

NAR Labs

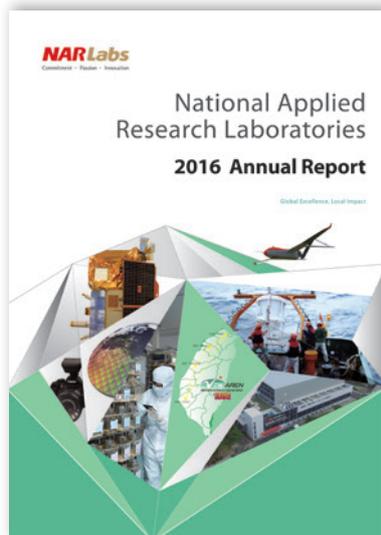
Commitment · Passion · Innovation

National Applied Research Laboratories

2016 Annual Report

Global Excellence, Local Impact





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)

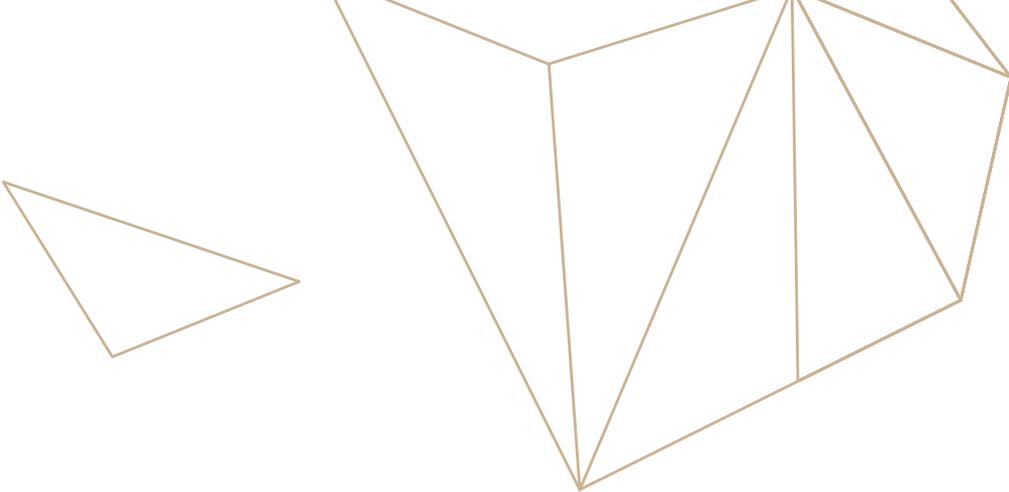
Science & Technology Policy Research and Information Center (STPI)

2008 TORI established

Taiwan Ocean Research Institute (TORI)

2011 TTFRI established

Taiwan Typhoon and Flood Research Institute (TTFRI)



Contents

Preface	_____	02
	Message from the Chairperson	02
	Message from the President	03
Overview	_____	04
	Organization	04
	Human Resources	05
	Financial Information	06
	Location	07
	2016 Event Highlights	08
	Our 10 Laboratories	12
R&D and Service Accomplishments	_____	14
	Earth and Environment	15
	Information and Communication Technology	23
	Biomedical Technology	31
	Science and Technology Policy	33
Connecting Industrial-academic Collaboration	—	36
Fostering of Scientific and Technological Manpower		40
International Cooperation	_____	44
Social Engagement	_____	48

Message from the Chairperson

National Applied Research Laboratories (NARLabs) has a vision to pursue global excellence and create local impacts. NARLabs provides an excellent research platform for academic researchers in Taiwan, adds value to research results, and creates a win-win model. Each of NARLabs' 10 research laboratories is well equipped with unique high-precision and high-efficiency instruments and software systems to help industries, government officials, and researchers in Taiwan to develop groundbreaking technologies. Over the years, NARLabs has presented innovative and unique research results and applications in various fields such as earth and environment, information and communication technology, biomedical technology, and science and technology policy, receiving many awards and recognitions.

In the past year, the performance of NARLabs was excellent. Its major achievements included the development of FORMOSAT-5 (an Earth observation satellite), which was the first self-reliant space optical system in Taiwan. In the future, FORMOSAT-5 can be employed in homeland security, environmental and disaster monitoring, and support scientific research. The FORMOSAT-7 project (a meteorological satellite constellation) will enhance global meteorological observation capability. Establishment of an ocean research fleet and ocean science research district will ensure that Taiwan has a competitive advantage in marine S&T research. Establishment of the National Center for Research on Earthquake Engineering Tainan Laboratory to facilitate advanced experimental research on near-fault effects will make Taiwan a world-class earthquake engineering research and development center.

Taiwan's 100G research and education backbone network, jointly established by NARLabs, the Ministry of Education, and Academia Sinica, began operation in October 2016. This advanced infrastructure is upgrading the strength of Taiwan's scientific research. In addition, NARLabs has established a one-stop technical service platform for biomedical R&D in Zhubei City that made the Biomedical Science Park internationally renowned for developing innovative biomedical devices. NARLabs also supported the Ministry of Science and Technology (MOST) to organize the 10th National Science and Technology Conference. The conference served as an important forum for the discussion and drafting of domestic S&T policies. The conference concluded with valuable suggestions on S&T policies leading to the design of a blueprint for future S&T development in Taiwan. In addition, NARLabs is working with MOST to implement "From IP to IPO" (FITI) program by setting up a stage for innovation & entrepreneurship and encouraging domestic universities and research institutes to push forward their research outcomes to create market value.

With the efforts of all our colleagues, NARLabs hopes to support MOST in strengthening the connection between industries and academia by applying research results to benefit industrial development and improve citizens' quality of life. In particular, NARLabs will assist MOST to advance future-generation innovative research in biotechnology & medicine, green energy, and artificial intelligence, and to expedite Taiwan's S&T innovation and increase the nation's international competitiveness.



Chairperson
Hung-Duen Yang

Message from the President

I am pleased to return and work in National Applied Research Laboratories (NARLabs). With the guidance and assistance of the Ministry of Science and Technology, I will work with all colleagues to transform NARLabs into a promoter of government policy, a service provider for academia, a creation catalyst for industry, a partner for international alliance, and a world-renowned center of excellence.

The four main missions of NARLabs are to establish R&D platforms, to support academic research, to promote frontier science and technology, and to foster high-tech manpower. Beyond that, I would like to extend its position to become a crucial supporter of the Ministry of Science and Technology in planning, promoting, managing, and assessing Taiwan's foresight industrial technologies. NARLabs' values lie in providing support to basic research and enabling connection between academia and industry. In addition to continuing to establish various cooperative platforms, NARLabs should proactively interact with universities and integrate their resources. Through the process of academic and technological development and innovation, value can be created and industry can be revitalized.

In the past year, NARLabs has successfully played a role in providing the R&D platform, which is essential in developing the technology for our nation's innovative economy. In addition, NARLabs has applied research results to enhance our citizen's quality of life. NARLabs' R&D platform provided services to 17,413 people and 77,274 cases in academia and industry. These excellent operational performances and innovative research achievements are recorded in this Annual Report.

In 2016, NARLabs worked with MOST to promote innovative industry flagship projects, such as the launches of the Shalun Green Energy Science City and the Center of Biomedical Industry Innovation Program. In 2017, several major facilities will begin operation. For example, the Southern Laboratory of the National Center for Research on Earthquake Engineering will begin operation in the middle of the year; FORMOSAT-5 is being prepared for launch in the third quarter of this year; a launch ceremony for the 2000-ton research vessel at the Taiwan Ocean Research Institute will be held in May and the vessel's inspection will be completed in the fourth quarter of this year. We all expect that NARLabs' R&D platform will improve synergistic accomplishments in the years to come.

Looking forward in 2017, I will continue to work with all colleagues at NARLabs to increase the organization's core competence, gain advantages in our research areas, integrate local characteristics, and actively establish partnership with world-class laboratories. In order to become a crucial supporter for the government, be a strong backbone of academia and industry, and be internationally competitive, we must enhance our research strength, particularly to provide the research capacity that is critical in supporting the academia and industry in Taiwan.



President
Yeong-Her Wang

Organization

Board of Directors & Supervisors

Chairperson	Hung-Duen Yang
Managing Director	Guan-Chung Chang , Liang-Gee Chen , Jing-Yang Jou , Tsung-Tsong Wu
Director	Ching-Fong Chang , Mau-Chung Frank Chang , Wen-Chang Chang , Mei-Yin Chou , Bon-Chu Chung , J. Raynien Kwo , Chih-Yuan Lu , Kuo-Fong Ma , Fong-Chin Su , Huey-Jen Su , Tri-Rung Yew
Executive Supervisor	Hsiu-Ming Lin
Supervisor	Der-Tsai Lee, Chein Tai

President Office

President	Yeong-Her Wang
Vice President	Jough-Tai Wang , Kuang-Chong Wu

Headquarters

	Director General
Human Resources Office	Chin-Ling Lin
Administration Office	Chia-Sung Chiu (acting)
Planning & Promotion Office	Ching-Ping Lu
Finance & Accounting Office	Tai-Ling Lian
International Affairs Office	Franz Ming-Chih Cheng
Auditing Office	Tai-Hsiang Wang

Laboratories

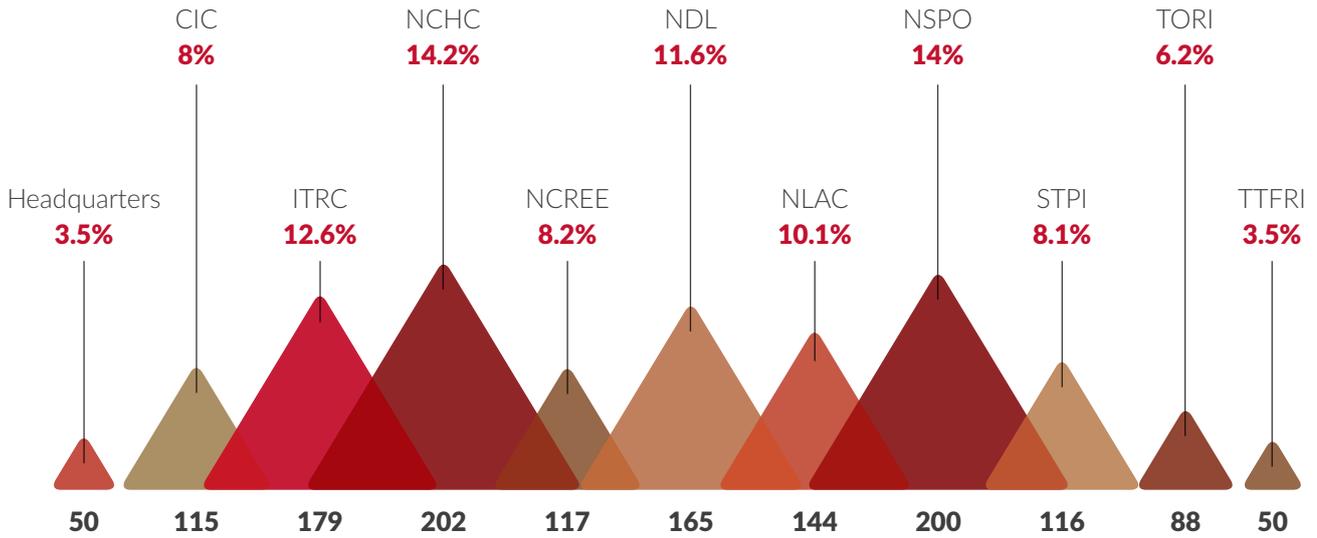
	Director General
National Chip Implementation Center (CIC)	Liang-Hung Lu
Instrument Technology Research Center (ITRC)	Yao-Joe Yang
National Center for High-performance Computing (NCHC)	Ce-Kuen Shieh
National Center for Research on Earthquake Engineering (NCREE)	Shyh-Jiann Hwang
National Nano Device Laboratories (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 May 2017)

