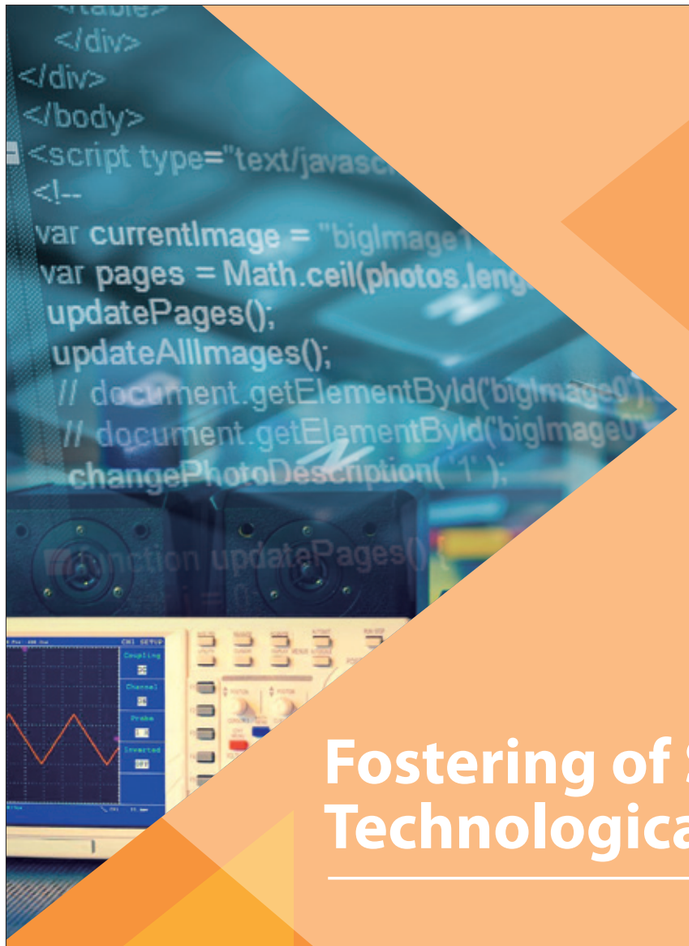
▲ President Ching-Hua Lo of the National Applied Research Laboratories, and other representatives sign the Bio ICT Cooperation MOU to promote Bio ICT industry in Taiwan.

The information and communications industry is Taiwan's most competitive industry, and many information and communications technology (ICT) firms are interested in entering the field of biotechnology. In order to help the ICT industry successfully integrate biomedical technologies, NARLabs, the Taiwan Bio Industry Organization, National Chiao Tung University, and Hukui Biotechnoloy Corporation jointly signed a cooperation MOU at the BioTaiwan Exhibition in July 2014. This agreement calls for the joint promotion of innovative R&D and focusing on the use of research results concerning value-added interdisciplinary applications. We expect the Bio ICT industry eventually to become Taiwan's next "diamond" industry.

The STPI "iKnow" Industrial Innovative Knowledge Service Platform

Helping Taiwan's companies upgrade from manufacturing to smart manufacturing

The Science & Technology Policy Research and Information Center's (STPI) "iKnow" (Innovation Knowledge) service provides one-stop service concerning industrial innovation knowledge, and uses a knowledge value-adding innovation service model to encourage industry to make the best use of their IP. The iKnow platform is currently relying on the Internet to achieve the diffusion of knowledge and offer the value-added intelligence service to the public. Close to 30,000 users from industry use the platform with more than 2.3 million service counts annually, including via cellphone application.



Fostering of Scientific and Technological Manpower

Under global competition, talent is our most important resource and also the key to sustaining national development. Cultivating scientific and technological manpower is one of NARLabs four major missions. We help establish links among professors, students, and industry via our innovative service platform. In addition, we continue to tap international human resources, with the ultimate goals of cultivating superior, innovative manpower and boosting Taiwan's international competitiveness.

