ITRI TODAY

Innovating on a Global Stage

ITRI shines at the 2023 R&D 100 Awards, securing eight honors including breakthrough technologies in manufacturing, sustainability, and biomedical fields. This marks the Institute's 16th consecutive year of excellence.

ITRI
Industrial Technology
Research Institute

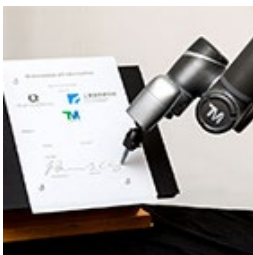# ITRI TODAY 115 Winter Issue 2023

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» Feature

Eight ITRI Technologies Win the 2023 R&D 100 Awards

Representatives of the eight R&D 100 Award winners accepted their accolades at the gala in San Diego on November 16.

ITRI was recognized for eight award-winning technologies at the 2023 R&D 100 Awards gala held in San Diego on November 16. This is the 16th consecutive year ITRI received the honor of the R&D 100 Awards, and eight awards is the second-highest number of awards won by a single organization this year. ITRI won five R&D 100 Awards for its manufacturing and sustainability technologies, and three R&D 100 Awards for its biomedical technologies.

ITRI President Edwin Liu expressed his excitement about ITRI's performance at the 2023 R&D 100 Awards. "We are honored to be recognized for the 16th consecutive year by the prestigious R&D 100 Awards, with eight winning innovations this year. Since 2008, ITRI has won 58 R&D 100 Awards. More than 90% of the winning technologies have been commercialized, showing that the innovations all have immense industry value. ITRI will continue to develop market-oriented R&D technologies and explore new opportunities to

innovate a better future for society."

Commenting on ITRI's performance at the R&D 100 Awards, R&D World VP and Editorial Director Paul Heney highlighted the Institute's consistent excellence, emphasizing that its technologies are "not just gradual evolutions but real innovative breakthroughs." Heney suggested that ITRI's technologies have earned the "ultimate compliment" from judges who find themselves saying, "Why didn't I think of this," demonstrating ITRI's contribution to shaping the innovation landscape.

Representatives of ITRI's research teams, Pegatron, and Asahi-Utou Technology were honored with the 2023 R&D 100 Awards at the gala in San Diego on November 16.

Explore our award-winning technologies:

| Biotechnologies for Glaucoma, Wet AMD & Tumor | > |
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🏆 R&D 100 Awards

Often referred to as "The Oscars of Innovation" and the "Nobel Prize of Engineering," the R&D 100 Awards is the only science and technology awards competition that recognizes the technological significance of new commercial products, technologies, and materials available for sale or license. Established in 1963, this year is the 60th in the awards' history. Visit R&D 100 World's website to see the complete list of 2023 winners.

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》**Feature**

Biotechnologies for Glaucoma, Wet AMD & Tumor

ITRI's triumph at the 2023 R&D 100 Awards comprises eight accolades, with a significant emphasis on three groundbreaking biomedical technologies, marking a historic win for the Institute's biotechnology sector. The biomedical innovations include the **Novel Targeted Therapy for Glaucoma**, the **Coordinated Supra-Molecular Complex (CSC) for Wet AMD Treatment**, and the **Intelligent Radio Frequency Ablation (iRFA)** for tumor therapy.

"It marks the fifth consecutive year that ITRI's biomedical innovations have earned the prestigious R&D 100 Awards, showcasing the international caliber of Taiwan's biomedical research capabilities," noted ITRI President Edwin Liu. All three award-winning technologies have been transferred to Taiwanese companies, reflecting the Institute's commitment to translating research into practical industrial applications. Notably, iRFA has been licensed to the ICT giant Compal Electronics, while the technologies behind the Novel Targeted Therapy for Glaucoma and the CSC for Wet AMD Treatment found their new home at Metagone Biotech.

Novel Targeted Therapy for Glaucoma

The Novel Targeted Therapy for Glaucoma , co-developed with TheratOcular Biotek, is a dual-target eye drop that significantly improves trabecular meshwork blockage and facilitates the drainage of aqueous humor to regulate intraocular pressure (IOP). The dual-target drug surpasses existing medications with three times the efficacy and overcomes prevailing limitations in managing ocular hypertension. In addition to its efficacy in treating glaucoma, it is suitable for individuals with elevated intraocular pressure.

Given that approximately half of glaucoma patients develop resistance within three years, this novel eye drop fills the treatment gap for those who have experienced treatment failure with initial medications. Administered once daily, it minimizes drug exposure to conjunctival tissue and mitigates common side effects such as irritation and inflammation. This in turn provides patients with a safer and more effective treatment option and better safety profiles in glaucoma management.


reakthrough in glaucoma treatment is recognized with the 2023 R&D 100 Award.

Coordinated Supra-Molecular Complex (CSC) for Wet AMD Treatment

Also co-developed with TheratOcular Biotek, the [CSC for Wet AMD Treatment](#) transforms the existing wet age-related macular degeneration (AMD) treatment by replacing invasive injections with a non-intrusive eye drop, significantly reducing the risk of complications such as bleeding, infection, and anxiety associated with ocular needle injections. Its exceptional drug delivery to the posterior eyeball negates the need for lifelong eye injection, thus lowering the risk of infection and the need for frequent hospital visits. Empowering patients to take control of their treatment, this self-care approach enhances their overall quality of life.