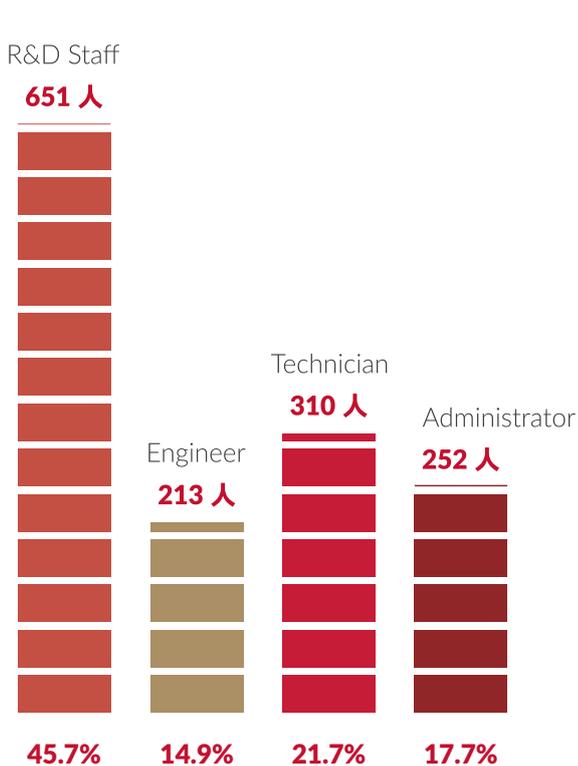
Human Resources

/ Number of Employees in Laboratories

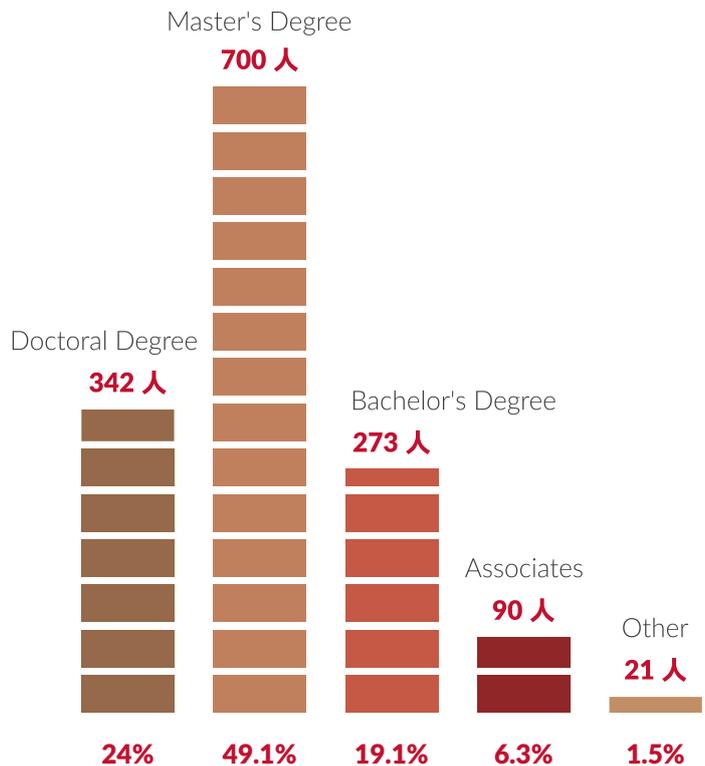
Number of Employees **1,426**



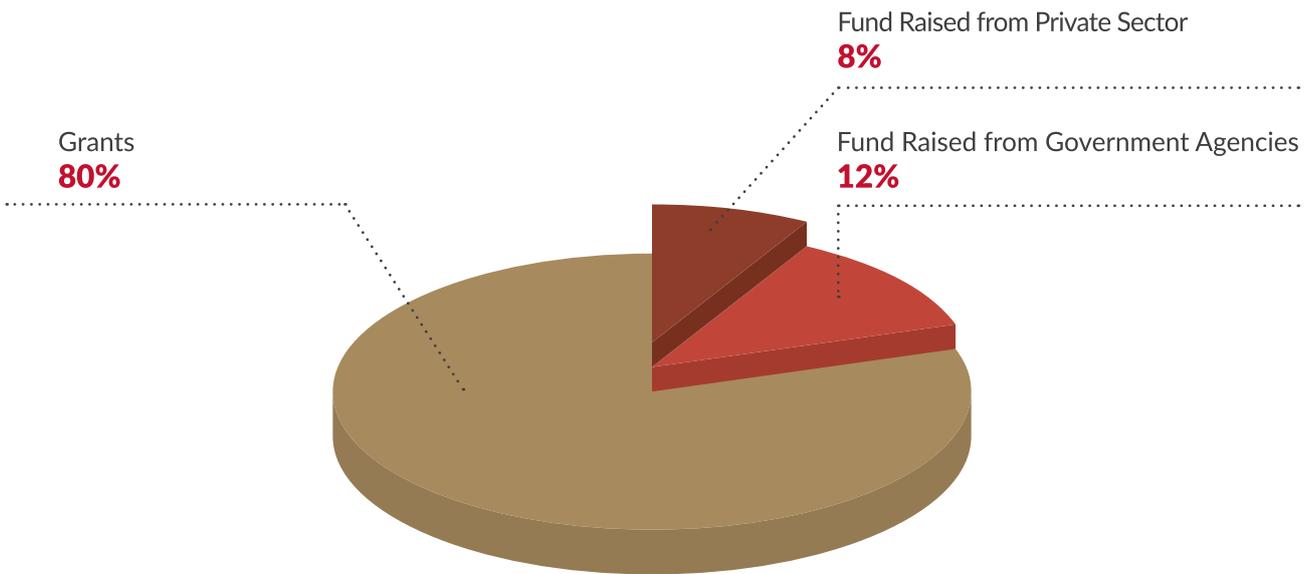
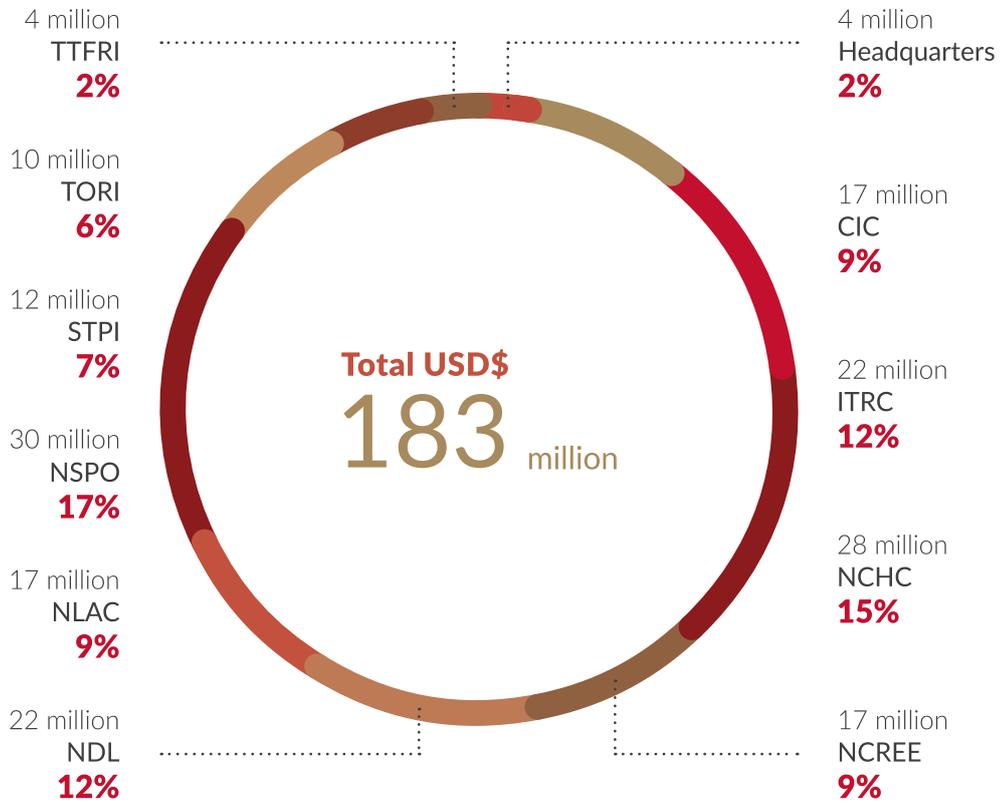
/ Human Resources Profile



/ Education Level



Financial Information



Revenue (FY 2016)
 (Rate: \$1USD = 32.3NTD)

Location

Taipei

NARLabs Headquarters
 National Center for Research on Earthquake Engineering
 National Laboratory Animal Center
 Science & Technology Policy Research and Information Center
 * Taiwan Typhoon and Flood Research Institute

Hsinchu

National Chip Implementation Center
 Instrument Technology Research Center
 National Center for High-performance Computing
 National Nano Device Laboratories
 National Laboratory Animal Center
 National Space Organization

Taichung

* National Center for High-performance Computing
 Taiwan Typhoon and Flood Research Institute

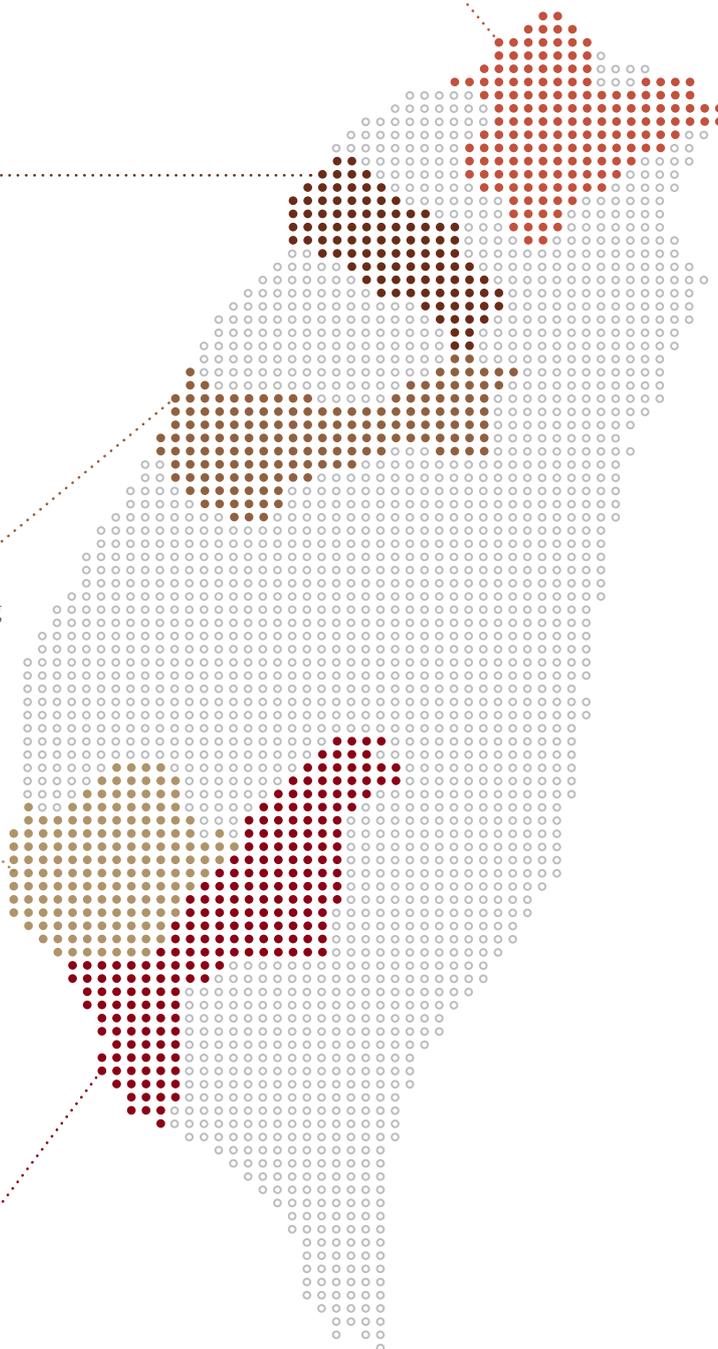
Tainan

* National Chip Implementation Center
 * National Center for High-performance Computing
 * National Center for Research on Earthquake Engineering
 * National Nano Device Laboratories
 * National Laboratory Animal Center

Kaohsiung

Taiwan Ocean Research Institute

* Branch Office



2016 Event Highlights

January

1/5 The Indocyanine Green Fluorescence Onsite Visualization and Assessment System developed by the Instrument Technology Research Center of National Applied Research Laboratories (NARLabs) won the 12th National Innovation Award.

1/8 Steel-cutting ceremony for the 2,000-ton Research Vessel.

1/16 The National Center for High-performance Computing of NARLabs and the European Organization for Nuclear Research signed a memorandum of cooperation.

February

2/1 The National Space Organization of NARLabs hosted the 2016 National Aerospace Winter Camp.

2/9 The National Center for Research on Earthquake Engineering of NARLabs announced that the shock-absorption component testing services platform was beginning to provide services to the public.

2/11 The Instrument Technology Research Center of NARLabs began the Taiwan-South Africa Transnational Cooperation Program to develop the ultra-high precision manufacturing techniques of customized contact-lens for African and Asian corneas.

March

3/9 The National Space Organization of NARLabs hosted the 10th anniversary of the launch of FORMOSAT-3 and the 3rd International Conference on Global Positioning System (GPS) Radio Occultation 2016.

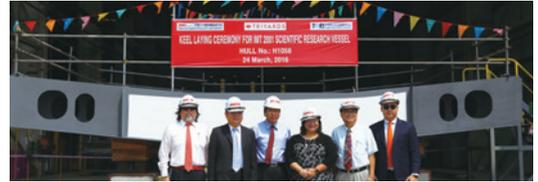


3/11 A patent regarding the prevention of obstructive sleep apnea that was developed by the National Center for High-performance Computing of NARLabs won the 2015 Outstanding Technology Transfer Award.

3/21 The National Center for Research on Earthquake

Engineering of NARLabs and National Cheng Kung University jointly held the Meinong Earthquake Symposium.

3/24 Keel-laying of the 2,000-ton Research Vessel.



3/30 Opening ceremony for TORI's Headquarter.



April

4/12 The Instrument Technology Research Center of NARLabs successfully developed a criminal identification tool, the Subcutaneous Hemorrhage Imaging System.

4/20 The paper "A Rugged Sensor System for Real-time Bridge Safety Monitoring in Taiwan," from the National Chip Implementation Center of NARLabs won the best poster award at the 2016 IEEE Sensors Applications Symposium (SAS).

May

5/12-13 The National Nano Device Laboratories of NARLabs held the 23rd Symposium on Nano Device Technology.

5/16-20 NARLabs participated in the 2016 Taiwan Geosciences Assembly.

5/23 The Taiwan Typhoon and Flood Research Institute of NARLabs, jointly conducted the 2016 Southwesterly flow observation experiment with government and academic units, which ended on October 6th.



5/24 The Taiwan Typhoon and Flood Research Institute of NARLabs held the 2016 Asia-Pacific Economic Cooperation (APEC) Typhoon Symposium at which industry, government officials, and researchers from 12 economies and 2 Western European countries discussed the latest typhoon and flood forecasting techniques and relevant applications.

5/26 The Instrument Technology Research Center of NARLabs held the year-end exhibition for the Internet of things sensor service platform project.

5/28 The paper "Wireless and Battery-less Smart Carbon Monoxide Sensor" from the National Chip Implementation Center of NARLabs won the best paper award at the 2016 IEEE International Conference on Applied System Innovation (ICASI).

5/31 The National Center for Research on Earthquake Engineering of NARLabs held a ceremony celebrating the completion of experimental facilities in Southern Taiwan.



June

6/2 The Science & Technology Policy Research and Information Center of NARLabs signed a memorandum of cooperation with Stanford University to cultivate talents of social sciences.

6/3 The National Laboratory Animal Center of NARLabs signed MOU with the Chinese-Taipei Society of Laboratory Animal Sciences.



6/13 Keysight Technologies and the National Chip Implementation Center of NARLabs held a press conference regarding their signing of a memorandum of cooperation on communication technology and software donation.

6/15 The Instrument Technology Research Center of NARLabs held an exhibition outlining the achievements of the NARLabs Smart Machinery Research Program.



July

7/14 The Instrument Technology Research Center of NARLabs held a ceremony celebrating the entrance into the international market of Taiwan's biomedical technology and an opening ceremony for the 3D printing joint laboratory of NAR Labs, the Tongtai Group, China Steel, and ThinTech Materials Technology.



7/16 The Premier of the Republic of China, Chuan Lin, visited the National Space Organization of NARLabs.



7/19 The National Nano Device Laboratories of NARLabs presented a smart gas sensing chip, which has the following advantages: miniaturization, low energy consumption, easy integration, high sensing accuracy, and most crucially, portability.