Injecting Dynamism and Innovation into Taiwan's MedTech Industry

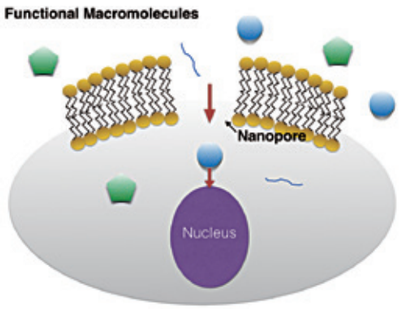
The first phase of STB program has reaped fruits of achievements: 30 STB fellows complete training and establish seven new startups

▲ The program head with STB fellows at Stanford School of Medicine

The Stanford-Taiwan Biomedical Fellowship Program (STB program) is a cooperative program in partnership with Stanford University, and supports multi-year projects intended to train entrepreneurial individuals specializing in the field of MedTech. It is hoped that this program will usher Taiwan's MedTech industry into a new age. A total of 30 STB fellows completed training in the first cohort of STB projects; apart from bringing back a plentiful MedTech innovation and entrepreneurship experience from Silicon Valley, several fellows have already successfully raised funds and established seven startup companies. Two of these startups currently have capital exceeding NT$100 million, some of the startups' products have obtained the European Union CE certification, and iXensor's product was selected in the eHealth Venture Summit and Innovation Award in MEDICA 2014. In July 2014, the Science & Technology Policy Research and Information Center (STPI) signed an agreement with Stanford University School of Medicine for a second phase of STB program, and it is expected that these projects will provide training to 30 MedTech entrepreneurship seed personnel, who will continue to inject dynamism and innovation into Taiwan's MedTech industry. In order to create even more successful startups, the STB program has arranged for trainees to participate in the "IN^3 Medical Device 360° Summit - San Francisco" in the United States for three consecutive years. Seeking to raise funds and find partners, fellows from four startup companies presented their innovative technologies at this event in 2014.

From Academic Discoveries to Commercialization at UCLA

Development of a magnetic particle platform for cell therapy



▲ Intracellular delivery of functional macromolecules through nanopores created by shape-anisotropic magnetic particles

Cell therapy has demonstrated many exciting results in cancer treatment and biomedical research. Nevertheless, there are challenges coming from translating research to clinical medicine. Intracellular delivery of DNA, siRNA, mRNA by liposomes and viral vectors are the conventional approaches, which results in the problem of cytotoxicity and only being able to target certain cell types. Instrument Technology Research Center has joined forces with a team led by Prof. Eric Pei-Yu Chiou of the Department of Mechanical Engineering at UCLA to develop a platform for cell therapy. The team includes medical doctors, professors at the school of medicine at UCLA, and a drug development company. The platform is developed by shape-anisotropic magnetization of micro-size magnetic particles, and able to successfully deliver therapeutic agents (such as enzyme, DNA, siRNA, and mRNA) into hard-to-transfect cells with high efficiency and high viability. The team has filed patent protection of intelligent properties, and embarked on the commercialization of their proprietary technologies.

Promoting the Translation of Taiwan's Biomedical and Medical Device Research Projects into Products (SPARK TAIWAN)

In emulation of Stanford University's highly-successful research results industrialization mechanism, Taiwan establishes an autonomous optimized biomedical training environment at universities

SPARK Taiwan program is helping the anchor universities to select R&D teams with promising industrialization cases, actively assisting in the commercialization of academic research findings, and establishing a platform for the diffusion and exchange of research results. Apart from providing a second year of industrialization assistance at National Taiwan University and National Cheng Kung University, STPI has also enlisted the participation of National Yang Ming University, Taipei Medical University, and China Medical University. At present, over 150 trainees in scientific, research, and medical fields in more than 50 biomedical teams have trained or are participating in training. The five anchor universities are providing their own matching funds, manpower, and equipment, engaging in consulting teams consisting of domestic and foreign industrialization specialists, and establishing customized training classes. The anchor universities are also employing practical assistance and milestone-based management to help the project teams to facilitate the commercialization of their innovative technologies and R&D results. Under the cooperation between industry, government, academia, and the research community, this program has initiated a new era in the translation of developed biomedical technologies at universities into commercialization.