Recognizing the potential of small molecules in advancing ocular disease treatment, ITRI has devoted its efforts to developing the Coordinated Supra-Molecular Complex (CSC) carrier technology, a critical component behind both the Novel Targeted Therapy for Glaucoma and the CSC for Wet AMD Treatment. This versatile technology can be applied to address other posterior ocular diseases, including dry AMD, posterior uveitis, and macular edema, offering versatile treatment options.
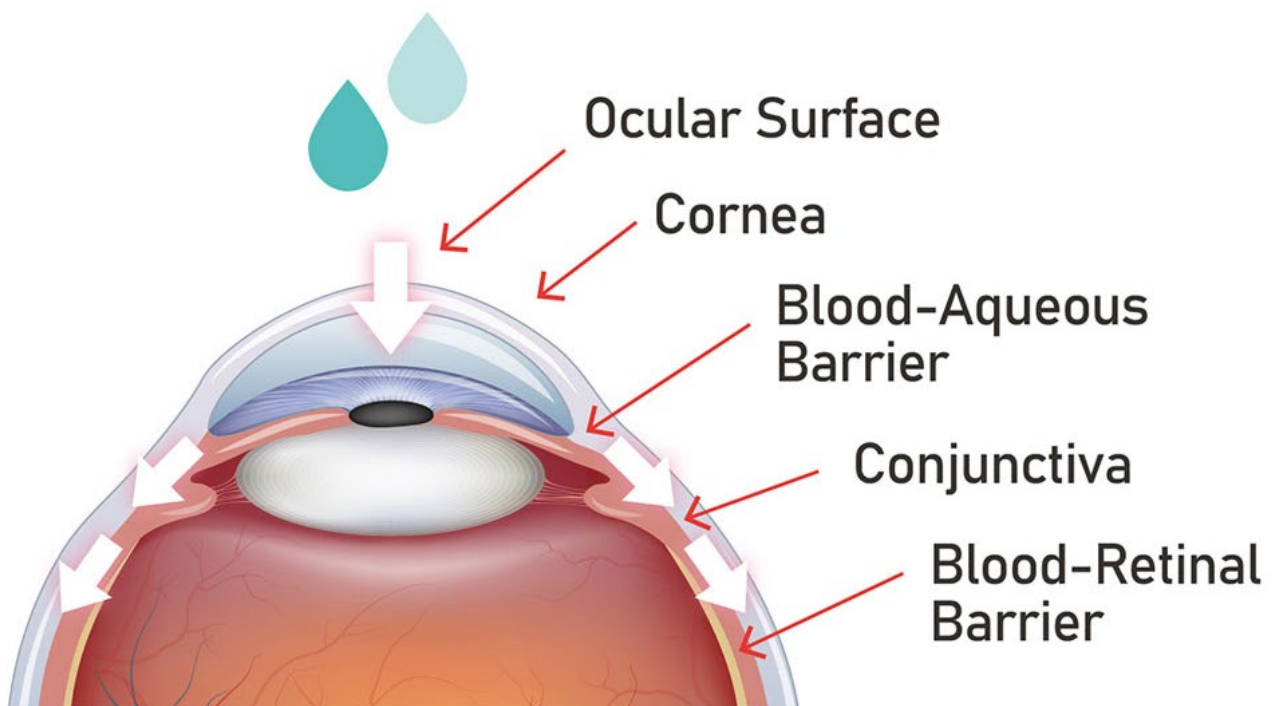
The CSC solution has the ability to penetrate through layers of eyeball tissues and reach the posterior segment of the eye.

Intelligent Radio Frequency Ablation (iRFA)

iRFA, co-developed with Compal Electronics, is an advanced radiofrequency ablation (RFA) system integrated with an ultrasonic real-time imaging module. With this advantage, iRFA can perform electrode insertion guidance and postoperative ablation confirmation. Its adjustable RF electrode makes it easier for surgeons to adjust the ablation volume and direction, enabling pinpoint ablating accuracy. It treats solid tumors in the liver, lungs, pancreas, or thyroid nodules, as well as cardiovascular and neurological diseases, with smaller wounds and shorter recovery time. Beyond its current applications, iRFA can potentially be extended to breast and orthopedic tumor ablation and even robotic-assisted surgery.

iRFA is the world's first ultrasound imaging-guided RFA system that features the integration of percutaneous RFA surgery equipment and ultrasound imaging.

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Manufacturing Tech with Sustainability at the Core

In the recent announcement of the 2023 R&D 100 Awards, five of ITRI's accolades go to its sustainable manufacturing solutions, reflecting the Institute's alignment with the global net-zero trend. These innovations include the **VOC-3R System**, **HEAD-Matrix ALD+ System**, **O-RAN Energy-Efficient Private Network Management Technology**, **AI-Driven Optimization for Precision Manufacturing**, and **SENSE**.

"Manufacturing stands at the forefront of carbon emissions, significantly impacting our environment. In light of the increasing demand for sustainable products, it becomes imperative to prioritize eco-friendly production methods. ITRI's five award-winning innovations not only advance various manufacturing aspects but also are designed to streamline production processes and markedly enhance energy efficiency," remarked ITRI President Edwin Liu.

VOC-3R System

The VOC-3R System, co-developed with Taimide, a leading polyimide film manufacturer, is an innovative solution for volatile organic compound (VOC) recovery in manufacturing processes using organic solvents. Suitable for various industries like electronics, pharmaceuticals, and coatings, the system addresses environmental concerns by capturing solvents from exhaust gases, eliminating direct carbon emissions. While traditional methods generated significant carbon emissions, this system ensures zero direct carbon emissions.

The three Rs of the VOC-3R System stand for CO2 reduction, solvent reclaim, and waste resourcezation.

Taimide, which produces 1,500 metric tons annually, faced challenges due to significant VOC emissions during its production processes. The baking phase released substantial VOCs, and conventional treatment methods were inefficient, resulting in secondary waste issues. Every kilogram of PI film produced led to approximately 5 to 6 kilograms of VOCs. The VOC-3R System successfully addresses this issue, effectively recovering solvents from exhaust gases. This adoption resulted in a noteworthy annual reduction of approximately 20,000 metric tons of direct carbon emissions, marking a significant stride in curtailing CO2 emissions in the polyimide film industry.

Notably, this technology provides an economically feasible and environmentally sustainable alternative, aligning with the global push for net-zero goals. Moreover, it promotes an environmental, social, and governance (ESG) framework in manufacturing, exemplifying a pivotal step toward greener industrial practices.