7/26 The National Space Organization of NARLabs hosted seminar for experts and users regarding the 3rd phase of the space technology development program.

7/28 The National Space Organization of NARLabs published a children's book: "I like to read the story of the satellite-FORMOSAT-series satellites".

2016 Event Highlights

August

8/2 The National Laboratory Animal Center of NARLabs established "NARLabs Animal Facility Accreditation Consulting Team".

8/15 The National Center for Research on Earthquake Engineering held the 5th International Symposium on the Influence of Surface Geology on Strong Ground Motion.



8/16 The 2,000-ton Research Vessel is officially named "Legend".

8/17 The typhoon and flood warning platform at the Taiwan Typhoon and Flood Research Institute of NARLabs began its online operation.

8/18 The National Laboratory Animal Center of NARLabs held a beam raising ceremony for the animal research building at the National Biotechnology Research Park.



8/19 FORMOSAT-2 decommissioning after 12-year service. FORMOSAT-2 ceased operation.

8/23 The Taiwan Typhoon and Flood Research Institute of NARLabs and the Water Resources Planning Institute at the Water Resources Agency of the Ministry of Economic Affairs jointly presented the results of watershed construction in Taiwan and the development of related technology.

September

9/5 The National Center for High-performance Computing of NARLabs held the 5th High-Performance Computing Kung Fu 3D animation competition.

9/10 The Science & Technology Policy Research and Information Center of NARLabs held the 2nd XFail Conference.

9/11 The British Council and the National Center for Research on Earthquake Engineering of NARLabs jointly held the 2016 Competition for Introducing and Demonstrating Earthquake Engineering Research in Schools.

9/30 NARLabs participated in the 12th 2016 Taipei International Invention Show and Technomart; the dual-core prestressing-stretching self-centering buckling diagonal brace damping apparatus developed by the National Center for Research on Earthquake Engineering of NAR Labs won the gold medal in the invention competition.

October

10/1 The Instrument Technology Research Center of NARLabs held the 8th NARLabs i-ONE Instrument Technology Innovation Competition.

10/6 The 100G Taiwan Advanced Research & Education Network collaboratively developed by the National Center for High-performance Computing of NARLabs, the Ministry of Education, and Academia Sinica began operation.

10/17 • Distinguished Professor Yeong-Her Wang served as the sixth president of NARLabs.



• The Taiwan Typhoon and Flood Research Institute of NARLabs held the 2016 APEC Research Center for Typhoon and Society (ACTS) Workshop on Risk Management Innovations for Weather-Related Natural Disasters and invited APEC representatives and scholars to communicate regarding financial, technological, and social innovation from the perspective of weather risk management.

10/20 The "Photo-annealing method and optical fiber apparatus using the same (patent 435126)" developed by the National Space Organization of NARLabs won the gold medal in the 105 National Invention Award.

10/26 The Science & Technology Policy Research and Information Center of NARLabs and Thomson Reuters jointly held a press conference to present Taiwan's S&T capacity.

November

11/3 NARLabs and the National Library of Public Information signed a memorandum of exhibition cooperation; during the next three years, the scientific research results from the ten national laboratories at NARLabs will be presented in the National Library of Public Information.

11/4 The Instrument Technology Research Center of NARLabs held the second-year midterm forum for the Internet of things sensor service platform project.



11/15 In Eastern Taiwan, the National Space Organization of NARLabs hosted a first and special exhibition on Formosan Satellites.

11/17 The National Space Organization of NARLabs hosted the 2016 remote sensing satellite technology workshop.

11/19 The National Chip Implementation Center of NARLabs held the final MorSensor Creative Application Design Contest and held an awards ceremony.

11/21-24 NARLabs and the South Korea Science and Technology Research Council jointly held the Taiwan and South Korean Forum.

11/30 The National Nano Device Laboratories of NARLabs held the Workshop on 2D Materials and Thin Film Characterization for Advanced Device Applications.

December

12/2 The National Chip Implementation Center of NARLabs and the Medical Device Innovation Center of National Cheng Kung University signed a cooperation agreement during the 2016 meeting of the Global Academia-Industry Alliance (GAIA).

12/3 The National Nano Device Laboratories of NARLabs published four articles in the International Electron Devices Meeting (IEDM).

12/5-7 The Science & Technology Policy Research and Information Center of NARLabs helped the Ministry of Science and Technology organize the 10th National Science and Technology Conference.



12/16 The Instrument Technology Research Center held the Advanced IC Packaging Process Stepper Demonstration Seminar.

12/27 TORI (Taiwan) and PNU (Korea) collaborated again in 2016 for a joint ocean-bottom-seismograph experiment offshore southeast Korea.

NAR Labs

Our 10 Laboratories

National Chip Implementation Center

- Missions

- To provide high-quality services in design environment, chip fabrication, system integration, measurement, and prototyping production
- To support advanced research and development in IC/System design
- To promote interdisciplinary and academia-industry collaborations
- To cultivate talents in the field of IC/System design

- Core Technologies

- IC/SoC design platforms
- SoC/SiP/heterogeneous integration technologies
- CMOS MEMS/BioMEMS design and fabrication technology
- Hybrid integrated chip design platform

- Core Facilities

- Automated IC design softwares
- EDA Cloud design platform
- SoC automated test system
- Microelectromechanical measurement system
- High-frequency measurement system
- Antenna radiation pattern measurement system

Instrument Technology Research Center

- Missions

- To promote the R&D of instrument technology and its applications in compliance with national S&T policies
- To participate in national S&T program and support the R&D of national laboratories
- To promote instrumentation engineering, maintenance of instrument resource banks, and talent cultivation

- Core Technologies

- Opto-electro-mechanical System Integration
- Precision Opto-mechanical Technology
- Electro-optics Remote Sensing
- Vacuum Equipment and Advanced Thin Film Technology

- Core Facilities

- Electro-optics Inspection and Measurement
- Precision Optical/ Mechanical Machining and Inspection
- Large Aperture Optics Polishing and Metrology
- Advanced Thin Film Coating and Testing
- Micro Fabrication and Inspection

National Center for High-performance Computing

- Missions

- To provide service platforms for research and development in HPC, big data, and network applications
- To facilitate R&D of HPC, big data, and network applications
- To develop advanced HPC, big data, and network integration technologies
- To cultivate HPC, big data, and network talents

- Core Technologies

- High-performance computing
- Big data computing
- Network and information security
- Software development and platform integration

- Core Facilities

- High-performance computers
- Advanced research and education network, TWAREN
- National level off-site storage, replication, and archive facilities
- Large-scale engineering and scientific software as well as chemical and biological databases

National Center for Research on Earthquake Engineering

- Missions

- To enhance pre-quake preparation, emergency response and post-quake recovery
- To integrate research capacities of various earthquake engineering research institutes in Taiwan to enhance the research capability of the nation
- To promote international research cooperation for earthquake hazard mitigation, and play a key role in the earthquake engineering research community of the world

- Core Technologies

- Seismic Testing and Numerical Simulation Technologies
- Seismic Resistant Design, Evaluation and Retrofit Technologies
- Earthquake Loss Estimation Technologies

- Core Facilities

- 5m x 5m Tri-axial Earthquake Simulator
- L-shaped Reaction Wall and Strong Floor Testbed
- Multi-Axial Testing System (MATS)
- 8m x 8m long stroke and high speed earthquake simulator
- Bi-Axial dynamic Testing System (BATS)

National Nano Device Laboratories

- Missions

- To build an openly experimental integrated environment for the R&D of nano-device technologies and electronic systems
- To support domestic academia in advanced research topics
- To promote integrated device technologies and applications in the post-silicon era
- To nurture cutting-edge technology engineers and scientists for Taiwan semiconductor manufacturing industry

- Core technologies

- High mobility (III-V or Ge) energy-efficient transistors.
- Atomic two-dimensional materials and devices.
- Microelectromechanical technologies and nano-sensors for Internet of Things (IoT) applications
- Low-cost and multifunctional three-dimensional heterogeneous integration

- Core facilities

- Pilot run with flexibility for semiconductor device development and process integration
- Testing lines for flexible semiconductor device manufacturing.
- Metrology analysis for semiconductor materials.
- High-frequency and electrical characterization of semiconductor devices and circuits



NARLabs

National Laboratory Animal Center

- Missions

- To provide a variety of laboratory animal species to fulfill the research and industrial demand
- To provide animal testing service for drug and medical devices development with a management system that meets the international animal welfare standard
- To implement the core humane values of animal studies by promoting alternative educational and experimental methodology
- To establish a talent cultivation mechanism to reduce the gap between the academic and industrial need

- Core Technologies

- Management for reproduction and breeding of laboratory animals
- Techniques of laboratory animal testing
- Techniques of Isolator
- Techniques of genetic modification

- Core Facilities

- AAALAC International accredited laboratory animal facility
- Iso9001 accredited laboratory animal supply platform
- TAF accredited diagnostic and testing laboratory
- Rodent Model Resource Center (RMRC)
- Preclinical animal surgical and care facility / Laboratory for preclinical testing

National Space Organization

- Missions

- Establish indigenous space technology
- Fulfill pronounced societal impacts
- Promote frontier space science research

- Core Technologies

- Satellite Systems Engineering
- Spacecraft Bus Development
- Electro-Optical Remote Sensing Instrument
- Satellite Control & Operation
- Remote Sensing Image Processing

- Core Facilities

- Satellite I&T Facility
- Ground Control & Operation Systems
- Image Processing Center
- Spacecraft R&D Laboratories

Science & Technology Policy Research and Information Center

- Missions

- To perform systematic research in S&T policy and make recommendations in the policy formulation process
- To support the government on S&T policy planning, evaluation and program management
- To establish national and international S&T information systems and provide integrated services
- To cultivate innovative and entrepreneurship talents and encourage local universities and research institutes to commercialize their research outputs

- Core Technologies

- Issue studies & foresight planning
- Patent mapping & information analysis
- Innovation ecosystem research
- Government S&T program management
- Integrated S&T information services
- Innovation & entrepreneurship talent development

Taiwan Ocean Research Institute

- Missions

- Instigate Marine Technology and Ocean Science Research Platforms
- Operation and Maintenance of Ocean Research Vessel
- Support and Enhance National Marine Technology and Ocean Science Researches
- Promote and Motivate Cutting-edge Ocean Researches
- Developing and Training of Ocean Research Personnel

- Core Technologies

- Physical Oceanographic Moored Observations and Modelling
- Marine Geoscience Observations
- Marine Biogeochemistry Observations
- Deep sea Exploration Technology
- Ocean Information Database and Network

- Core Facilities

- Taiwan Ocean Radar Observing System (TOROS)
- Ocean Bottom Seismometers (OBS)
- Long-term Deep-sea Moorings
- Sediment Traps
- Remotely Operated Vehicle (ROV)
- Marine Core Repository and Laboratory (MCRL)
- Long offset Multichannel Seismic System (LOMCS)
- Marine Biogeochemical Laboratory

Taiwan Typhoon and Flood Research Institute

- Missions

- To implement an advanced hydro-meteorological monitoring network in the southwestern part of Taiwan for extreme weather events
- To develop key technologies for the simulation, forecast, and warning of typhoon and flood
- To establish an atmospheric and hydrologic research platform to serve academia, industry, and government

- Core Technologies

- Advanced atmospheric and hydrologic observation and measurement
- Numerical weather modeling
- Quantitative precipitation forecast (QPF)
- Hydrological modeling

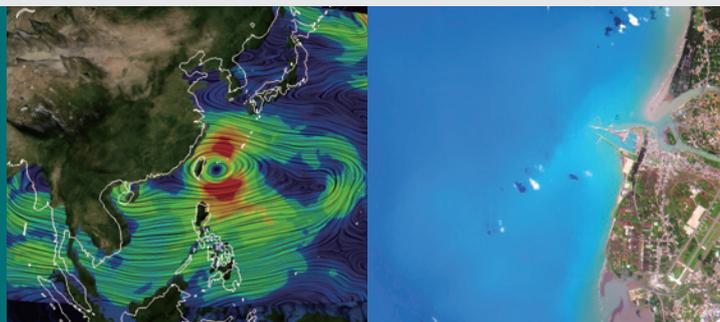
- Core Facilities

- Unmanned Aircraft Sounding System (Aerosonde)
- Precipitation Research Radar, Wind Profiler, Radiometer and Disdrometers
- Taiwan Experimental Watersheds and Hydrological Observational Facilities
- Data Bank for Atmospheric and Hydrologic Research
- Typhoon and Flood Research Application Testbed



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



The Successful Development of the Satellite System for FORMOSAT-5

FORMOSAT-5 satellite ready to launch

FORMOSAT-5 satellite system had passed all performance tests and ready for launch in the end of 2015. SpaceX is the launch service provider for the FORMOSAT-5 mission. During 2016, FORMOSAT-5 launch was postponed few times due to the rocket production schedule delays and the September explosion while performing propellant loading for a static fire test at launch pad. However, FORMOSAT-5 engineering team exercised an outstanding team spirit and diligently maintained the launch readiness of the satellite while FORMOSAT-5 program office is closely working with SpaceX to settle down a launch date as soon as possible. As long as a launch date is mutually determined, the shipping preparation process will be immediately activated and an engineering team will be dispatched to the launch site to conduct FORMOSAT-5 launch campaign.

■ National Space Organization



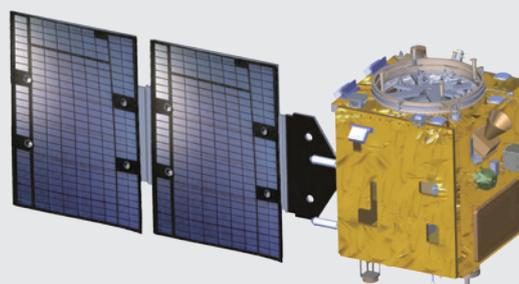
▼ FORMOSAT-5 Satellite Ready to Launch

FORMOSAT-7 NSPO-Built Satellite into Manufacturing and Testing Stages

Developing the key components setting a new milestone

The NSPO-built FORMOSAT-7 satellite is a 300-kg class satellite carrying a GNSS Reflectometry (GNSS-R) receiver made by NSPO and Taiwan's domestic team. The data of GNSS-R help to understand the sea typhoon structure, and can be air-sea interaction studies. In 2016, the major activities of the project include manufacturing and testing of domestic key components. The designs of these domestic key components include On Board Computer, Power Control Unit, GPS Receiver, Fiber Optic Gyro, and H₂O₂ propulsion module, will be validated through testing.