International Training Program for Seismic Design of Structures

Employing scientific diplomacy to enhance Taiwan's international prestige

▲ The group photo of national representatives at the 2014 international training session

In order to help developing nations subject to the threat of earthquakes to reduce seismic damage by enhancing their seismic strengthening technology standards and seismic resistance design ability, the National Center for Research on Earthquake Engineering (NCREE) held the first International Training Program for Seismic Design of Structures in 2002 with funding from the National Science Council (now the Ministry of Science and Technology). This program had been held 12 times as of 2013, and has provided training to nearly 400 participants from 23 countries.

Held this year (2014), the 13th program session included 26 trainees from 13 countries, which included friendly nations in Southeast Asia and Latin America, and the trainees consisted of engineers, academic researchers, and government personnel. The training classes were taught by research personnel at NCREE, NARLabs, and the class content focused on Taiwan's structural seismic resistance design technology knowledge. Interaction between the trainees and lecturers was warm and enthusiastic, and the trainees gave high marks to the program, which has greatly boosted Taiwan's international influence in the field of seismic engineering technology.

Class on the Effect of Functional Safety Requirements in ISO 26262 on the Electronic Connection Industry

Class on the Effect of Functional Safety Requirements in ISO 26262 on the Electronic Connection Industry

The National Space Organization and Taiwan Electronic Connection Association jointly held a training class for industrial engineers on the "Effect of Auto Electronic Control System Functional Safety Requirements in ISO 26262 on the Electronic Connection Industry." The content of this class consisted of four major parts, namely the concept of functional safety and its relationship with product reliability (overall auto safety grade), safety management (ISO 26262) and quality management (ISO/TS 16949) requirements, industrial and automotive electronic connector quality requirements (including management and technology aspects), and a comparison of industrial and automotive electronic connector environmental testing and durability testing specifications. The in-depth curriculum provided firms with relevant electronic connector functional safety, quality management, environmental testing, and reliability assessment requirements and techniques needed in the information and communications technology and automotive electronic applications. The class has helped companies to increase product's added value and employ space QA technology in industrial applications.

Implement Hurricane WRF Research Model

Boosting international cooperation and enhancing Taiwan's international status

The Hurricane Weather Research and Forecast system (HWRF) has become one of the most widely used typhoon forecasting models in recent years. The HWRF with high-resolution moving nested-grids configuration can enhance the ability to simulate and forecast the inner structure of typhoons. The Taiwan Typhoon and Flood Research Institute (TTFRI) had implemented this model, which has been adapted and designed as an ensemble member in Taiwan Quantitative Precipitation Ensemble Forecast Experiment (TAPEX). The Quantitative Precipitation Forecast capability of HWRF in Taiwan had also been evaluated. In addition, TTFRI had held a joint international workshop on the HWRF with Central Weather Bureau (CWB), America's National Oceanic and Atmospheric Administration (NOAA) and National Center for Atmospheric Research (NCAR). This workshop allowed researchers and model developers from the U.S., Britain, Thailand, Vietnam, and Malaysia to exchange their experiences and research results of HWRF. It also increased the visibility of TTFRI in the world.

▼ The group photo of the trainees and speakers from the US, Britain, Thailand, Vietnam, and Malaysia

International Cooperation

NARLabs' international cooperation strategy is to establish global partnerships and online platforms, and its core vision embraces the pursuit of "Global Excellence, Local Impact." NARLabs strives to promote innovative R&D efforts, and a range of international collaborative undertakings to establish academic exchange channels for leading researchers in Taiwan and abroad.