O-RAN Energy-efficient Private Network Management Technology

O-RAN Energy-efficient Private Network Management Technology is the world's first 5G open radio access network (O-RAN) private network management system with energy savings. It was co-developed with leading electronics manufacturer PEGATRON Corporation , which includes this system in its 5G O-RAN products. This technology contributes to reducing energy consumption and can be used with any private network, field, or base station brand.
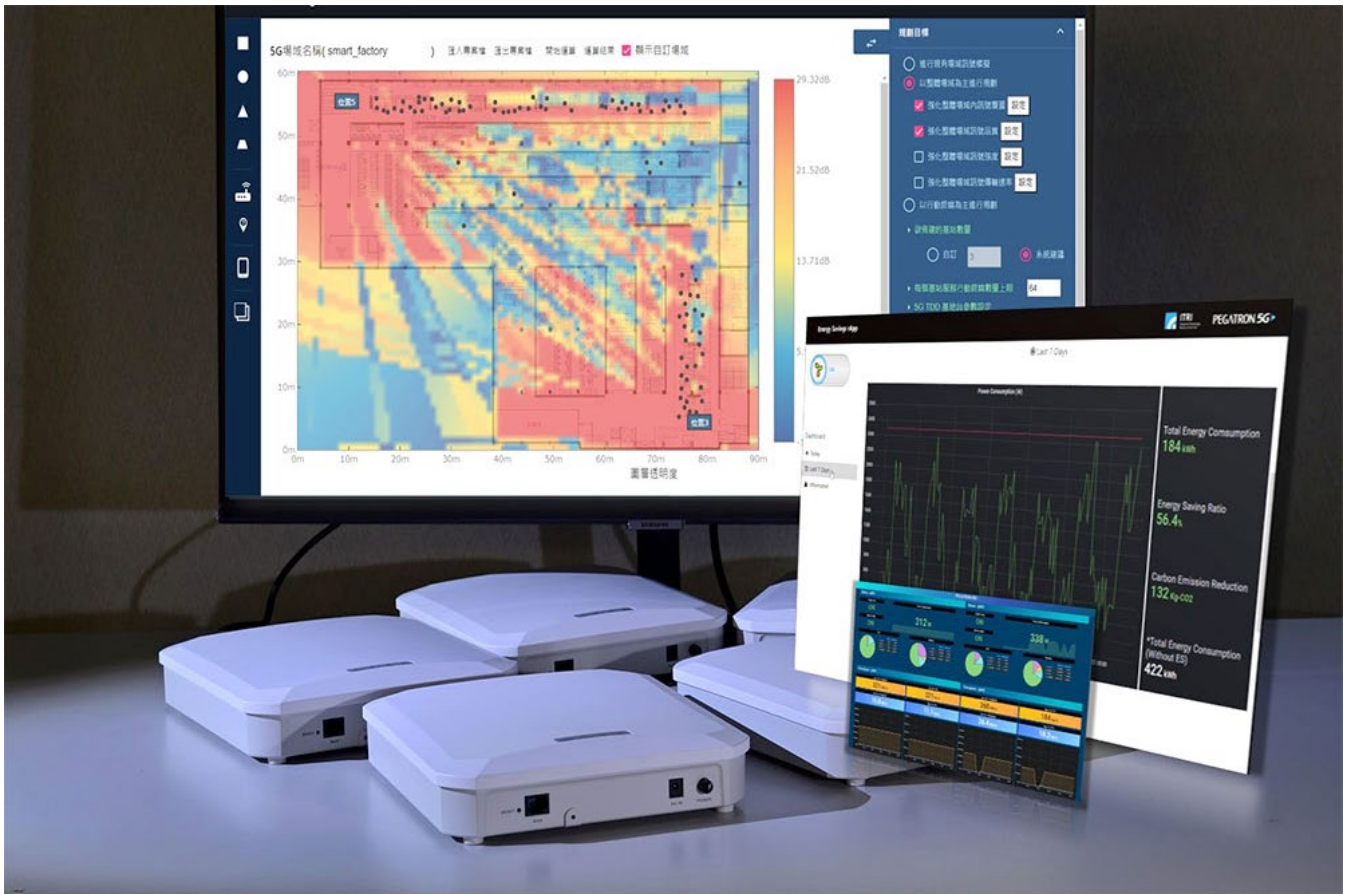
The energy-saving management platform for 5G-ORAN private networks is adaptable to any private networks, fields, and brands of base stations.

- **High deployment efficiency**: A single click mimics base stations to plan a private network. It provides base stations plug-and-play and performs automatic optimization, monitoring, and repair capabilities to reduce operation and maintenance costs.

- **Energy savings**: Artificial intelligence (AI) monitors flows and diversions for smart distribution and allows idle base stations to hibernate for energy savings. According to real-world trial results, this method saves 20% on power consumption.

- **Smart modularization**: It allows for agile private network deployment in 5G vertical applications such as hospitals, entertainment, warehouses, logistics, and drones.

According to [IEEE research](#), base stations consume 50% to 60% of private network electricity. This system decreases energy usage through flow monitoring and diversion, allowing idle base stations to sleep. Its one-click deployment function reduces deployment time by 80% because its AI optimizes, monitors, and repairs base stations in minutes. Furthermore, clever modularization offers a tailored developer interface for individual network requirements and adaptable applications.

HEAD-Matrix ALD+ System

The HEAD-Matrix ALD+ System streamlines semiconductor manufacturing by integrating multiple deposition processes into a single chamber, enhancing accuracy, efficiency, and sustainability. It meets the demands of high aspect ratios, multicomponent uniformity, and precise application of thin films.

HEAD-Matrix ALD+ satisfies the semiconductor process requirements of a high aspect ratio, multicomponent uniformity, and precise application of dense thin films.

It can be applied to emerging industries such as the semiconductor industry, OLED optoelectronic components, LED lighting, LCD backlight panels, solar photovoltaics, thin-film solid-state batteries, biomedical chip sensors, and 5G wireless communications devices.

HEAD-Matrix ALD+ has been tested and verified by upstream and downstream leading manufacturers, including leading domestic and foreign equipment and device manufacturers.

- **High aspect ratio**: It meets the memory 3D IC high aspect ratio requirement.

- **High uniformity**: As the size of chip components decreases during the 3D IC process, HEAD-Matrix ALD+ addresses the problem of conformal deposition of thin films containing multiple components that are uniform in thickness.

- **Enhance devices' lifetime and production yield**: It ensures a high rate of product yield. The prototype system will undergo production validation to meet commercial product specifications.

- **Energy savings and carbon reduction**: It significantly reduces equipment footprint and cost, and effectively abbreviates the transmission time of wafer replacement in the deposition process to increase production capacity and achieve energy savings and carbon reduction as a result.

AI-Driven Optimization for Precision Manufacturing

The AI-Driven Optimization for Precision Manufacturing software significantly improves the accuracy of machine tools for high-precision manufacturing, reducing production errors, time, and costs. It enables high-precision and customized machining processes without the need for precise temperature control from the process environment (e.g., 25±4°C). Unlike manual adjustment, which takes at least 14 days, this software can be rapidly adjusted and calibrated within just 30 minutes.