■ National Space Organization



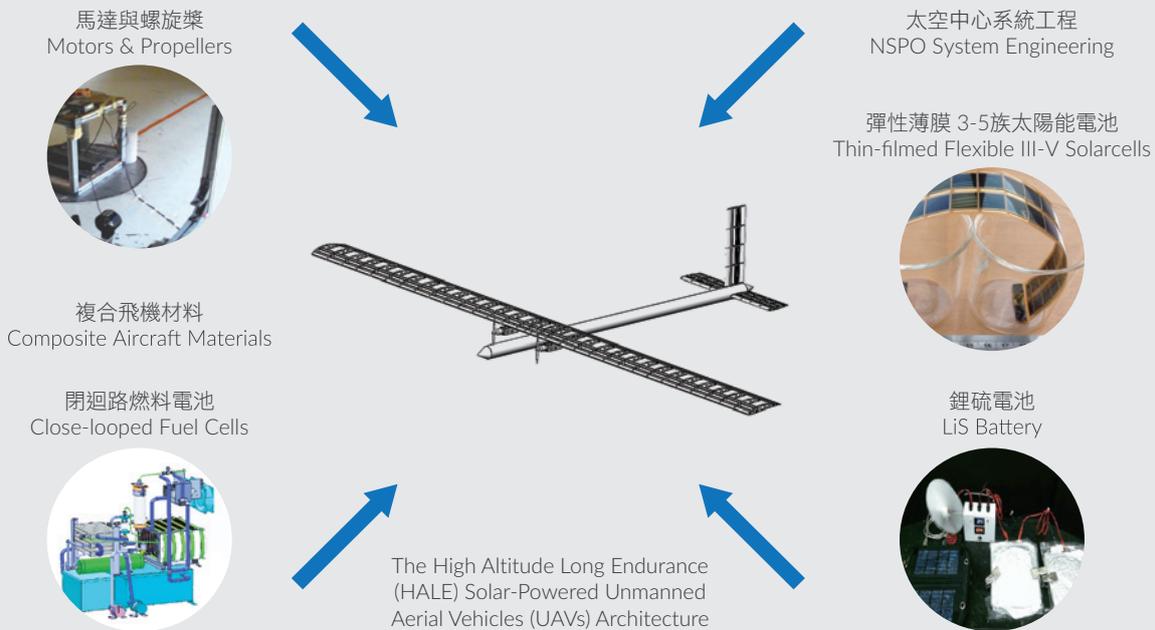
▼ FORMOSAT-7 NSPO-Built Satellite

The Critical Technology Development of Atmospheric Satellite

Soaring the sky, exploring emerging technology

The High Altitude Long Endurance (HALE) Solar-powered Unmanned Aerial Vehicles (UAVs) are also known as the so-called atmospheric satellite in the international aeronautics Industries. They fly at stratospheric altitudes, about 20 km above the sea level and offer satellite-style services for a fraction costs and shorter deployment times, as compared to those of satellites. Meanwhile, they possess recoverable and retrievable capabilities. HALE UAVs reveal various extensive civilian applications and commercial potentials. NSPO has been linked up domestic industries, academic, and research institute to proceed critical designs, such as light-weighted composite airframe, flight control unit and simulator, high-efficient flexible solar cell, air-borne hydrogen fuel cells, high-torqued motor, high pressure thin-filmed tank, and full-scaled propellers. Up to date, the current jobs focus on aircraft assembly, ground test, and flight verification. The maiden flight will take place within one year to feature a target, altitude of 10 km and duration of 8 hours. By the way of these pivot self-effort crucial developments, there will promote the grade of renewable green technologies and extend the economical competitive advantages.

■ National Space Organization

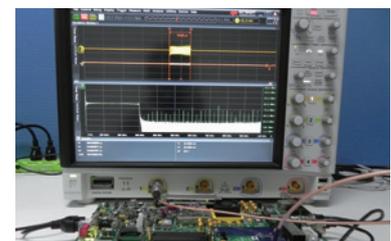


A Big Step in SAR Technology Development

Accomplishment of the development of high bandwidth digital LFM signal generator

The key technology for high resolution SAR (Synthetic Aperture Radar) including high gain antenna、RF high power amplifier、and High Bandwidth Linear Frequency Modulation (LFM) Signal (Chirp Signal) Generator. A 300MHz bandwidth LFM is required to achieve 1 meter resolution SAR mission. NSPO has finished the development of FPGA-based digital LFM signal generator with the main feature of using parallel processing architecture which can make the bandwidth extension easier. The follow on development will be 600MHz bandwidth for 0.5 meter resolution SAR mission in the future.

■ National Space Organization



▼ 300MHz bandwidth LFM

Implementation of Advanced Optical Remote Sensing Instrument

A milestone in the development of very-high (sub-meter) resolution optical remote sensing instrument

Upgraded from the Cassegrain telescope system of FORMOSAT-5, the optical system of advanced optical remote sensing instrument was improved to off-axis Korsch Telescope system. In 2016, NSPO developed many important techniques including optical system design, opto-mechanical design, optical components manufacturing, mirror assembly, off-axis optical system alignment and verification for an experimental Korsch telescope with 300 mm diameter aperture. A more light-weighting and compact optical remote sensing instrument can be implemented for 100kg micro-satellite based on the 300 mm experimental baseline Korsch telescope in the future.

■ National Space Organization

FORMOSAT-2 is Honorably Decommissioning After 12-Year Services

Grateful and farewell FORMOSAT-2

NSPO announced that FORMOSAT-2 is honorably decommissioning after over 12-year services. NSPO was hosting a farewell ceremony to recognize the great contributions achieved by FORMOSAT-2 on 19th August 2016. FORMOSAT-2 was orbiting the Earth and providing services almost 2.5 times of the original mission life (launched in May 2004 and designed for 5-year mission life.). After 12-year operations and services, FORMOSAT-2 has accumulated over 2.5 million images provided to thousands of domestic and international users. With the unique daily revisit capability, FORMOSAT-2 has quick access to disaster areas and can provide continuous monitoring information useful for rescue planning. FORMOSAT-2 scientific payload (ISUAL) has observed and recorded a total of 41, 863 High-altitude short luminescence phenomenon and eligible Nature journal reported many times, has published more than 300 papers.



▼FORMOSAT-2 in Orbit

■ National Space Organization

The Plan to Establish NCREE Tainan Laboratory

Creating a new era of disaster prevention for earthquakes in Taiwan

Earthquake often happens in Taiwan because of a lot of active faults inside the island. Therefore, the near-fault effect is a big issue for the people live in Taiwan. The near-fault effect has special characteristics with large displacement and fast speed. The new opening of NCREE Tainan Laboratory is including a high performance 8m×8m six degree-of-freedom seismic simulation testing system. This new facility can simulate the near-fault motions with large displacement and fast speed. In the future, NCREE can provide better seismic experimental services to the government agencies, the academia and the industry, which is beneficial to improving public safety against earthquake disasters.

■ National Center for Research on Earthquake Engineering

▼The photo of NCREE Tainan Laboratory



Earthquake Simulation System for the Water Supply System in Taiwan

Enhancing the earthquake resistance and recovery capabilities of the water supply system

The severe damage of the water supply system caused by earthquakes substantially impacts people's livelihood and the economy. Therefore, NCREE cooperated with Water Resources Agency, Ministry of Economic Affairs, Taiwan Water Corporation, and Taipei Water Department to develop an earthquake simulation system for the water supply system (Twater). The system can analyze the earthquake-induced damage to pipelines and facilities and evaluate the extent to which the public water supply system was affected and the consequential losses. Currently, the system has offered a report service for response personnel to enhance their understanding of the disaster impacts.

■ National Center for Research on Earthquake Engineering

Applications of Advanced Technology for Earthquake Damage Mitigation

Meinong earthquake event as an example

Since the 1999 Chi-chi earthquake, the National Center for Research on Earthquake Engineering (NCREE) has been collaborating with the county and city governments to implement the Earthquake Mitigation Plan. The goals of this plan are to: (1) conduct seismic evaluations and retrofit buildings; (2) use the Earthquake Early Warning System for damage reduction; and (3) use the Taiwan Earthquake Loss Estimation System (TELES) to help first responders. The damage report of the Meinong earthquake event revealed that the Seismic Evaluation and Retrofit Project of School Buildings has improved school buildings substantially, leading to a considerable reduction of life and economic losses. In addition, the Earthquake Early Warning System developed by NCREE, covering 236 schools and science and industrial parks, provided early warnings across the island during the Meinong earthquake event. When an earthquake occurs, TELES requires 1 minute after receiving report of the Meinong earthquake from the Central Weather Bureau to analyze the possible consequences and damage locations and transmit text-message reports for first responders and relevant agencies to use for rescue activities. Application of these advanced technology systems is expected to lead to tremendous improvements in earthquake damage mitigation, and contribute considerably toward a reliable and sustainable society.

■ National Center for Research on Earthquake Engineering

Seismic Rapid Evaluation Technique for the Existing Residential Buildings

Inspection of the existing buildings by owners, retrofitting for the existing buildings by the professional engineers

Taiwan government promotes a policy on seismic inspection for all the existing residential buildings, which majority of the policy focuses on seismic assessment. The National Center for Research on Earthquake Engineering proposed an information website for seismic assessment and retrofit of street houses, which can assist owners to inspect their own houses. If the buildings were tagged with seismic capacity doubts, owners can carry out seismic retrofit with the help of professional engineers. Ultimately, what the government needs to do is to encourage the owners to implement seismic retrofit.

■ National Center for Research on Earthquake Engineering

Implementation of an All-Fiber Optic Monitoring System

Secure the way home

The National Center for Research on Earthquake Engineering employed the communicating tube principle and buoyancy principle, as well as the elastic principle of fiber Bragg grating, to construct a long-distance fiber system capable of monitoring multiple bridges simultaneously. The system has been implemented in the following road sections to conduct safety monitoring: Dazhi Bridge, several sections of Taiwan High Speed Rail, Wugu-Yangmei Elevated Expressway, Bridge 24 of Provincial Highway 86, and three new bridges of West Coast Expressway. In addition to bridge and highway monitoring, the system application can be extended to monitoring utility or oil pipelines in the future.

■ National Center for Research on Earthquake Engineering

Long-Term Monitoring of the Biogeochemical Cycles at SEATS in the South China Sea

Seeing the world from a grain of sand

Undertaking the proceeding observations at SEATS (South East Asia Time-Series Station), sediment trap moorings are deployed for marine chemistry and ecology study. Variations of chemical compositions and sources of sinking particles are revealed based on inorganic and organic chemistry, isotopic fingerprinting, and bioinformatics analyses.

■ Taiwan Ocean Research Institute



▼ Preparing the deployment of sediment trap mooring on deck; basic chemical laboratory facilities were established and integrated in 2016.

Long-Term Monitoring of Near-Shore Marine Biology and Ecosystems

Little Liuqiu Island, the coral reef paradise

The objective of this project is to study the environmental impact on near-shore marine biology and ecosystems by integrating the biological and water-quality parameters. At present, our works focus on the Little Liuqiu Island. Primary data indicate that the shallow water temperature around Little Liuqiu Island decreases during high tides. Even though coral bleaching events have been diagnosed frequently around the world this year, the coral reef in Little Liuqiu Island is survived benefitted from the temperature drop.

■ Taiwan Ocean Research Institute



▼ The coral reef in Little Liuqiu Island shows only partially bleached

Mini-ROV

Home-made mini-ROV

Mini-ROV (Remotely operated underwater vehicle) is capable of monitoring the water temperature, salinity, and depth in real time. Nevertheless, the ROV is also able to observe the biological activity and its ambient conditions through video recording. With in-house developed control panel, the Mini ROV can proceed stably and remain at a certain range in water up to 200 meters depth. Exploring a brand new underwater world by attaching VR on to the mini-ROV can be expected in the futur.

■ Taiwan Ocean Research Institute



▼ Home-made Mini ROV by TORI

Wind Lidar Measurement and its Application to the Offshore Wind Farm

Near surface wind-field characteristics in Taiwan coastal area

Lidar measurement techniques and data analysis are applied to the offshore wind farm project in cooperation with industry. Lidar observations were conducted at the Hanbou intertidal zone located at Fangyuan, Changhua, where offshore wind farms are planned for future construction. Seasonal monsoons were measured to characterize the wind profile and turbulence. The results will provide for the assessment of the wind energy and the reference for selection of wind turbines.

■ Taiwan Ocean Research Institute



▼ Southwest airflow observations with a Lidar profiler at Hanbou intertidal zone (Changhua coastal area)

Locator

Observing ocean current with GPS- Locator

A real-time and low cost Locator has been successfully developed by TOROS team. Its design is a microcontroller with GPS and VHF transmission embedded. The locator has various valuable applications for ocean observation. This device can also be applied to the current observation and verification, sea waves, and parameters collections.

■ Taiwan Ocean Research Institute



▼ Locator GUI (Graphical user Interface)

Establishment of the Marine Environmental Databank

Providing a near real-time exhibit of the marine observational data

The Marine Environmental Databank (MED) is responsible for collecting, storing, processing and managing the data received from research vessel explorations for various scientific tasks. It provides a platform for multiple data integration and a value-added application services. To improve effectiveness of the data display, the network exhibition was updated with elements of a new generation of design and provides an interface for user-friendly operation. It also provides a near real-time exhibition of the marine observational data.

■ Taiwan Ocean Research Institute



▼ A recently revised home page for the Marine Environmental Databank. website: <http://med.tori.narlabs.org.tw>

Launching of the Experimental Watersheds

Recording Taiwan's unique hydrological characteristics

In order to record Taiwan's hydrological and geographical changes, accordingly the Taiwan Typhoon and Flood Research Institute (TTFRI) and the Water Resources Agency (WRA) work together to launch the Experimental Watersheds in Taiwan. After the Yilan River and the Dianbao Creek Experimental Watersheds have been built up, more than 88 million sources of data have been gathered. These measured data will be helpful for the government agencies to improve data quality, watershed management and flood early warning for disaster operations. In addition, these data are also beneficial to the TTFRI for the development of flood early warning and disaster reduction technology in river basins.