NARLabs and Korea Research Council of Fundamental Science & Technology Jointly Hold Summit

Jointly hosted by the Korea Research Council of Fundamental Science & Technology (KRCF) and NARLabs, the 2014 KRCF-NARLabs bilateral symposium was held in Daejeon, South Korea from March 31 to April 3 in 2014. The symposium provided both parties' participants with an outstanding opportunity for technological discussion, knowledge sharing, and announcement of R&D results. The symposium attracted more than 300 scientists and researchers, and it amply displayed the vigor of Taiwanese-Korean S&T research and development.

KRCF has ten subordinate scientific research units, and NARLabs is also a key national-level research organization. NARLabs first signed a memorandum of understanding with KRCF in June 2012, and both parties have agreed to hold at least one conference or bilateral symposium each year. This year's symposium was hosted by KRCF, and co-hosted by NARLabs. The highly productive symposium provided researchers from both countries an opportunity to exchange experience and absorb new knowledge, and the two parties shared recent research discoveries and future development trends.

JAMSTEC Delegation Visits NARLabs

▲ Group photo showing JAMSTEC representatives, Deputy Minister of Science and Technology Chien Chung-Liang, and President Ching-Hua Lo of NARLabs

NARLabs established the Taiwan Ocean Research Institute (TORI) in 2008 in order to integrate the marine science, technology, and R&D capabilities of industry, government, academia, and the research community. TORI is not only an important platform for cultivating domestic marine science and technology research manpower, but also strives to enhance the country's marine science and technology standing and make it an international leader in this field. In the wake of NARLabs President Ching-Hua Lo's visit to the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) on November 28, 2013, which initiated a cooperative relationship between the two organizations, JAMSTEC head Dr. Hitoshi Hotta led a delegation to visit NARLabs on April 9, 2014. The two parties also held a bilateral NARLabs-JAMSTEC symposium at National Sun Yat-sen University in Kaohsiung, and used this opportunity to discuss future development trends and the two organizations' mode of cooperation with regard to the important topics of global climate change, undersea engineering technology, and marine geological disasters. More than 50 leading individuals affiliated with universities and research organizations attended this event, and shared new knowledge and innovative technology. Looking ahead to the near future, the JAMSTEC visit promises to catalyze more substantive joint marine research involving Taiwan and Japan, and will help invigorate NARLabs' international collaboration and exchange efforts.

National Applied Research Laboratories Inks Alliance Agreement with Remote Sensing Technology Center of Japan and the Tokai University Research & Information Center

▲ Representatives of the Remote Sensing Technology Center of Japan and Tokai University Research & Information Center with NARLabs President Ching-Hua Lo

Space science and technology is one of the most important, cutting-edge research areas of the 21st century. The establishment of strategic alliances will therefore be an essential task if the achievements of Taiwan's FORMOSAT satellites are to receive international recognition, and the country's earth observation and geospatial information research capabilities are to keep up with those of leading nations. Led by President Ching-Hua Lo, NARLabs signed cooperation agreements with Remote Sensing Technology Center of Japan (RESTEC) and Japan's Tokai University Research & Information Center (TRIC) on April 14, 2014. These agreements call for close collaboration in the field of image processing technology, including a five-year multinational research project. This project is expected to substantially expand the environmental monitoring applications of FORMOSAT-2 images of Japan, as well as enhance the reception and application of satellite image data, and will take advantage of the strengths of both countries to boost NARLabs' earth observation and geospatial information research capabilities, propelling Taiwan's space science and technology onto the international stage.