High-precision machining is a manufacturing process using advanced tools, machinery, and control techniques to achieve highly accurate and precise machining of workpieces at the micron or even submicron scale. Common applications for high-precision machining include the automotive industry, semiconductor fabrication, precision instruments, and optical components.
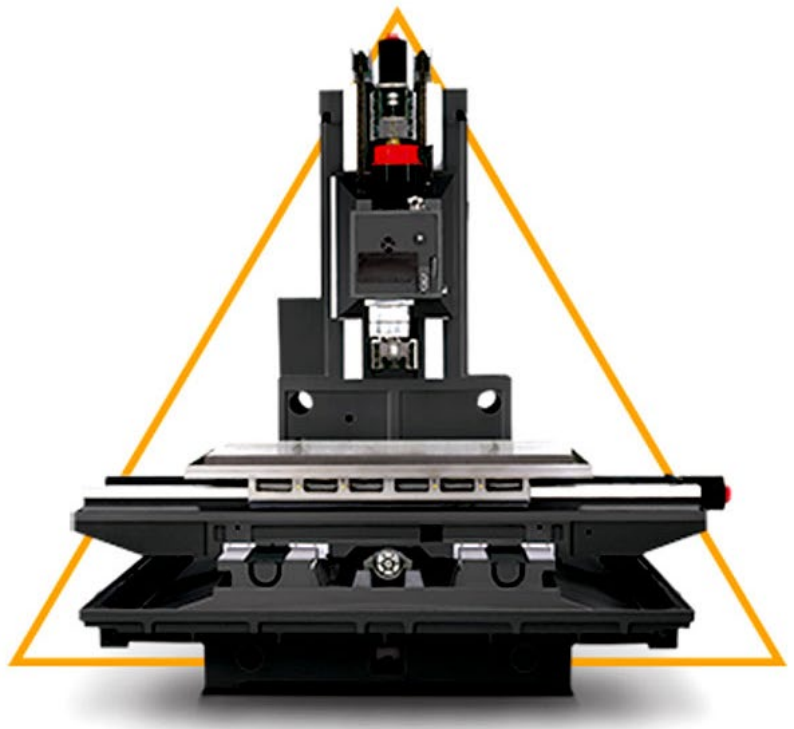
The AI-Driven Optimization for Precision Manufacturing software can adjust and calibrate high-precision machining equipment within just 30 minutes.

To reach micron-scale machining accuracy is quite challenging; many factors, such as stability, accuracy, processed materials, and the operating capabilities of the machine tools have direct impacts on product quality. Before the introduction of this technology, a manufacturer could only count on skilled and experienced technicians to try and minimize errors, but errors still occurred, which increased the costs and time to meet the requirements.

This innovation has three features:

- A built-in machining feature recognition function, advanced sensor monitoring technology, image recognition and analysis technology, and an AI control parameter optimization learning module to optimize the process.

- The software enables high-precision, accurate, and customized machining processes without the need for precise temperature control from the process environment (e.g., 25±4°C). Unlike manual adjustment, which takes at least 14 days, this software can be rapidly adjusted and calibrated within just 30 minutes.

- It achieves high-precision machining even with equipment that lacks professional calibration capabilities.

SENSE

Smart Energy for a Sustainable Ecosystem (SENSE) is a collection of environmentally friendly recycling power solutions. It includes mobile electricity consumption (for example, electric vehicles), turnover electricity consumption (e.g. an electric energy supplementary system), and dispatching electricity consumption (e.g. an energy storage system and a power grid). It can triple the service life of various electric energy units, from batteries to energy storage, minimize energy loss by 35%, and reduce construction costs by 30%. SENSE is a successful example of employing recycled resources to create batteries, and performing long-term battery management, which is completely consistent with the sustainable development trend.

SENSE was developed in partnership with CPC Corporation, Taiwan, a state-owned enterprise established in 1976 and one of the largest petroleum companies in Taiwan. This technology is conducive to CPC's transformation from a primary focus on petroleum to actively investing in green energy projects, providing a more environmentally friendly energy supply for electric vehicles to respond to future market changes.

SENSE pioneers in aggregating diverse power sources, including waste EV batteries, optimizing distribution dispatch and cutting carbon emissions.

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» **Spotlight**

Explore Our Latest Innovations at CES 2024

We invite you to **CES 2024 booth 9255**, North Hall, LVCC, to explore our innovations in smart sports, digital health, AI display and entertainment, and AI robotics. Join us also at **CES Unveiled Las Vegas**, Shoreline Exhibit Hall, Mandalay Bay Convention Center, for an exclusive look at our advancements in smart sports and AI display and entertainment. For more details, visit our **CES event website**.

Join us at CES 2024, booth 9255, North Hall, LVCC, from January 9 to 12, 2024.

Our CES 2024 highlights include the **AR Interactive Vehicle Display**, a transparent display that allows passengers to view and interact with augmented reality (AR) content without the need to wear any devices in a moving vehicle; the **Hyper-Realistic 3D Display** , the world's first interactive system with your digital avatar; the **Detachable Joint Robot System**, an innovative robot joint module for the rapid assembly of robots with different

numbers of joints and various payloads; **RoboTwin: Metaverse Smart Factory Simulation Platform**, which adopts state-of-the-art AI and Sim2Real technologies to create a realistic simulation of a manufacturing factory; and **iGolfPutter**, a smart golf analysis and training system that provides indoor players with the sensation of playing on an outdoor course.

Get a sneak peek at our CES 2024 innovations!

AI Display & Entertainment

- At CES and CES Unveiled: **PetPet Cam** is the world's first pet camera that utilizes generative AI to train a deep neural network (DNN) model to accurately capture "cute events," such as yawning, belly showing, and stretching. It automatically generates engaging photo and video mashups that owners can effortlessly share on social media platforms. Furthermore, PetPet Cam can identify individual pets and track their drinking and feeding frequency, allowing owners to monitor each pet's dietary habits and unusual pet behavior. Through notifications on the supporting mobile application, owners can enjoy happy moments with their furry friends anytime while keeping track of their overall health status.

- At CES: The **AR Interactive Vehicle Display** is a transparent display that allows passengers to view and interact with augmented reality (AR) content without the need to wear any devices in a moving vehicle. When passengers spot a site of interest, visual information is presented in real time, following their line of sight. Passengers can touch a visual cue on the screen to access detailed information. The system can be customized for various modes of transportation and incorporated into vehicle windows.

- At CES: The **Hyper-Realistic 3D Interactive Display** is the world's first interactive

system that can interact with your digital avatar. In addition to 3D animations and live broadcasts, the avatar is powered by AI to carry out real-time image processing, including image matting, single 2D to 3D imaging, and 3D virtual-real image fusion. The animation it presents is 3D to the naked eye from various angles. This system has made its mark with the LED display company Excellence Optoelectronics, offering interactive robots to the market.

AI Robotics

- At CES: **RoboTwin: Metaverse Smart Factory Simulation Platform** adopts state-of-the-art AI and Sim2Real technologies to create a realistic simulation of a manufacturing factory where engineers and operators can experience realistic and immersive manipulations and interactions via specifically designed user interfaces. With RoboTwin, operators can receive coaching to resolve issues during the manufacturing process from an engineer via teleoperation capability. In addition, it can be extended to various applications including multi-agent collaboration from various sites, remote troubleshooting, and maintenance via teleoperation. RoboTwin can be applied to diverse industries, such as semiconductors, machinery, and manufacturing. A leading Taiwan motor manufacturer TECO has adopted RoboTwin to create a virtual factory for increasing production efficiency.