■ Taiwan Typhoon and Flood Research Institute



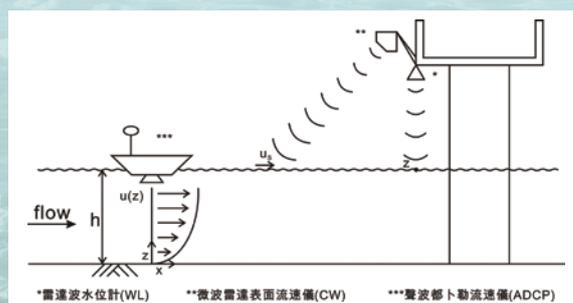
▼ The observation stations of Yilan River Experimental Watersheds

Developing the Automatic Real-time River Discharge Estimation Technique

Helping with downstream flood early warning

In cooperation with the Water Resources Planning Institute, the Taiwan Typhoon and Flood Research Institute has developed the Automatic Real-time River Discharge Estimation Technique. The concept of this technique is based on comparisons of the data obtained from river discharge measurements in experimental watersheds. With Microwave Radar Surface Current Meter, Radar Water Level Gauge, and this Automatic Real-time River Discharge Estimation Technique, the river flow then can be estimated instantly, accurately, and automatically. Furthermore, the technique of river discharge estimation can be utilized to evaluate the downstream flood-prone areas for flood early warning.

■ Taiwan Typhoon and Flood Research Institute



▼ The Taiwan Typhoon and Flood Research Institute has developed the Automatic Real-time River Discharge Estimation Technique. With this technique, the river flow discharge can be estimated instantly, accurately and automatically

Running the Unmanned Aircraft Sounding System Project

Completing the long endurance and distance test flight

The Taiwan Typhoon and Flood Research Institute has been running the project "Unmanned Aircraft Sounding System" since 2015. The goal is to enter and investigate the convection core of typhoons to collect weather information. Aerosonde Mark 4.7E already completed a long endurance (over 17 hours) and distance (over 1,300 kilometers) test flight under autopilot controlling. The data gathered from airborne is transmitted near real-time to ground controller via Iridium satellite communication, expected to improve the accuracy of Tropical Cyclone analysis, track forecasts and disaster response decisions.



▼ The Aerosonde Mark 4.7E is ready for the mission.

■ Taiwan Typhoon and Flood Research Institute

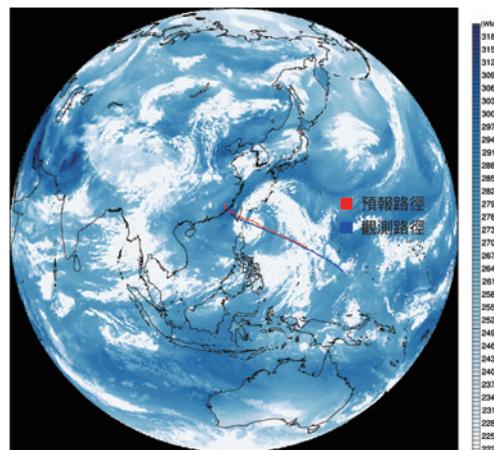
Implementing 10-Day Forecast Experiments With the Model for Prediction Across Scales (MPAS)

Predicting the large-scale weather pattern

The Taiwan Typhoon and Flood Research Institute implements 10-day forecast experiments daily with a variable resolution Model for Prediction Across Scales (MPAS) global model (FIG. 1). We evaluate the extend forecast results for typhoon cases in 2015 and 2016. Our preliminary results indicate that MPAS is capable to predict the typhoon motion, for example, Typhoon Nepartak (2016) (FIG. 2). The future plan is to focus on the application of extend 5-10 days rainfall forecasts in Taiwan Reservoir watersheds.

■ Taiwan Typhoon and Flood Research Institute

▼ The Model for Prediction Across Scales (MPAS) result of Typhoon Nepartak's forecasting. The red line indicates the typhoon forecasting track, and the blue line is the observation track.



Developing Advanced Observation Technology

Improving the ability of mountain rainfall estimation

The Taiwan Typhoon and Flood Research Institute tries to improve the radar quantitative precipitation estimation formula by using the dual polarization radar, which is installed in the Kaohsiung mountain area and the distrometer observation data. The preliminary results indicate that the improved formula has more than 10% accuracy than the traditional one. These research results will be provided to the Central Weather Bureau as a reference for future regional disaster prevention rainfall radar operations. The high resolution and accurate rainfall information is very important for the flood protection and disaster mitigation.

■ Taiwan Typhoon and Flood Research Institute

Information and Communication Technology

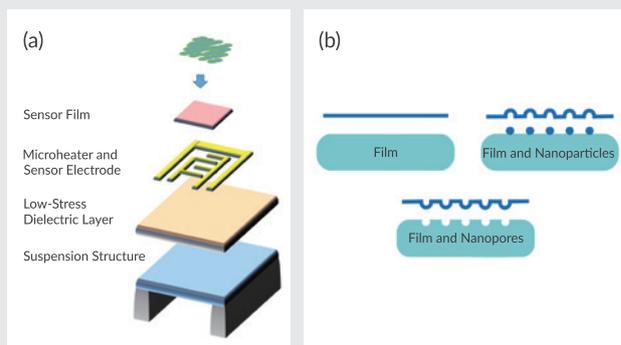


Next-Generation Key Technology and Innovation in Nano Devices

Smart gas-sensing chips

A smart gas-sensing chip which is capable of detecting volatile organic compounds, carbon monoxide, carbon dioxide, and formaldehyde was developed. Fabricated by Lite-On Co. Ltd under microelectromechanical systems technology cooperation, this chip features miniaturization, energy efficiency, integrability, and a precise detection of gases, which enable the development of "mobile gas sensors" .

■ National Nano Device Laboratories



▼ (a) Structure of the smart gas-sensing chip; (b) Nanotechnologies applied in the chip.

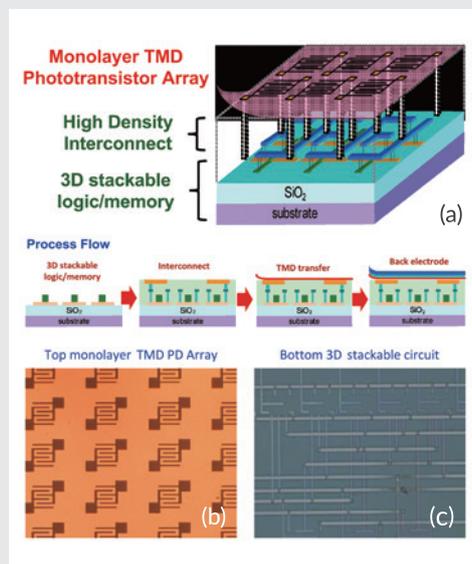
Monolithic 3D Image Sensor

Developing monolayer transition metal dichalcogenides

A monolithic 3D image sensor was developed by integrating large-area monolayer transition metal dichalcogenides and a monolithic 3D integrated circuit (3D IC) with low thermal budget. In this sensor, the upper layer comprises a monolayer MoS_2 photosensor with high linearity and photoelectric current response, whereas the lower layer comprises a monolithic 3D IC fabricated with high-performance, energy-efficient, stackable 3D epitaxial nanowire transistors.

■ National Nano Device Laboratories

▼ Schematic illustration of monolithic 3D image sensor fabricated with transition metal dichalcogenides.



Low Power Consumption Vibration Sensor Chip

Real time detection for industrial vibration failure analysis

National Nano Device Laboratories (NDL) brings a low power consumption-vibrational (LPV) sensor and offers a sensing solution of End-User. The LPV sensing system integrated with CMOS process is completed by MEMS packaging and chip-level sensor for smart industry such as the inspection for manufacturing security and machine health maintenance. This cost effective broad-band CMOS compatible vibration sensor integrated with passive devices provides real-time detection to machine failure analysis for industry 4.0 applications.

■ National Nano Device Laboratories

▼ Low power consumption-vibration (LPV) sensing IC was settled on the IPX vacuum pump of Lam 2300 8" etcher for real time vibration analysis.

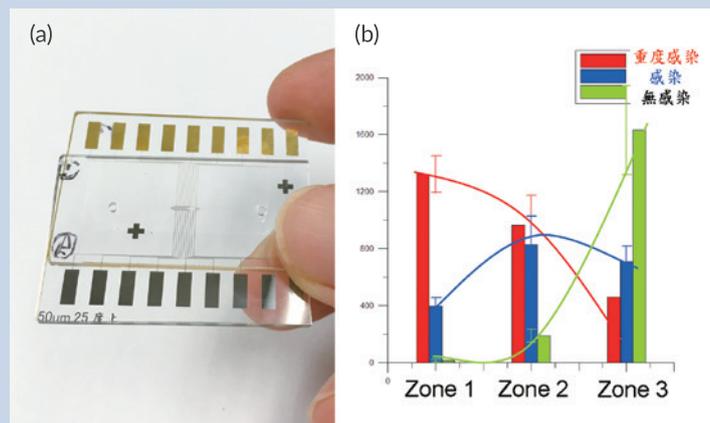


Development of a Biochip for Rapid Detection of Dengue Virus

Rapid detection of dengue virus and infection assessment

This biochip rapidly detects dengue fever virus and assesses patients' infection conditions. Using 0.05 mL of blood for detection and assessment, and yielding results within 30 minutes, the chip can be applied at checkpoints, clinics, and other facilities where treatment for dengue fever is provided.

■ National Nano Device Laboratories



▼ (a) Microfluidic chip for the rapid detection of dengue fever virus infection; (b) Detection results, determined according to the intensity of signals in different zones (e.g., a strong signal in Zone 1 indicates severe infection, whereas a weak signal in Zone 1 and a strong one in Zone 3 indicates serum specimen in healthy subjects).

MorSensor-Wireless Sensor Bricks

Expediting the realization of creativity through a brick game concept

MorSensor wireless sensor building blocks consist of modular sensor units that can be assembled to form multilayer integrated sensor platforms. MorSensor building blocks can be used to combine various types of sensors, which can be applied in conjunction with cell phone and PC APPs to demonstrate sensor applications involving hardware and software. In 2016, CIC completed the development of seven new sensor bricks and released these bricks to academia for research and teaching purposes. The newly developed bricks include WiFi communication bricks as well as sensor bricks for CO₂, CO, pressure, ultrasonic range, infrared (Ir) range, and Ir image. CIC was awarded the NARLabs Technical Achievement Award for its outstanding achievement.



▼ APPs for MorSensor new sensor bricks

Moreover, in 2016, CIC held the "MorSensor Creative Application Design Contest" to stimulate creativity and innovation in academia for applications in the areas of wearables and the Internet of things (IoT).

■ National Chip Implementation Center

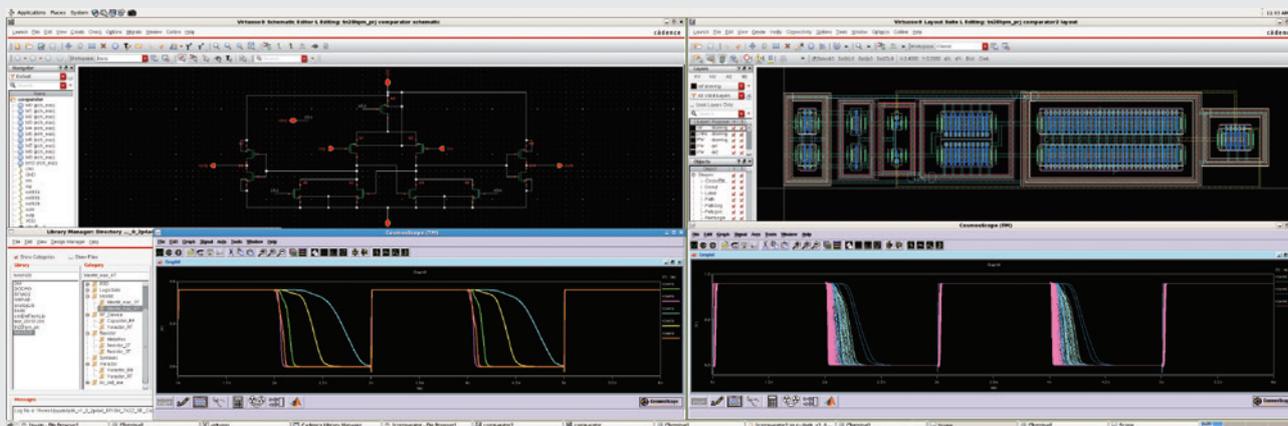
TN28HPM Advanced Technology Chip

Implementation Service and Training Course

CIC 28nm complementary metal-oxide-semiconductor (CMOS) high-performance mobile technology chip implementation service and training course

In 2016, to satisfy the demand for a chip design with a high performance and low power and leakage, CIC provided 28nm low power technology as well as 28nm CMOS high-performance mobile technology with a complete Interoperable Process Design Kit (iPDK) design environment and chip implementation service. To promote the TN28HPM technology and enable new designers to adapt to the technology faster, CIC provided a 28nm chip implementation course. In the first round, 14 students completed this course.

■ National Chip Implementation Center



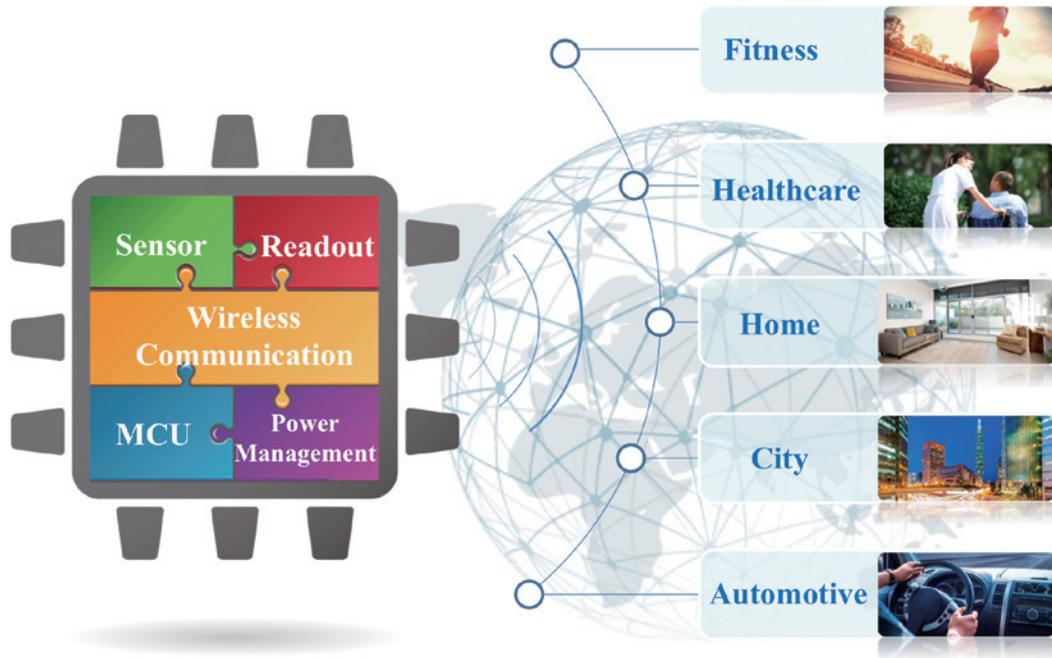
▼ Reference circuit design for a 28nm chip implementation course

CMOS Sensor IP Technology

Realization of IoT chips by integrating verified sensors and circuit

CMOS sensor IPs include motion, environmental, and biomedical sensors. In addition, circuit IPs include sensor signal readout, analog-to-digital, wireless communication, and power management circuit IPs. Integrating the verified sensor and circuit IPs can facilitate the rapid realization of sensor chips for wearables and IoT applications.