NARLabs Signs MOU with Germany's Siemens

▲ NARLabs signs MOU with Germany's Siemens

Siemens has long been a global pioneer in the electrical machinery and electronics industries, and is active in the four areas of energy, medicine, industry, and infrastructure & cities. Siemens is dedicated to benefiting its customers in over 190 countries worldwide with its innovative technology and professional knowledge. Siemens is involved in product R&D and manufacturing, design, and installation of precision systems and projects, and provides customized integrated solutions and services aimed at customers' needs. On August 4, 2014, NARLabs President Ching-Hua Lo signed a MOU with Dr. Rudolf Freytag, CEO of Siemens CT Innovative Ventures, and Dr. Sven Scheuble, head of TTB at Siemens CT. The MOU established the Siemens and NARLabs joint Open Innovation Hub (OIH). Under this collaborative arrangement, both parties will continuously exchange new knowledge and engage in innovative development, hold joint lectures and symposia, and conduct mutual visits. NARLabs hopes that OIH will help Taiwan develop an open use system for innovative technologies and find ways for Taiwan to realize its research and development results.

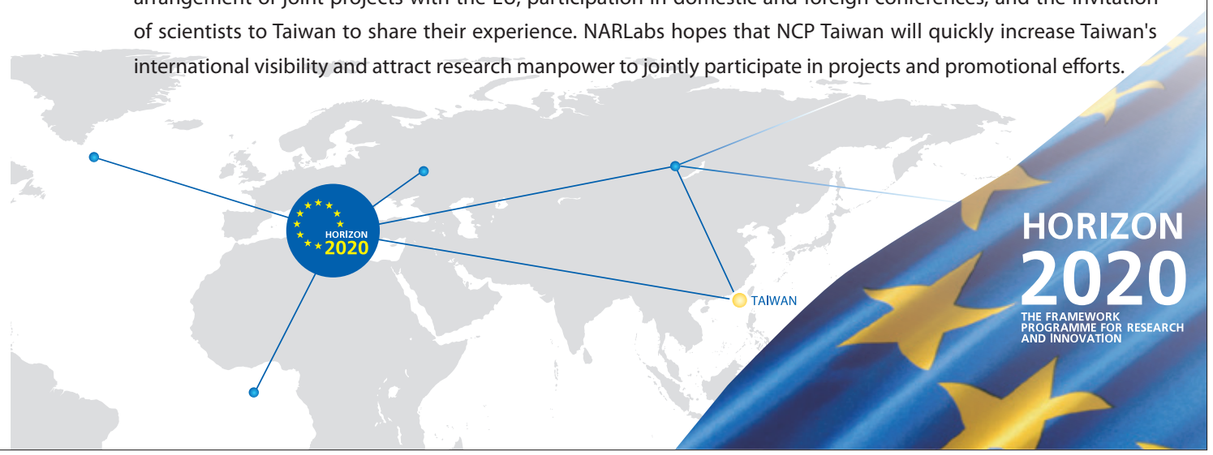
NARLabs Signs MOU with International Academy of Engineering, Russia

▲ NARLabs President Ching-Hua Lo (right) signs MOU with Boris V. Gusev (left), head of the International Academy of Engineering, Russia

The Soviet Academy of Engineering was the predecessor of both the Russian Academy of Engineering and the International Academy of Engineering. After the collapse of the Soviet Union in 1992, the Soviet Academy of Engineering was forced to change its name, and it successively established the Russian Academy of Engineering and International Academy of Engineering in order to maintain its relationship with the members of the Commonwealth of Independent States. The Russian Academy of Engineering and International Academy of Engineering maintain a very close relationship. Boris V. Gusev is the head of both the Russian Academy of Engineering and International Academy of Engineering. On September 16, 2014, NARLabs President Ching-Hua Lo signed an MOU with Boris V. Gusev as head of the International Academy of Engineering, Russia. This agreement calls for both parties to jointly participate in science and technology R&D projects in accordance with the principles of equality and mutual benefit; possible areas of cooperation include investigation of policy issues, machinery, high-performance computing and networks, biotech medicine, nanotechnology, space, marine science, seismic engineering, and disaster mitigation. Both parties have agreed to hold a symposium at least once every two years in order to build on the results of Taiwanese-Russian academic research cooperation.