- At CES: The **Detachable Joint Robot System** is an innovative robot joint module for rapid assembly of various robots with different configurations, including different numbers of joints and various payloads. This innovative robot joint module utilizes EtherCat for communications among peripherals for integration and coordination such as various sensors, drive controllers, encoders, motors, and brakes. Its compact design helps achieve the world's highest torque-to-volume ratio. Instead of the time-consuming substitution of robot arm joints due to repair and maintenance, five minutes is adequate for joint replacement via the detachable mechanism designed in ITRI's robot joint. This innovative robot joint with a rapid detachable mechanism will enable new thinking about use cases, and it can be applied to diverse industries such as machinery, manufacturing, medicine, and even services.

Smart Sports

- At CES and CES Unveiled: **iSwimWeaR** is a smart personal health management solution for underwater sports enthusiasts. Featuring ITRI's low-power microwave sensing technology, the device monitors real-time physiological vitals in underwater environments. It can be easily applied as an add-on for existing swimming goggles and diving masks to capture underwater vitals, including heart rate, breathing rate, and physical activity level. Combined with a user-friendly app, the device records vitals and underwater activities for long-term tracking. In the event of fatigue, cramps, or drowning, iSwimWeaR sends safety alerts to prevent a training session from turning into an emergency.

  At CES and CES Unveiled: **Mountain Watch** is an outdoor safety system comprising an app and a mesh network device. The device, equipped with long-range communication technology, acts as a relay station for hikers, allowing them to update and share their real-time location on the map, even in remote mountainous areas with no cell phone coverage. These devices also feature an emergency system that can promptly send SOS messages to other hikers nearby. Additionally, hikers can plan routes, navigate, and stay connected with family and friends through this integrated service.

- At CES and CES Unveiled: **iGolfPutter** is a smart golf analysis and training system that provides indoor players with the sensation of playing on an outdoor course. Powered by ITRI's 3D sensing AI analysis technology, iGolfPutter enables players to analyze their swing posture and body stance with their smartphone. Sensing chips are placed within the golf balls and the club head to collect data, including swing angles, swing speeds, ball flight trajectories, speeds, and paths. Immediately after each swing, the AIoT green under the player's feet dynamically recreates the terrain of real golf course landscapes for the player's next shot. It offers an immersive golf training experience that can be utilized for instructional purposes.

Digital Health

- At CES: **DeeGoo Digital Test & Training for Cognition Health** is a science-based management solution designed to assess and stimulate cognitive functions. Powered by a database that integrates published research and cognitive screening tools, the solution ensures effective mitigation of cognitive decline. Through AI analysis, posture recognition, and algorithms for both body and cognitive functions, DeeGoo offers personalized cognitive exercises to train performance in perception, attention, memory, executive function, language, as well as motor skills. As a user-friendly service, DeeGoo enables the aging community to take tests whenever convenient. By tracking their progress, DeeGoo has demonstrated a significant impact in delaying cognitive decline and improving overall cognitive health.

- At CES: **BeatSync** is an AI-powered interactive music training device designed to relieve emotional stress and enhance mental health. Through button-press musical instruments, BeatSync tracks and analyzes individual preferences and user performance to customize practice sessions according to AI analysis, tailoring the training experience to individual needs. With long-term use, the device can serve as a reference for assessing the status of users' well-being and progress. ITRI has collaborated with care facilities to benefit children and the elderly with this smart service.

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>> **Spotlight**

Envisioning a Better Future International Forum

The International Forum, "Envisioning a Better Future," explores the prospective industry landscape in Taiwan up to 2035.

As a part of its 50th anniversary celebration, ITRI hosted the International Forum Envisioning a Better Future on September 12 to explore Taiwan's forthcoming industry opportunities toward 2035. The event featured participation from industry giants such as Applied Materials, Corning Incorporated, Merck, Oxford Instruments, Mitsubishi Electric, and AVL List GmbH. These leaders shared their success stories and insights into industrial trends, attracting over a thousand forum participants both on-site and online.

Premier Chen Chien-jen attended the opening ceremony and acknowledged ITRI's pivotal role in empowering Taiwan's global competitiveness. This recognition came as Taiwan secured the sixth position in the 2023 IMD World Competitiveness Ranking, marking its strongest performance since 2012. Supported by ITRI's continuous pioneering innovations over the past five decades, Taiwan has cemented its position in the global semiconductor sector and high-tech supply chains. Chen hopes to see ITRI drive more cross-border collaborations through innovative technologies, solidifying Taiwan's position as a trusted partner within the

international community and leading the way in shaping future industries.

*Front row from left: Mayra Alvarado, Economic Section Deputy Chief, AIT; Filip Grzegorzewski, Head of the European Economic and Trade Office; Executive Yuan spokesman Lin Tze-luen; Premier Chen Chien-jen; ITRI Chairman Chih-Kung Lee; ITRI President Edwin Liu; John Dennis, Representative at the British Office Taipei; Takashi HATTORI, Deputy Representative, Japan Taiwan Exchange Association.*

ITRI Chairman Chih-Kung Lee also underscored ITRI's contributions to Taiwan's economic advancement. He highlighted ITRI's recent engagement with the European Association of Research & Technology Organisations (EARTO), where ITRI now chairs EARTO's RTOs International Network (RIN), exemplifying its commitment to international collaboration. With representatives from the US, UK, Japan, and Europe, alongside ITRI's international partners at the forum, Lee trusted that strengthening Taiwan's global ties could ensure a reliable global supply chain.

To address future challenges, ITRI President Edwin Liu announced the introduction of the 2035 Technology Strategy & Roadmap, which focuses on the application domains of Smart Living, Quality Health, Sustainable Environment, and the newly incorporated Resilient Society. ITRI aims to support the development of these four cross-industry application domains by harnessing AI and cybersecurity, semiconductor, communication, and smart sensing technologies. In the process of industrializing technology, international cooperation is the key to success. To align with the international ecosystem, this forum has invited six international industrial leaders as speakers, all of whom are ITRI's longstanding partners

across various sectors, including semiconductor equipment, display glass, healthcare, scientific instruments, electromechanics, and automotive power systems. Together, these collaborative efforts have played a crucial role in creating new interdisciplinary value for Taiwan's industry.