■ National Chip Implementation Center



▼ Integrating sensor and circuit IPs to realize chips for various applications

Millimeter Wave Multichannel Transceiver Measurement System

Accelerating circuit design by combining software and hardware

CIC provided the first millimeter wave multichannel transceiver measurement system to academia in Taiwan. The system provides a millimeter wave multi-input multi-output (MIMO) modulation signal by combining software and hardware. A high level oscilloscope is adopted to digitize the millimeter wave MIMO modulation signal for signal demodulation and analysis. By combining software and hardware we can provide and expedite the verification and measurement of millimeter wave multichannel circuits, subsystems, and systems.

■ National Chip Implementation Center



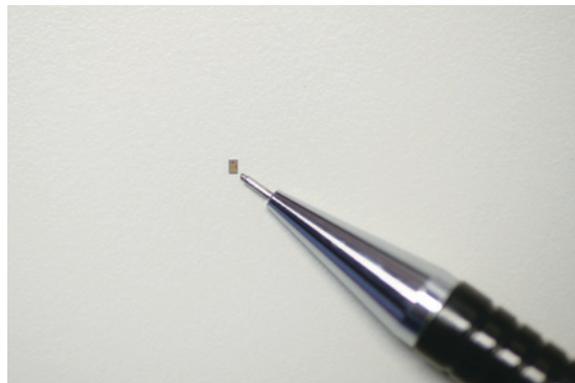
▼ Millimeter wave multichannel transceiver measurement system

Energy Harvest and Management Chip

Providing electrical power to wearables and phones IPs

CIC has developed an energy harvest and management chip that can cover a wide range of energy input from small vibrations to high solar energy. This chip is only 1 mm² in size and can be adopted in wearables and IoT applications.

■ National Chip Implementation Center



▼ Energy harvest and management chip

Blood Images Can Talk-Subcutaneous Hemorrhage Imaging System

Novel criminal forensics tool testified by Dr. Henry Lee

IIRC of NARLabs has successfully developed "Subcutaneous Hemorrhage Imaging System" to make complete subcutaneous bleeding detection during the early stages of the injury examination. The technology of "Subcutaneous Hemorrhage Imaging System" was developed by IIRC while the product was realized through the engineering of its partner, Lumos Technology Co., Ltd. Testified by internationally renowned forensics expert Dr. Henry Lee, "Subcutaneous Hemorrhage Imaging System" anticipates the wide adaptations in criminal forensics in the future.

■ Instrument Technology Research Center



▼ Subcutaneous Hemorrhage Imaging System was cooperated by IIRC and Lumos Technology Co., Ltd.

12" Plasma-Enhanced Atomic Layer Deposition System Was Successfully Developed

High step-coverage ultra-thin (<20 nm) film deposition process

ITRC successfully developed a 12" plasma-enhanced atomic layer deposition (PEALD) system under a joint development project with a Taiwanese semiconductor foundry. Improvement of precursor delivery efficiency can provide a uniform plasma reaction over 12" substrate. Modular design of electrode components also offers fast switch between direct and remote plasma-assisted ALD processes, which can meet the research requirements of semiconductor foundry.

■ Instrument Technology Research Center



▼ The 12" RF Capacitive PEALD System

Customized Contact Lens Technology

Taiwan-South Africa R&D collaboration on ultra-precise processing

ITRC launched the three-year international collaboration project on "Contact Lens Ultra Precision Machining Technology Applicable for Africans and Asians" with the Nelson Mandela Metropolitan University of South Africa since 2016. This project aims to develop improved contact lens customization technologies for various ethnic groups worldwide. This collaboration project fully demonstrates that ITRC's ultra-precise processing technology has gained the recognition of a world-class research team.

■ Instrument Technology Research Center



▼ Taiwan-South Africa Cross National Ultra-precise Processing R&D Team Participating at the US SPIE International Conference

Indocyanine Green Fluorescence Onsite Visualization and Assessment System (iFOVAS) for Optical Guided Surgery

The 12th National Innovation Award Winner-iFOVAS

The Indocyanine Green Fluorescence Onsite Visualization and Assessment System (iFOVAS) for optical guided surgery is a state-of-the-art imaging system developed by a multidisciplinary team from NTUH, ITRC of NARLabs, NTU-CSIE, and Wan Fang Hospital. The research team has received the 12th National Innovation Award from the Institute for Biotechnology and Medicine Industry.

■ Instrument Technology Research Center



▼ The iFOVAS research team has received the 12th National Innovation Award.

高效智慧100G 接軌世界創新機

主辦單位：國家實驗研究院國家高速網路與計算中心

協辦單位：各區域網路中心



▼The NCHC, MOE, Academia Sinica, and the heads of universities announced to launch TWAREN 100G network

TWAREN 100G is Launched

Leap in academic research network, 100G backbone upgrade

The NCHC collaborated with the MOE and Academia Sinica in the 100G academic research network bandwidth expansion plan. The upgrade was finally completed in 2016 after two years of construction, transfer, adjustment and testing. Formally launched in October, the TWAREN 100G backbone will bring Taiwan's academic research network into the new era of super high speed transfer.

■ National Center for High-performance Computing

First Step to Building a Petascale Supercomputer

Planning the next generation high-performance computing platform required for domestic scientific research

To build a new generation petascale supercomputer and green data center, the NCHC in 2016 continued to plan hardware and future operations, and its 2017 budget was approved by the MOST. In the future, the new petascale supercomputer will be able to reach 1.4 petaflops and higher, which is 7~8 times the current performance of ALPS, and will be provided for large scale computing, breaking through the current computing scale and limitations to accelerate the output of results.

■ National Center for High-performance Computing

Value-Added Application Service of Big Data Analysis Platform

Industry-academia-research collaboration in innovative applications

Braavos began formally providing academia and research institutes with big data analysis service in 2016, and served as the designated analysis platform for sensitive government data. This year it served 7 major projects of the MOST, including health and biomedicine, environmental disaster prevention, smart cities, and finance and taxes. The NCHC also worked with Trend Micro, in which Trend Micro provided practical data while the NCHC provided a computing platform; academia used the platform to develop information security related deep learning technologies and algorithms, so that industry, academia, and research institutes can achieve win-win.

■ National Center for High-performance Computing

Biomedical Technology



Establishment of a Mouse Behavior Analysis Platform for Neurodegenerative Diseases

Monitoring Parkinson's disease and Alzheimer's disease in animals

The causes of neurodegenerative diseases of the central nervous system, such as Parkinson's disease and Alzheimer's disease, are still unclear. Currently, new drugs developments for these diseases rely on behavioral analysis on disease animal models. NLAC has established a mouse behavior analysis platform for monitoring the disease progress that integrates with the Bussey-Saksida Touch Screen System, which is virtually identical to the tests performed on human subjects. The integrated behavior analysis platform can be applied on pre-clinical tests for new drug development.

■ National Laboratory Animal Center

New Opportunities for the Cure Discovery of Polycystic Kidney Disease

Wdr19 gene deficiency causes polycystic kidney disease

Polycystic kidney disease is an inherited disorder with no disease gene identified. NLAC uses Bacterial Artificial Chromosome (BAC) technique to specifically knockout the Wdr19 gene from mouse renal tubular epithelial cells. The Wdr19 knockout mice are found to develop polycystic kidney disease that includes symptoms of enlarged kidneys, cysts (fluid-filled sacs) in kidneys, and severe renal impairment. The new findings of the Wdr19 as a disease gene of polycystic kidney disease lead to new opportunities for the cure development.

■ National Laboratory Animal Center

NARLabs Animal Facility Accreditation Consulting Team

A good helper of domestic animal facilities to promote management quality and earn AAALAC International Accreditation

NLAC has established a task force namely "NARLabs Animal Facility Accreditation Consulting Team" to introduce the AAALAC International Accreditation Program, an internationally recognized standard to Taiwan. The team is experienced in animal facility planning and accreditation with team members serving as AAALAC ad hoc specialist. The consulting team would assist domestic animal facilities to meet the accredited standard on the aspects of animal care and use. It provides a firm foundation for the biomedical industry of Taiwan to enter the international market.

■ National Laboratory Animal Center



▼ President Luo of NARLabs declared that the "NARLabs Animal Facility Accreditation Consulting Team" is established.

First Taiwan 3D Printed Artificial Joints Marching into the International Market

ITRC leading the way to cross infinite possibilities

ITRC held the "3D Printed Medical Materials Advancing to the World Cup" press conference. ITRC successfully assisted ThinTech Materials Technology Co., Ltd. to be first Taiwan manufacturer passing preclinical animal test for biomedical grade 3D metal printing powder. Integrated with Tongtai Machine & Tool Company's self-developed 3D metal printing equipment, a medical material product has been successfully printed for the United Orthopedic Corporation and it has passed the stringent ISO 10993 biocompatibility international regulations and certification. This ensures the quality of animal testing meeting with international requirements and strictly control product safety.

■ Instrument Technology Research Center



▼ Torch Lighting Ceremony Celebrating the Advancement of 3D Printed Medical Materials to the "World Cup"

ITRC Transforms Traditional Industries

Taiwan biomedical technology takes giant leap

ITRC held the "Taiwan Biomedical Technology Advance to Global Market Launching Ceremony" and "NARLabs / Tongtai Machine & Tool / China Steel / ThinTech Materials Technology (TTMC) 3D Printing Joint Laboratory Opening Ceremony." ITRC facilitated the entry of Taiwan biomedical equipment brands in the international market through mutual technological cooperation and strategic alliance partners based on 3D printed medical materials.

■ Instrument Technology Research Center



▼ Group photo: Opening Ceremony of the 3D Printing Joint Laboratory

Science and Technology Policy



STPI Assistance in Organizing the 10th National Science and Technology Conference

The government focused on crucial issues to draw up a map for technological development

As a professional think tank, the STPI assisted the Ministry of Science and Technology to organize the 10th National Science and Technology Conference. A blueprint focusing on the crucial issues of our nation's scientific and technological development for the next four years has been drawn up in a long-term and forward-looking perspective, as well as on the basis of diverse opinions from experts, scholars, and citizens.

■ Science & Technology Policy Research and Information Center

Selection Process of Potential Science and Technology

Analyze in technological megatrends to specify R&D focus

By perusing the global megatrends and technology developments, we outlined our scenarios for the next 10-15 years, and the local demands of Taiwan are also identified by a survey. Moreover, we analyzed our R&D capabilities and determined some of the more advantageous fields. Our results would therefore be a reference to assist policy makers to specify the R&D focus for investments.

■ Science & Technology Policy Research and Information Center

Patent Information Service-Trend Monitoring and Strategy Planning

From quantitative analysis to customized information service

The STPI monitors the trends in important technology areas by means of a systematic patent analysis, and it provides intellectual property strategy services based on the patent information analysis. In 2016, the STPI has analyzed patent data in the technology areas such as intelligent car and telemedicine, and it has provided customized patent information services to several university research teams.

■ Science & Technology Policy Research and Information Center

Energy Technology: Safeguarding Taiwan, and Creating a Sustainable Future

Linking international resources, and meeting local demands

The Ministry of Science and Technology (MOST) promotes national energy programs through the integration of resources from various governmental agencies to meet the domestic demands on energy security, technology development, and environmental sustainability. Therefore, to move Taiwan forward into a sustainable future, energy efficient and low-carbon technologies are thereby developed on the basis of academia-industry collaboration, international cooperation, and the promotion of industrializing R&D results. In this process, the STPI assists the Department of Engineering and Technologies of the MOST in establishing a managing mechanism and processing the performance of the National Energy Program- II (NEP-II), improving a quality control circle of the PDCA cycle, and diffusing the R&D results in a way that is not only more people friendly, but also spreads the benefits of energy technology innovation more broadly. It is hoped that through this research, the accountability of the government's spending on energy technology R&D can be measured and enhanced.

■ Science & Technology Policy Research and Information Center

The Analysis on S&T Capacity Via Scientometric Indicators

Advantages and opportunities of Taiwan

Science and Technology Policy Research and Information Center utilized academic publications and patents to analyze S&T performance in Taiwan. The quantity and the quality of academic publications in Taiwan are both increasing, especially in computer science, engineering, material sciences, and physics. The number of granted patents of USPTO in Taiwan is ranked the fifth in the world, and the impact of patents is ranked the 12th.

■ Science & Technology Policy Research and Information Center

New Tool for the S&T Program Review

Transform the texts into graphs

To assist the review work of the S&T program, a new tool, entitled the S&T Program Budget and Contents Analysis System, was created. It has been embedded in the Government S&T Program Platform to provide interactive infographics representing the text contents of the S&T programs. Reviewers can easily access the emphases of the S&T budget allocation in recent years through the interactive webpages.

■ Science & Technology Policy Research and Information Center

A "Science, Technology & Innovation Policy Outlook" for Daily Reading

Grasping the latest international prospects and trends for you

The "Science, Technology & Innovation Policy Outlook" is the only free web portal, which collects and handles a substantial amount of information from integral databases, valuable research reports, renowned official websites, organizations, mainstream media, and core journals worldwide for international innovative policy and technology. Six categories such as the Policy Trend, Information and Communication Technology, Advanced Manufacturing, Biopharmaceuticals, Sustainable Environment, and Energy are covered. Only 10 minutes a day can keep you up to date with the pace of global trend.