The EU National Contact Point, Taiwan

The EU National Contact Point, Taiwan (NCP Taiwan) moved from the National Center for High-Performance Computing (NCHC) to NARLabs headquarters in November of 2014, and senior researcher Hsiao-Wei Yuan took the helm as director. Looking ahead to the future, not only will NCP Taiwan serve as a national program office, but will also act as a platform for international exchange and promotion, and coordinate participation in scientific research by elite personnel from industry, government, and academia. NCP Taiwan will assume responsibility for arrangement of joint projects with the EU, participation in domestic and foreign conferences, and the invitation of scientists to Taiwan to share their experience. NARLabs hopes that NCP Taiwan will quickly increase Taiwan's international visibility and attract research manpower to jointly participate in projects and promotional efforts.



Social Engagement

In the area of social impacts, NARLabs is commissioned to serve as the guardian of Taiwan by developing innovative science and technology for reducing damages from natural disasters and enhancing the quality of living for people in Taiwan. NARLabs employees devote their efforts to foster Taiwan's technological innovation as S&T volunteers. As climate change causes a growing number of natural disasters, NARLabs' researcher have made significant impacts through accurate rainfall and typhoon forecasts. NARLabs researchers also played a key role in planning and execution of reinforcing buildings in Taiwanese schools for them to survive stronger earthquakes.

Street House Seismic Performance Website

Increasing residential earthquake resistance online

▲ Street house seismic performance website

To establish an earthquake preparedness mindset throughout society, National Center for Research on Earthquake Engineering (NCREE) in Taiwan has established the first seismic rapid assessment website for the street house in Taiwan. Apart from enabling members of the public to rapidly and easily assess the seismic resistance of their homes, the website provides a rapid assessment method based on over 6,000 detailed building seismic assessment data items, and employs the virtual seismic performance expert "Dr. E" in a lively interactive approach. Following instructions, users can input basic information concerning their home, such as the floor area on each story and area of columns and walls, in order to rapidly assess the building's ability to withstand earthquakes. As of December 2014, the website had attracted close to 63,000 browsers. Do you want to know how well your home will hold up in the event of an earthquake? Quickly let the street house seismic performance website find out for you! (URL: http://streethouse.ncree.narl.org.tw/)

2014 Creative Contest on Disaster Prevention and Mitigation

Innovation ideas for disaster prevention from the public

▲ A group photo of participants and judges taken right after the contest.

The Taiwan Typhoon and Flood Research Institute (TTFRI) held the 2014 Creative Contest on Disaster Prevention and Mitigation with cooperating institutes to make new sparks for disaster prevention. Ten teams passed the preliminary review, and a workshop was held before the final contest for the purpose of perfecting the core value of these teams' ideas. The champion was a team from National Chi-Nan University with their innovation of the "Manis" disaster prevention and prevention board game. The "101 Story House" came to the second place with an idea of a story truck for disaster prevention. The last but not the least, the 3rd place was gained by a joint team from the Ministry of Transportation and Communication and National Chiao-Tung University for their idea of the early warning system for rogue waves. These creative ideas are expected to be applied into our lives and benefit disaster prevention industries.

Participation in the 54th National Primary and High School Science Fair

Instilling scientific knowledge from childhood

▲ School children have fun using 3D glasses which have been made by themselves

Held on July 22-27, 2014 at National Ilan University, NARLabs was invited to set up four science theme pavilions. NSPO's pavilion featured various activities showing the public the FORMOSAT-2 satellite's major contributions to land use, environmental monitoring, and disaster support. NCREE's pavilion introduced the basic concepts of building structures, seismic isolation and mitigation methods, the phenomenon of soil liquefaction, side slope slumping, and basin effects. NCHC provided 3D scientific demonstrations and interactive games, and let adults and children make their own 3D glasses. NLAC offered the Quick Answer Cyclone interactive educational game, let visitors compare animal embryos, and displayed animal care plans, which enabled participants to understand, respect, and cherish laboratory animals.