The keynote speaker of the forum, President of Applied Materials Taiwan Erix Yu, spotlighted the interconnectivity between the semiconductor industry's growth and carbon emissions. While focusing on market expansion, Applied Materials is working closely with its customers and suppliers to minimize environmental impact by reducing its products' energy, water, and carbon emissions.
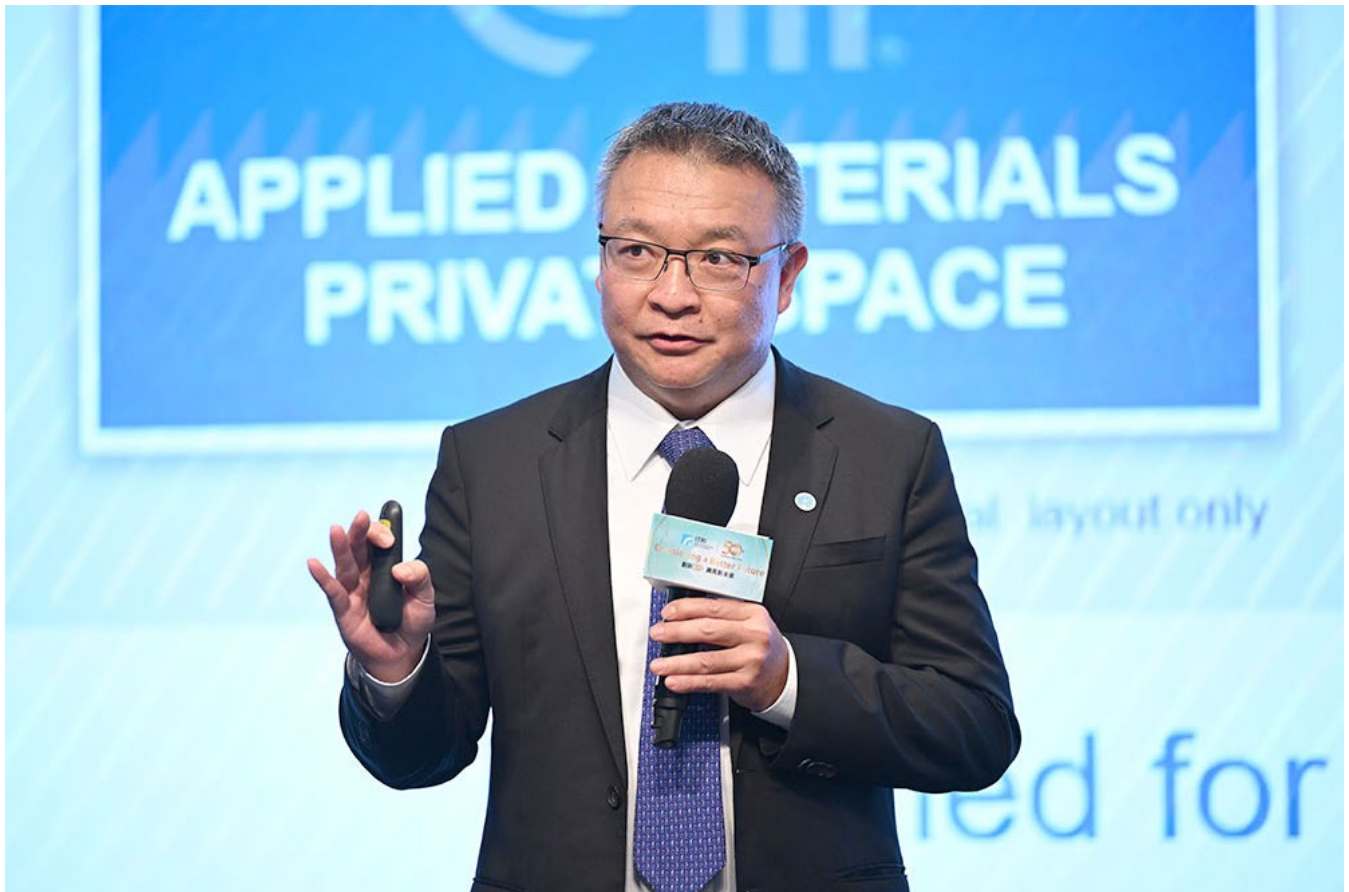
Erix Yu, President of Applied Materials Taiwan and the keynote speaker of the forum.

Andrew Ho, President of Corning Taiwan, confirmed the vital role that precision glass layers play in the advancement of emerging display technologies. In addition, Ho noted that Corning remains steadfast in applying its expertise in materials science and glass manufacturing to help shape a sustainable future.

Andrew Ho, President of Corning Taiwan.

Matt Kelly, Managing Director of Oxford Instruments Plasma Technology, explored how the company leverages its compound semiconductor capability to create highly efficient, low-energy, and carbon-reducing applications that drive sustainability across industries.

Matt Kelly, Managing Director of Oxford Instruments Plasma Technology.

Dr. John Lee, Managing Director of Merck Group in Taiwan, attributed the company's enduring success over 355 years to its emphasis on sustainable entrepreneurship and its ability to drive innovation. He highlighted Merck's endeavors in sustainability innovations, cross-sector innovations, and digital innovations, depicting how Merck navigated the competitive global market and seized long-term industrial opportunities.

Dr. John Lee, Managing Director of Merck Group in Taiwan.

Masahiro Oya, Executive Officer and Vice President of Mitsubishi Electric, detailed the company's fundamental management principles, which encompass growth potential, profitability and efficiency, soundness of work systems, and a commitment to sustainability. These efforts reflect the company's dedication to enhancing corporate value while addressing societal challenges through business.

Masahiro Oya, Executive Officer and Vice President of Mitsubishi Electric.