■ Science & Technology Policy Research and Information Center

Taiwan-US Cooperate to Cultivate Talents in Policy Planning

STPI signed MOU with the CASBS of Stanford University

The STPI signed an MOU with the Center for Advanced Study in the Behavioral Sciences (CASBS) at Stanford University in May to cultivate talents in policy planning. The collaboration targets the policy scholars and researchers of great renown in Taiwan. After a series of strict screening processes, a candidate will be dispatched to the CASBS for the opportunity of a one year visiting research fellowship at Stanford University starting from 2017. This fellow will have the chance to closely interact with those elites in policy research from around the world, hoping to generate fresh perspectives in coping with challenging social issues in Taiwan.

■ Science & Technology Policy Research and Information Center

SPARK Taiwan Delegation Left Japan With a Pocketful of Friendship

A fruitful trip in biomedical research

Led by Dr. Yuh-Jzer Joung, the Principal Investigator of SPARK Taiwan, a delegation of 10, including professors from six anchor universities who visited the University of Tokyo, Tohoku University, and Osaka University in Japan from March 7-11. The main purpose of the trip was for the SPARK Taiwan office and local anchor universities to learn how SPARK Japan cultivates future teams and team projects in preparation for their entrance into the pharmaceutical industry or the medical device industry. At the same time, the delegation aimed to share Taiwan's experiences in translation, medical regulation implementation, intellectual property registry, negotiation, commercialization planning, as well as expanding the sales market for promising products. During their visit in Sendai, the delegation received an overwhelming gift from the grade school students in northeastern Japan: a ROC flag woven with the Sen Ba Tzu Ru (thousand paper cranes), a prayer gift for those who suffered from the February earthquake in southern Taiwan.

■ Science & Technology Policy Research and Information Center



▼ A woven ROC flag: The gift for SPARK Taiwan delegation

"Research Portal"-Analyze Key Issues in Science and Technology Policy

Connect external social media and spread influence in society

The Research Portal is a website that presents the STPI's research outcome in short essays. More than 240 essays have been uploaded since it was launched in 2014. In 2016, it focused on spreading its influence through social media such as Facebook, email newsletters, and other external media, in order to promote key issues to the general public and raise discussions in the community of science and technology policy.

■ Science & Technology Policy Research and Information Center



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.

Connecting Industries, Academics, and Research, Creating Values, and Renewing Industries

Aggregating innovative energy

The four major missions of the National Applied Research Laboratories (NARLabs) are to establish R&D platforms, support academic research, promote frontier science and technology, and foster high-tech manpower. Having signed cooperation agreements with nearly 30 domestic universities regarding scientific research collaboration, facilities sharing, personnel employment, and student training, NARLabs share resources with universities and develop new technologies to create values and renew industries.

In 2016, NARLabs accorded with the industry innovation projects implemented by the government, assisting the Ministry of Science and Technology in promoting the "The Shalun Green Energy Science City Program" and "The Biomedical Industrial Innovation Promotion Program". In addition, we endeavored to form connections between industries, academics, and research through projects such as the Internet-of-Things sensors service platform program, a cooperation memorandum with Taichung Veterans General Hospital, the collaboration with the Aerospace Industrial Development Corporation on Industry 4.0, and a cooperation memorandum with the Medical Device Innovation Center (MDIC) of National Cheng Kung University (NCKU), etc. The NARLabs will continue to promote industrial-academic links, thereby converting research results into innovative industries and enhancing social well-being.



President Yeong-Her Wang (Right) witnesses the signing ceremony between CIC of NARLabs and MDIC of NCKU. (Deputy Minister Fong-Chin Su, left, was the former Director of MDIC)

The Cooperation Memorandum Between NARLabs and Keysight Technologies on 5G Communication Technology

Accelerating the development of 5G technology

With the support of the Ministry of Science and Technology, the National Chip Implementation Center of NARLabs has endeavored to develop 5G wireless communication technology and millimeter-wave front-end technology through the integration of industries, academics, and research. Keysight Technologies and CIC signed a cooperation memorandum regarding 5G communication technology on June 13, 2016 and endeavored to develop wireless communication technology to increase economic outputs and to help Taiwan establish a central position in the global communications field.



Team photo of NARLabs and Keysight Technologies in front of 5G communication testing devices.

2016 Taipei International Invention Show and Technomart

NARLabs' smart disaster prevention applications win gold in the invention competition

Numerous inventions of NARLabs were displayed this year. For example, the Sloped Rolling-Type Isolation Platform can effectively reduce damage to industrial facilities caused by earthquakes. The underwater stress sensing technology used in environmental monitoring and vibration sensing systems can be employed to monitor real-time bridge erosion. Besides, the Dual-Core Self-Centering Sandwiched Buckling-Restrained Brace devices invented by NCREE entered the invention competition this year and won the gold medal. The environmental sensing alarm system invented by CIC can be used to improve environmental safety.

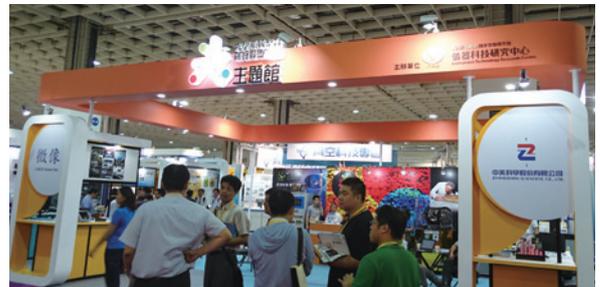


▼ Mi-Ching Tsai (left, the former Deputy Minister at the Ministry of Science and Technology) visited NARLabs's show booth.

Instrument Technology Research Center at 2016 Photonics Festival in Taiwan

Theme pavilion for the optical systems integration R&D consortium

The Instrument Technology Research Center of NARLabs integrated relevant industrial, government, academic, and research units and founded the Optical Systems Integration R&D Consortium in 2013. This is the first time that ITRC invited members of the Consortium to co-exhibit their inventions at a theme pavilion at the 2016 Photonics Festival. They attracted many visitors and obtained opportunities to cooperate with numerous enterprises and businesses.



▼ The Theme Pavilion for ITRC's Optical Systems Integration R&D Consortium

Co-Establishment of Laboratories Adds Another 3D Printing Platform

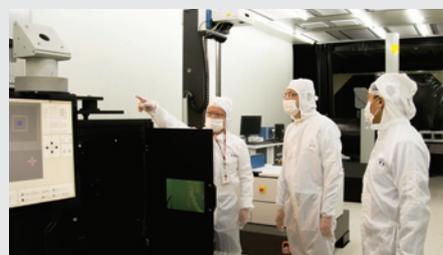
Industry-academia collaboration to seek new business opportunities in Taiwan for medical materials

NARLabs has combined research capacity from industries and academics to establish an open and innovative system. After establishing the Atomic Layer Deposition Laboratory (ITRC & tsmc), the Earthquake Disaster Prevention Laboratory (NCREE & Taiwan SECOM), and the Disaster Prevention Laboratory (TTFRI & Taiwan SECOM), NARLabs established a 3D printing laboratory with Tongtai Group, China Steel, and Thin Tech Materials Technology Co. This laboratory is a system construction laboratory that mainly focuses on 3D additive manufacturing technology and serves as the most comprehensive biomedical printing platform in Taiwan, providing one-stop services in the medical materials industry and bringing the Taiwan medical materials industry to the world stage.

Advanced IC Packaging Process Stepper Investment Seminar at the Instrument Technology Research Center

The first system developed in Taiwan that leads industrial development

On December 16, 2016, the Instrument Technology Research Center held a demonstration and investment seminar for its advanced IC packaging process stepper, which is the first locally made packaging stepper for manufacturing use. At the seminar, ITRC shared its technological capacity with the semiconductor equipment industry to stimulate the local development of critical upstream and downstream components. In the future, semiconductor devices and critical optical components can be manufactured in Taiwan, and the competitiveness of Taiwan's semiconductor industry can be enhanced.



▼ Vice President J.K. Lin of tsmc inspects the advanced IC packaging process stepper.

Demonstration of the Internet-of-Things Sensor Service Platform

NARLabs self-develops internet-of-things sensors, embracing the era of Industry 4.0

The Department of Engineering and Technologies at the Ministry of Science and Technology and the National Applied Research Laboratories jointly promoted the Internet-of-Things sensor service platform program. The Instrument Technology Research Center, National Chip Implementation Center, and National Nano Device Laboratories of NARLabs jointly established the sensor prototype verification platform. At the demonstration, eight Taiwanese universities and 17 academic research teams presented their research results concerning autonomous sensor components. Accordingly, we hope to apply academic research results to help the industry develop autonomous sensor technology.

▲ Group photo of the program's team members and industrial experts





Under global competition, talent is our most important resource and also the key to sustain national development. Fostering high-tech manpower is one of NARLabs four major missions. We help establish links between academia and industry via our innovative service platforms. In addition, we continue to tap international human resources, with the ultimate goals of cultivating superior, innovative manpower and boosting Taiwan's international competitiveness.

The 5th HPC Kung Fu-NCHC 3D Animation Challenge

Cultivating interdisciplinary talent of technology and art

The NCHC held the 5th "HPC Kung Fu-NCHC 3D Animation Challenge" to bridge the gap in talent cultivation and promote the integration of technology and art. This event has involved 50 universities, thousands of students, and more than 200 employment opportunities are connected, further driving the establishment of companies by young entrepreneurs. It is a cradle for talents of the domestic 3D animation and gaming industry.

■ National Center for High-performance Computing



▼ The 5th NCHC 3D Animation Challenge

Taiwan Student Cluster Competition (TSCC) 2016

Laying the foundation for high-performance computing talent in Taiwan

The NCHC has maintained long-term efforts to cultivate high-performance talent in Taiwan. Nine teams entered the finals of TSCC 2016 and competed in cluster assembly, hardware performance optimization, and using the cluster for solving problems. National Cheng Kung University placed first and Tunghai University was the dark horse that came in second.

■ National Center for High-performance Computing



▼ 2016 Taiwan Student Cluster Competition

Introduction and Demonstrating Earthquake Engineering Research in Schools (IDEERS) 2016

The sixteenth annual Introducing and Demonstrating Earthquake Engineering to Students (IDEERS) competition was held thanks to the efforts of the National Applied Research Laboratories (NARLabs), the National Center for Research on Earthquake Engineering (NCREE), and the British Council (BC), on September 9-11, 2016. There were a total of 13 graduate teams, 49 undergraduate teams, and 42 high school teams participating in the IDEERS modeling and testing event this year. The foreign teams came from United Kingdom, Australia, New Zealand, Korea, Indonesia, Malaysia, Hong Kong, Macao, Philippines, Singapore, and Vietnam. On September 10, participants had 6.5 hours to complete their models using simple materials and tools including long strips of wood, rectangular wooden base boards, PVC hot melt glues, rubber bands, and string. On September 11, after the opening ceremony, models were tested on a shaking table with earthquakes of different intensities. In the end, the Kaohsiung Industrial High School team won first prize in the high school division, the National Taiwan University of Science and Technology team won first prize in the undergraduate division, and the National Taiwan University team won first prize in the graduate division. More information about IDEERS is available at <http://www.ncree.org/ideers/2016/>.

■ National Center for Research on Earthquake Engineering



▼ Models were tested on a shaking table

The MorSensor Creative Application Design Contest

Building blocks that inspire a creative lifestyle

To inspire student creativity in combining wearable technology with the Internet of things (IoT), CIC organized the "MorSensor Creative Application Design Contest". The participants were invited to build their own electronic intelligent sensing system using MorSensor wireless sensing blocks, and demonstrate the system's functions and capabilities with custom-made mobile application software. The competition has received wide academic acclaim since its inception in 2015, and for its 2016 edition, it has attracted the participation of 90 research teams from across the country.

■ National Chip Implementation Center



▼ Awarding Ceremony of "2016 MorSensor Creative Application Design Contest"

ITRC Assisted in Hosting 2016 ASME SPDC

ITRC assisted in hosting 2016 ASME SPDC

In 2016, ITRC assisted the American Society of Mechanical Engineers (ASME) Taiwan Section in hosting the Student Professional Development Conference (SPDC) competition, which was divided into two aspects. The first one was design competition, whose theme this year was to design a robot which can automatically make and eject paper planes; the other was English lecture competition, whose topic had to be relevant to mechanics. 14 groups from 7 universities participated in the design competition, while 6 students engaged in the lecture competition. It is expected that the world will get to know the research capability of students from Taiwan through ASME SPDC.

■ Instrument Technology Research Center



▼ Group Photo of 2016 ASME SPDC Participants

the world will get to know the research capability of

The 8th NARLabs *i*-ONE Instrument Technology Innovation Competition

Implementing the spirit of creating and developing researchers of basic science and technology

ITRC is dedicated to the innovative research and development of instrument technology and the education of researchers in basic science and technology. The NARLabs *i*-ONE Instrument Technology Innovation Competition was launched in 2009 and has since entered its 8th anniversary. Through this event, ITRC expects to encourage young learners to make use of their innovative potential, stimulate creative ideas, and join the creation culture, thereby injecting a continuous supply of vitality into Taiwan industries through innovative research and development.

■ Instrument Technology Research Center



▼ The 8th NARLabs *i*-ONE Instrument Technology Innovation Competition

Embrace Failure and Keep Trying Everything

Response to Silicon Valley entrepreneurship: stand up and move forward from your failure

The first X Fail Conference received a tremendous response from the domestic entrepreneurs, so the STPI co-organized the 2016 X Fail again. Around 500 young people participated in the conference and exchanged their experiences. Four famous speakers shared their failures as an encouragement for others: "fail often and learn from it". Embracing Silicon Valley entrepreneurship will be able to lead Taiwan into an "innovation era".

■ Science & Technology Policy Research and Information Center



▼ X Fail Conference delivered the message from Silicon Valley "learn from fails".

Talent Cultivation of Underwater Technologies

Talent cultivation of underwater technologies

The I-Dream project of Development and Application of Underwater Technologies has been financially supported by NARL in 2016. To integrate academic resources in Kaohsiung City, TORI, NSYSU, NKUAS and NKMU join together to contribute their research facilities on this project. Besides, talent cultivation is one of the missions to the development of underwater technologies in this project. The courses of "Embedded System Development" and "Signal Processing and Database Practice" are held to improve the skill of underwater technologies.