NCHC's 3D Animation Challenge

Promoting the development of domestic movie animation and encouraging students' creativity

▲ Winning work "Red Spot" from NTUA

The National Center for High-Performance Computing (NCHC) established Taiwan's first rendering farm, and uses supercomputers and rendering technology to assist cultural creativity in Taiwan. NCHC held the 3rd animation competition, and 24 teams made it to the final. "Red Spot" from National Taiwan University of Arts won the championship.

Introducing the Knowledge Co-life Website

Learning and sharing with others

The National Center for High-Performance Computing (NCHC) uses Co-Life to develop a collaborative innovation environment integrating educational resources. NCHC's Knowledge Co-Life website provides content such as the MOST-sponsored "Weekday Reading about Master Scientists," and other lectures held by affiliated organizations. Users can view pre-recorded broadcast lectures for free and immerse themselves.

Publication of the Space Science Education Manga " Visitors from the 8th Wormhole"

Taiwan's first satellite science manga aimed exclusively at adolescents

▲ Visitors from the 8th Wormhole

National Space Organization (NSPO) and the Mandarin Daily News have jointly produced the educational space science manga "Visitors from the 8th Wormhole," which contains a mixture of space science knowledge, interesting science-related stories, and a vivid and memorable manga illustration style. As a result, this manga is able to convey satellite and space science knowledge through lavish illustrations, and can interest curious teenagers in space exploration. Easily-understood explanations and lively, humorous plots make this publication fun to read and an effective learning resource. Apart from the interesting story lines concerning the FORMOSAT-2 satellite and related scientific knowledge, the manga further takes readers behind the scenes for a glimpse of all the dedicated personnel who keep the satellite healthy and functioning effectively. It also introduces the skills used to interpret satellite images, enhances readers' remote-sensing image knowledge, and awakens their interest in science. This publication consequently exemplifies an optimal popular science teaching resource combining entertainment with knowledge.

Space Science Activities in Four Townships of Matsu

Strengthening space science education on offshore islands

▲ A water rocket blasts off at Renai Elementary School on Matsu

National Space Organization (NSPO) teamed up with the space center at National Central University (NCU) to hold space science activities at schools in the four townships of Matsu, including Renai Elementary School in Nankan, Zhuangjing Elementary and Junior High School in Xiju, and Zhongshan Junior High School and Dongyin Elementary and Junior High School in Beigan. A digital globe was used to let students personally experience a journey through space, see the mysteries of the eight major planets, observe the Earth and view its landforms from space during the daytime, and witness the city light of human urban development at night. The participants also strolled on the moon with Armstrong, viewed a meteorite crater close up, and landed on Mars with the Curiosity rover and crossed Taiji Canyon. To encourage their interest in science, students were able to create their own space shuttles and take part in a water rocket competition. In order to instill curiosity in science and give even more children an opportunity to experience the wonders of space, NSPO will continue to hold space science activities throughout offshore islands and isolated parts of Taiwan.

Contact Information

NARLabs
National Applied Research Laboratories

3F., 106 Heping E. Rd., Sec. 2, Taipei 106, Taiwan, R.O.C.
www.narlabs.org.tw **TEL** +886-2-2737-8000 **FAX** +886-2-2737-8044

National Chip Implementation Center (CIC)
7F., 26 Prosperity 1st Rd., Hsinchu Science Park,Hsinchu 300, Taiwan, R.O.C.
TEL +886-3-577-3693 **FAX** +886-3-577-4064
http://www.cic.narlabs.org.tw

Instrument Technology Research Center (ITRC)
20 R&D 6th Rd., Hsinchu Science Park,Hsinchu 300, Taiwan, R.O.C.
TEL +886-3-577-9911 **FAX** +886-3-577-3947
http://www.itrc.narlabs.org.tw