Reiner John, Coordinator Research Funding Corporate Strategy at AVL List GmbH, stressed the importance of the convergence of mobility, energy, and infrastructure systems in electronic components and systems (ECS) innovation. He cited ITRI's collaboration with European research projects in autonomous driving as a model for technological solutions with global impact, illuminating Taiwan's pathway to becoming an ideal R&D partner for Europe.
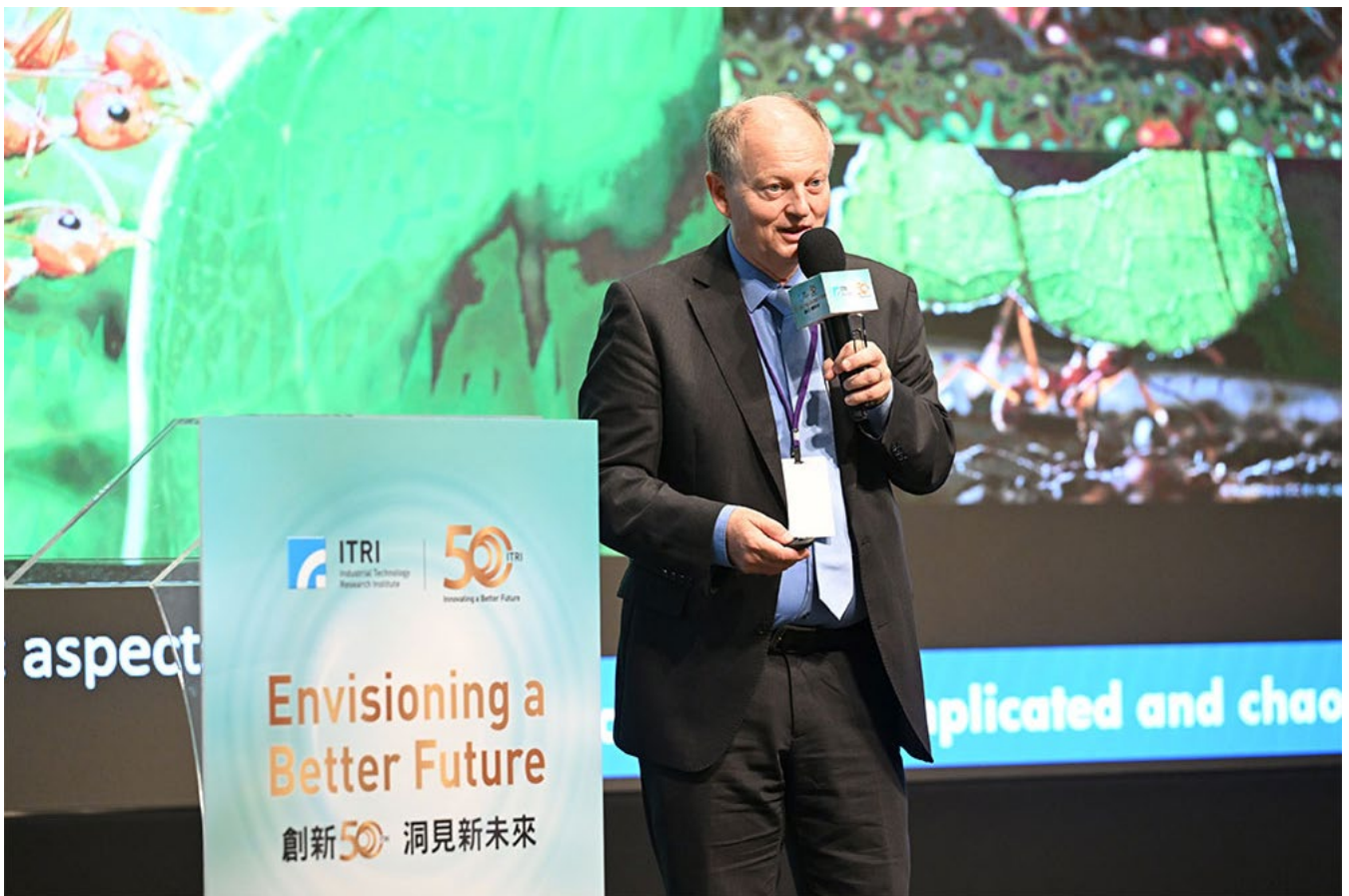
Reiner John, Coordinator Research Funding Corporate Strategy at AVL List GmbH.

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» Collaboration

Bridging European 6G-SANDBOX with Taiwan's Telecommunications Ecosystem

ITRI signed a memorandum of understanding (MoU) with 6G-SANDBOX, a pan-European testbed for 6G experimentation funded by Smart Networks and Service Joint Undertaking under Horizon Europe. This partnership aims to enhance cooperation between European and Taiwanese enterprises in the realm of 6G research by connecting 6G-SANDBOX testbeds with Taiwan's telecommunications ecosystem.

Delving into 6G research domains, ITRI and 6G-SANDBOX will focus on areas such as joint communications and sensing (JCAS) and reconfigurable intelligent surfaces (RIS). ITRI will facilitate 6G-SANDBOX's access to critical components, including 5G cores, 5G O-RAN base stations, SMO/RIC management platforms, JCAS frameworks, and advanced network planning and emulation tools. Functioning as a vital catalyst within the Taiwanese ecosystem, ITRI will proactively engage companies in the MoU. To commemorate the initiation of this collaboration, ITRI representatives visited the 6G-SANDBOX testbed in Malaga on November 8, 2023.

Pang-An Ting, General Director of ITRI's Information and Communications Research Laboratories, shared ITRI's recent strides in the ICT sector. "During our visit to Gothenburg for the EuCNC & 6G Summit this year, ITRI collaborated closely with leading lights in the 6G academia and industry. We explored robust research and development partnerships with European counterparts. I'm also pleased to announce that ITRI has successfully joined the esteemed ranks of the 6G-IA. By seamlessly integrating technologies, applications, and experimental networks from Taiwan into the 6G-SANDBOX testbeds, we are paving the way for collaborative experimentation for people in Europe and Taiwanese companies and institutes, focusing on both 5G and 6G technologies. Auray Technology has expressed keen interest in contributing their expertise in OTIC, including RAN Intelligent Controller and security testing. Looking ahead, we plan to extend invitations to universities and additional Taiwanese companies, aligning our shared commitment to innovating 5G networks and defining 6G standards."

6G-SANDBOX coordinator Michael Dieudonne stated, "Through a robust interconnection

between 6G-SANDBOX testbeds and the ITRI experimental network, we aim to create a comprehensive research platform for 6G applications. This MoU will further our ability to work with thought leaders across the globe and jointly run experiments to further advances in wireless communications."

(From left) Jeffrey Chen, General Manager of Greater China Wireless and Network Solutions Engineering at Keysight; Selena Hsu, VP of Auray Technology; Dong Yang Hsu, Director of ITRI's Information and Communications Research Laboratories; Dr. Pang-An Ting, General Director of ITRI's Information and Communications Research Laboratories; Michael Dieudonne, 6G-SANDBOX coordinator; Prof. Pedro Merino Gomez from the University of Malaga; and special consultant Morten Møller.

Launched in January 2023, the 6G-SANDBOX project is led by Keysight Technologies and includes esteemed partners such as COSMOTE, Eurescom, FOGUS Innovations & Services P.C., Fraunhofer FOKUS, ICTFICIAL OY, INFOLYSIS P.C., Institute for Software Engineering and Technologies (ITIS) at the University of Malaga, Lenovo, IS-Wireless (ISRD), the National Centre for Scientific Research "Demokritos" (NCSRD), Nokia eXtended Reality Lab, OpenNebula Systems SL, OWO, Queen's University Belfast, Telefonica, and the University of Oulu. The project's objective is to develop a large-scale EU-wide experimental platform for 6G technologies. This platform allows companies and research institutions to test and validate their new technologies, including promising technical 6G enablers such as network automation, cybersecurity, digital twins, Artificial Intelligence (AI), and technologies that optimize energy consumption. 6G-SANDBOX delivers fully configurable, manageable, and controlled end-to-end networks comprising digital and physical nodes, enabling the validation

of new technologies and research advancements for 6G.