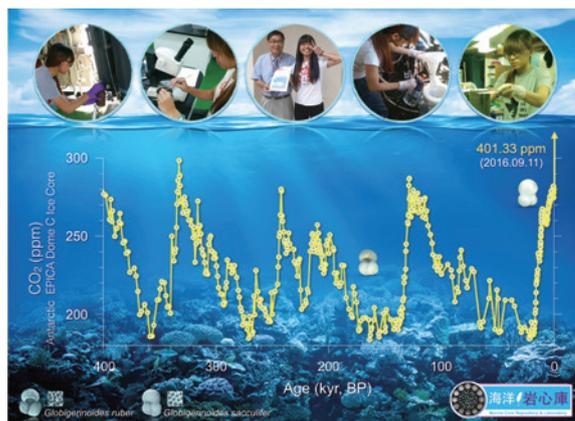
■ Taiwan Ocean Research Institute

Taiwan Ocean Research Institute

Effects of ocean acidification on modern living planktonic foraminiferal shells

Climate change caused by rising concentration of atmospheric carbon dioxide is shifting the natural balance in the oceans. These chemical reactions as "ocean acidification" have a dramatic impact on the marine ecosystems. For assessing this key issue, an undergraduate student Ms. Chi-Hsuan Wu from the National Sun Yat-Sen University participated 2016 Summer Program at TORI and had an opportunity to engage in challenging academic work with the marine geology and geophysics team. During this summer, she had her first cruise experience onboard of R/V Ocean Researcher I. The shell size and weight of planktonic foraminifera, *Globigerinoides ruber* and *Globigerinoides sacculifer*, were measured from plankton tows collected off the southeastern China. Long-term investigations on planktonic foraminiferal shell will be needed to monitor the potential damages caused by ocean acidification in the future.

■ Taiwan Ocean Research Institute



▼ Another greenhouse effects concern-A vision on ocean acidification problems through area density measurements of planktonic foraminiferal shells.



International Cooperation

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

Promoting Research and Innovation Collaboration Between Europe and Taiwan

Promoting research and innovation collaboration between Europe and Taiwan

The Ministry of Science and Technology (MOST) and National Applied Research Laboratories (NARLabs) organized a reception to promote Taiwan's participation in Horizon 2020 on July 1, 2016 at the Shangri-La's Far Eastern Plaza Hotel Taipei. Minister Hung-Duen Yang of MOST, President Ching-Hua Lo of NARLabs and Director Hsiao-Wei Yuan of the International Affairs Office at NARLabs hosted the reception, which was attended by the European representatives offices in Taiwan, European Union research and innovation collaboration departments at the various ministries, as well as universities and research institutions in Taiwan. The reception served as an opportunity for connection and interaction between Europe and Taiwan with the aim to increase Taiwan's involvement in Horizon 2020 and other research collaboration with the EU so that Taiwan may continue developing into an influential and valuable collaborator in the international scientific community.



▼ Group Photo of Horizon 2020 Reception Attendees

Promoting Research and Innovation Collaboration Between South Korea and Taiwan

National Applied Research Laboratories and National Research Council of Science & Technology Co-Host Bilateral Workshop

In order to promote international prospect on natural disaster prevention and nano technological research at National Applied Research Laboratories (NARLabs), a bilateral workshop was jointly held by NARLabs and Korea's National Research Council of Science & Technology (NST) at National Nano Device Laboratories (NDL) on November 22, 2016. Led by Dr. Sangchun Lee from NST, 15 scholars and experts from NST research institutes joined the workshop to share their experience on earthquake warning and response system as well as nano material research. In addition to researchers from NARLab's National Center for Research on Earthquake Engineering (NCREE) and NDL led by NARLab's President Yeong-Her Wang, scholars from National Taiwan University, National Cheng Kung University and National Taiwan University of Science and Technology also attended the workshop. During this trip, the Korean team also visited the Instrument Technology Research Center, National Center for High-performance Computing, National Space Organization, National Chip Implementation Center, NDL and NCREE.

During this NARLabs-NST Bilateral Workshop, scholars from each side shared 12 oral presentations on disaster prevention and nano technology research issues, and exchanged views on their respective topics. Scholars and experts from both teams gained insightful information on the exchange of technology and research. Both teams expect to achieve closer and more substantive cooperation, and plan to hold another workshop in Korea next year.



▼ Group photo of speakers and honorable guests at the NARLabs-NST Bilateral Workshop

Hosting the 2016 APEC Typhoon Symposium

Sharing the Typhoon and Flood Forecasting Research and Techniques with the Asian-Pacific Economic Cooperation (APEC) Member Economies

The APEC Research Center for Typhoon and Society (ACTS) held its annual APEC Typhoon Symposium (APTS) along with Student Poster Competition at the GIS NTU Convention Center in Taipei City from May 24 to 25, 2016. The theme this year was "Recent Development of Typhoon and Flood Forecasting Techniques and Applications". The symposium gathered around 280 representatives and participants from 12 member economies and 2 European countries to discuss the applications of weather forecasting and how to minimize the possibility of disasters.

■ Taiwan Typhoon and Flood Research Institute



▼ Group photo of speakers and honorable guests joining the 2016 APEC Typhoon Symposium

5th IASPEI / IAEE International Symposium: Effects of Surface Geology on Seismic Motion (ESG5)

Top international academic exchange of earthquake disaster prevention

The National Center for Research on Earthquake Engineering held ESG5 in Taipei on August 15-17, 2016. The significant contributions from the participants made ESG5 a great success. The ESG5 program included 8 keynote lectures, 20 invited speeches, and 100 poster presentations, involving about 200 participants from 28 countries. The ESG5 symposium showcased site effect related topics with a main theme of "Challenges of Applying Ground Motion Simulation to Earthquake Engineering," which focused on discussing characteristics of subsurface geology, structural response under strong ground motions, observation of ground motions, near fault effects, etc. The advanced strong motion simulation technologies can be applied to probabilistic seismic hazard analysis and earthquake disaster simulation to help reach the goal of earthquake preparedness and disaster mitigation.

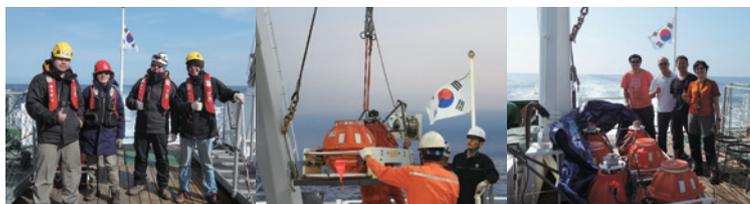
■ National Center for Research on Earthquake Engineering

Joint Collaboration Between Taiwan Ocean Research Institute and Pusan National University

A joint ocean-bottom-seismograph experiment offshore southeast Korea

The Memorandum of Understanding (MoU) between TORI and College of Natural Sciences, Pusan National University (PNU) was signed in 2016. The collaboration is aimed to deploy three ocean-bottom seismographs (OBS), which were fabricated by TORI, the Institute of Earth Science of Academia Sinica and the Institute of Undersea Technology of the National Sun Yat-sen University in Taiwan, for 1 year to investigate seismic activity and potential geohazard. The OBS array is expected to enhance the precision of hypocenters offshore southeast Korea. It also is a great opportunity to bring Taiwan self-designed OBS and associated technology development in TORI into international collaborations.

■ Taiwan Ocean Research Institute



▼ The photos of the teams of TORI (From left to right in the lower right panel: Hsu-Kuang Chang, Jia-Pu Jang, Po-Chi Chen and Pei-Ying Lin), PNU and M/V *Gisang 1* taken in deployment and recovery cruises.

FORMOSAT-7 Has Passed the Compatibility Test and Space Environment Tests

Next generation GNSS-RO meteorological satellite constellation

FORMOSAT-7 is a meteorological satellite project conducted cooperatively by Taiwan and the United States. In 2016, NSPO completed the assembling of the 6 sets of spacecraft buses and the mission and scientific payloads. Each of the 6 satellites has passed the space environment tests including thermal vacuum test, system integration test, mass property measurement, and electromagnetic compatibility test, etc.. In addition, through the satellite system to ground operation system end-to-end test, the domestic developed Cross-Platform Satellite Operation Control (XPSOC) system is verified and proven to meet the mission operations requirement for FORMOSAT-7.

■ National Space Organization



For social engagement, 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 researchers have made significant impacts through monitoring and early warning technologies.

Science Exhibition Jointly Organized by NARLabs and National Library of Public Information

When laboratory science walks into your daily life

NARLabs and National Library of Public Information jointly launched a series of Science Exhibitions on November 3, 2016. The National Center for Research on Earthquake Engineering became a NARLabs "starter" to showcase a main theme of "A Seismically Safe Home-Introducing Earthquake Engineering" by asking a basic question: "Is your home safe during earthquakes?" The exhibition introduces seismic isolation and energy dissipation buildings that oftentimes show up in real estate advertising leaflets. The exhibition finally ends with displaying Earthquake Early Warning System to raise earthquake awareness and preparedness in general public.



▼ Group photo of Jough-Tai Wang (VP of NARLabs), Director C.C. Liu of NLPI, and staff from NARLabs

■ National Center for Research on Earthquake Engineering

Taiwan Geosciences Assembly-Talking About Science

2016 Taiwan Geosciences Assembly

The National Applied Research Laboratories has endeavored to develop intelligent disaster prevention technology. To improve knowledge and strengthen the education and popular science communication of disaster prevention technology, NARLabs joined a series of science salon lectures hosted by the Taiwan Geosciences Assembly (TGA) from May 16 to May 20, 2016. At this science salon, attendees networked with scientists and renowned researchers. Scientists also took questions about disaster prevention technology through a live YouTube channel during lectures. In addition, NARLabs organized DIY science activities that visitors could try to make mini weather radars, mini FORMOSAT-5 models, and models of earthquake proof houses. A full scale mockup of FORMOSAT-7 satellite also put on display in TGA exhibition. With these fun and easy activities, the knowledge of weather forecasting, artificial satellites, and earthquake engineering would be able to make use in visitor's daily lives.

2016 National Science Exploration Competition

Co-organized by the NCHC, Kaohsiung City Government Education Bureau, and National Museum of Natural Science

The NCHC, Education Bureau of Kaohsiung City Government, and National Museum of Natural Science co-organized the National Science Exploration Competition to inspire schools around the nation to improve their science exploration ability and expression and description abilities; a total of 182 schools and over 1,450 students and teachers participated in the event.



▼ 2016 National Science Exploration Competition

Participants learned about science from different perspectives through this event and their interaction inspired more creativity in learning.

■ National Center for High-performance Computing

The NCHC and NPM Work Together to Bring the NPM into Classrooms

NPM education channel-creative teaching plan competition

To let students access the collection of the NPM through the internet, the NCHC applied cloud technology to help the NPM create a "NPM Education Channel", which will promote e-learning. The NCHC and NPM co-organized a creative teaching plan competition to bring digital resources of the NPM into classrooms; over 84 middle and elementary schools and over 14,000 teachers and students participated over three years, bringing the NPM into classrooms.

■ National Center for High-performance Computing

Expedition to a Mini World

Exploring nanotechnologies

In this exploration camp hosted by National Nano Device Laboratories, kids obtained hands-on experience wearing cleanroom suits and explored how nano devices are made from chips through gadget use and videos. They also played with solar battery boxes to learn how electrons absorb light for movement. A flurry of activities and games elicited several questions and enthusiastic participation.

■ National Nano Device Laboratories



▼ Eyes focused on the modulated artificial sunlight



▼ Experiencing dry-cleaning in air shower



▼ A happy, intellectually stimulating camp!

NASA-A Human Adventure Special Exhibition

A showcase of space technology in Taiwan

NSPO and JDI Corporation co-organized an exhibition, entitled "NASA-A Human Adventure", on 2016/5/28~9/18. An exclusive section is held for showcasing the space technologies in Taiwan, which included the description of the missions of all FORMOSAT programs, introduction to satellite specification/configuration and illustrates a magnificent experience of seeing Earth from outer space through the camera from FORMOSAT-2. The satellite control center is displayed on site which is duplicated from NSPO, consequently, visitors is able to experiences the spacecraft operations and also, the live video trajectory is showing the ground antenna and simulates the satellite flying orbit on the ground, all of which provide varieties of immersive space experiences and the knowledge to space sciences for visitors.

■ National Space Organization



▼ NASA-Opening Press Conference

Space Exploration Camps Sensational Opening

Animated and excited experiences

NSPO, JDI Corporation and FLST Corporation are jointly held a National Aeronautics and Astronautics Winter and Summer Camp respectively at Taipei, Hsinchu, Taichung, Tainan and Kaohsiung in 2016. Totally, 975 elementary and junior high school students are participated in such unprecedented events. The content of these camps is focusing on the fundamental space science; the practical is also included in order to emphasize the basic concepts of the relevant theories of space sciences. Finally, the presentations with the topic "Myself Space Project" is presented to each of grouped participants themselves at the last of the events.

■ National Space Organization



▼ Visit the NASA- A Human Adventure Special Exhibition

Laboratory Animal Science Camp-The Coolest Experience for High School Students!

Specially designed for high school students to learn and appreciate the truth of laboratory animal science

In 2016, the National Laboratory Animal Center (NLAC) designed a Laboratory Animal Science Camp for high school students, which allows the students to visit the animal breeding facility, write animal use protocols that integrate animal welfare, observe mouse behaviors, practice assisted reproductive techniques, and experience surgical training used fruits, which implement the replacement spirit of 3R principle. Through those programs, the students learned and appreciated the truth of laboratory animal science; they became more respectful and thankful to all lives.

■ National Laboratory Animal Center



▼ Students experienced the strict codes before entering the access controlled animal breeding area

I like to Read the Story of the Satellite-FORMOSAT-Series Satellites

The 1st publication in combination with the history of space science and technology development and Taiwan's space program

NSPO and Global Views-Commonwealth Publishing Group has published a literary called "I like to read the story of the satellite-FORMOSAT-series satellites", which is in combination with the history of space science and technology development and space program in Taiwan. The characteristics of the book is having abundant of figures and illustrations to help the readers/children understand the space sciences and technologies, in order to cultivates their imagination for space exploration. The book can be purchased in every bookstore to whom interest in space sciences.

■ National Space Organization



▼ I like to read the story of the satellite-FORMOSAT-Series Satellites

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