National Center for High-performance Computing (NCHC)
7 R&D 6th Rd., Hsinchu Science Park, Hsinchu 300, Taiwan, R.O.C.
TEL +886-3-577-6085 **FAX** +886-3-577-6082
http://www.nchc.narlabs.org.tw

National Center for Research on Earthquake Engineering (NCREE)
200, Hsinhai Rd., Sec. 3,Taipei 106, Taiwan, R.O.C.
TEL +886-2-6630-0888 **FAX** +886-2-6630-0858
http://www.ncree.narlabs.org.tw

National Nano Device Laboratories (NDL)
26, Prosperity 1st Rd., Hsinchu Science Park,Hsinchu 300, Taiwan, R.O.C.
TEL +886-3-572-6100 **FAX** +886-3-572-2715
http://www.ndl.narlabs.org.tw

National Laboratory Animal Center (NLAC)
128, Academia Rd., Sec. 2,Taipei 115, Taiwan, R.O.C.
TEL +886-2-2651-8900 **FAX** +886-2-2789-5588
http://www.nlac.narlabs.org.tw

National Space Organization (NSPO)
8F., 9, Prosperity 1st Rd., Hsinchu Science Park, Hsinchu 300, Taiwan, R.O.C.
TEL +886-3-578-4208 **FAX** +886-3-578-4246
http://www.nspo.narlabs.org.tw

Science & Technology Policy Research and Information Center (STPI)
14F., 106 Heping E. Rd., Sec. 2, Taipei 106, Taiwan, R.O.C.
TEL +886-2-2737-7657 **FAX** +886-2-2737-7258
http://www.stpi.narlabs.org.tw

Taiwan Ocean Research Institute (TORI)
No.219, Sec. 1, Dongfang Rd., Qieding Dist., Kaohsiung City 852, Taiwan, R.O.C.
TEL +886-7-698-6886 **FAX** +886-7-698-6656
http://www.tori.narlabs.org.tw

Taiwan Typhoon and Flood Research Institute (TTFRI)
22, Keyuan Road, Central Taiwan Science Park, Taichung 407, Taiwan, R.O.C.
TEL +886-4-2460-8822 **FAX** +886-4-2462-7733
http://www.ttfri.narlabs.org.tw

Honorable Publisher Jyuo-Min Shyu
Publisher Ching-Hua Lo
Vice Publisher Tzi-Dar Chiueh, Jough-Tai Wang
Editorial Committee Guey-Shin Chang, Kuo-Chun Chang, Wen-Yen Chang, Yuh-Jzer Joung, Cheng-shang Lee, Ying-Yun Lee, Tai-Ling Lian, Chin-Ling Lin, Hui-Ling Lin, Ching-Ping Lu, Liang-Hung Lu, Peter J. Sher, Ce-Kuen Shieh, Nan-hung Ting, J. Andrew Yeh, Wen-Kuan Yeh, Chun-Keung Yu

Editor-in-Chief Ching-Yin Wang
Executive Editor An Yeh
Editorial Group Hsin-Ning Huang, Yi-Wei Huang, Chien-Feng Lai, Pei-Shan Lee, Ming-Yang Lee, Chieh-hua Lee, Ya-Chuan Tsou, Annie Wei, Chia-Chun Wu, Chiun-lin Wu, Szu-Ying Wu, Wen-Rong Yang

National Applied Research Laboratories
3F., 106 Heping E. Rd., Sec. 2, Taipei 106, Taiwan, R.O.C.
TEL: 02-2737-8000
FAX: 02-2737-8044
http://www.narlabs.org.tw

Global Excellence, Local Impact

NARLabs
National Applied Research Laboratories
3F., No.106, Sec. 2, Heping E. Rd., Taipei City 106, Taiwan (R.O.C.)
TEL：+886-2-2737-8000 FAX：+886-2-2737-8044
Email：service@narlabs.org.tw
www.narlabs.org.tw

ISSN 2072-2567
9 772072 256005