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>> **Collaboration**

Hi-CHIP Alliance to Pioneer Pilot Production Solutions

The introduction of Generative AI (GAI) has significantly increased the demand for advanced semiconductor chips, drawing increased attention to the development of complex calculations for large-scale AI models and high-speed transmission interfaces. To assist the industry in grasping the key to high-end semiconductor manufacturing and integration capabilities, the Heterogeneous Integrated Chiplet System Package (Hi-CHIP) Alliance brings together leading semiconductor companies from Taiwan and around the world to provide comprehensive services, spanning from packaging design, testing and verification, to pilot production. Since its establishment in 2021, the alliance has accumulated important industry players as its members, including EVG, Kulicke and Soffa (K&S), USI, Raytek Semiconductor, Unimicron, DuPont, and Brewer Science. Looking forward, the alliance is set to actively explore its global market potential.

ITRI collaborates with semiconductor industry players including Unimicron, AITA, USI, and Raytek to deliver comprehensive semiconductor services.

Dr. Shih-Chieh Chang, General Director of Electronic and Optoelectronic System Research Laboratories at ITRI and Chairman of the Hi-CHIP Alliance, indicated that advanced manufacturing processes have led to a considerable increase in IC design cycles and costs. Multi-dimensional chip design and heterogeneous integrated packaging architecture are key tools to tackle this demand in semiconductors. On top of that, the advent of GAI such as ChatGPT, which demands substantial computing power and transmission speed, requires even higher levels of integration capacity in chip manufacturing. ITRI has been committed to developing manufacturing technologies and upgrading materials and equipment to enhance heterogeneous integration technologies. Achievements include the fan-out wafer level packaging (FOWLP), 2.5 and 3D chips, embedded interposer connections (EIC), and programmable packages. With both local and foreign semiconductor manufacturer members, the Hi-CHIP Alliance is establishing an advanced packaging process production line to provide an integrated one-stop service platform.

Nicky Lu, Chair of the AI-on-Chip Taiwan Alliance (AITA), highlighted AITA's objectives, which encompass building an AI ecosystem, jointly developing critical technologies, and fostering collaboration to accelerate AI chip hardware, software, and product development. As a vital component of AITA, the Hi-CHIP Alliance brings together significant semiconductor players from Taiwan and overseas. USI, Raytek, and Unimicron are currently serving as the general coordinators for the Hi-CHIP Alliance to connect related industries through AITA. This collaboration seeks to establish a common verification platform, create a 3D/FO common technology platform, develop customized adoption models, and core manufacturing process capabilities. The objective is to nurture international partnerships, fuel technological advancements in equipment and materials, and propel the semiconductor industry to new horizons.

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❯❯ Collaboration

Artistic Horizons: Robotic Collaboration with UfG Linz

ITRI signed a Memorandum of Understanding (MOU) with the University of Art and Design Linz (UfG Linz), paving the way for artist exchanges and laboratory cooperation projects between ITRI and Creative Robotics (CR), a research unit within UfG Linz dedicated to arts-based and industrial research on robotics. The MOU was inked with the assistance of a collaborative robot provided by Techman Robot, exemplifying the technological strength of Taiwan.

The MOU is signed by a Techman robotic arm, representing ITRI's General Director of Service Systems Technology Center, Jen-Chieh Cheng, and CR Founder Johannes Braumann.

General Director of ITRI's Service Systems Technology Center Jen-Chieh Cheng highlighted ITRI's ongoing efforts in partnering with artists as well as public and private sectors to explore

the convergence of technology and art since 2019. He emphasized Techman Robot's role in yielding fruitful robotics-based artworks throughout the project, stressing that the MOU is set to stimulate multimedia creations and expand international artists' access to cutting-edge technologies. An exemplary demonstration of this engineer-artist collaboration is seen in the international success of new media artist Yen-Tzu Chang's media dance performance, Mirage Replicas 2.0. This performance, showcased at the 2023 Ars Electronic Festival in Linz, is based on ITRI's Automated Vehicle with Smart Multi-Directional Sensing Cyber-Physical Display System, which integrates cyber-physical fusion displays, real-time interaction technology, and automated mechanical systems.

Erik Aigner, Vice Rector at UfG Linz, expressed his enthusiasm for future cooperation with the leading international research institute. He emphasized the importance of technology and resource exchanges, aimed at facilitating innovative robotics applications at the crossroads of art, science, and industry.

UfG Linz Vice Rector Erik Aigner (second from the right) and Karl Singline of Creative Robotics (first from the left) alongside representatives from ITRI and Taiwan's Ministry of Culture.

Techman Robot Chief Operating Officer Scott Huang remarked that Techman Robot's AI-powered collaborative robot series, the TM AI Cobot, which was used to complete the MOU signing, is planned to be utilized to assist in realizing artistic aspirations that arise from the cooperation between ITRI and CR.

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» Activity

Tech Highlights from 2023 ITRI ICT TechDay

The 2023 ITRI ICT TechDay, an all-day forum and technology exhibition, showcased groundbreaking information and communication innovations with a focus on low Earth orbit (LEO) Satellites, the Internet of Vehicles (IoV), 5G/6G communications, cyber security, and generative AI (GAI). Industrial heavyweights such as Nippon Telegraph and Telephone (NTT), Taiwan Space Agency, Taiwan Information Security Center (TWISC), and MediaTek were present to share insights into the latest trends and achievements in these areas.

The event is graced by representatives from the Taiwan Association of Information and Communication Standards (TAICS), TWISC, NTT, ADI and DOIT of the Ministry of Economic Affairs (MOEA), ITRI, Taiwan Space Agency (TASA), and Cloud Computing and IoT Association in Taiwan (CIAT).

General Director of ITRI's Information and Communications Research Laboratories Pang-An Ting pointed out how the innovations exhibited at the event mirrored the changing landscape

of the global ICT industry, such as the regionalization and localization of ICT supply chains, the heightened limitations anticipated in hardware sales, and the worldwide pursuit of sustainability. Innovations promoting openness, intelligence, and green have emerged as the driving forces behind ICT development, fostering the growth of startups that are injecting new energy into Taiwan's ICT industry.

LEO Satellite Ground Communication Radio Frequency Subsystem

Utilizing self-developed array antenna RF chips and a beam tracking algorithm, this system enables satellite ground equipment to connect LEO satellites within one second, a speed 11 times faster than that of an F16 fighter jet. Taiwan's ICT companies independently completed the LEO satellite ground equipment architecture and interface design, positioning them among the top three satellite manufacturers globally.
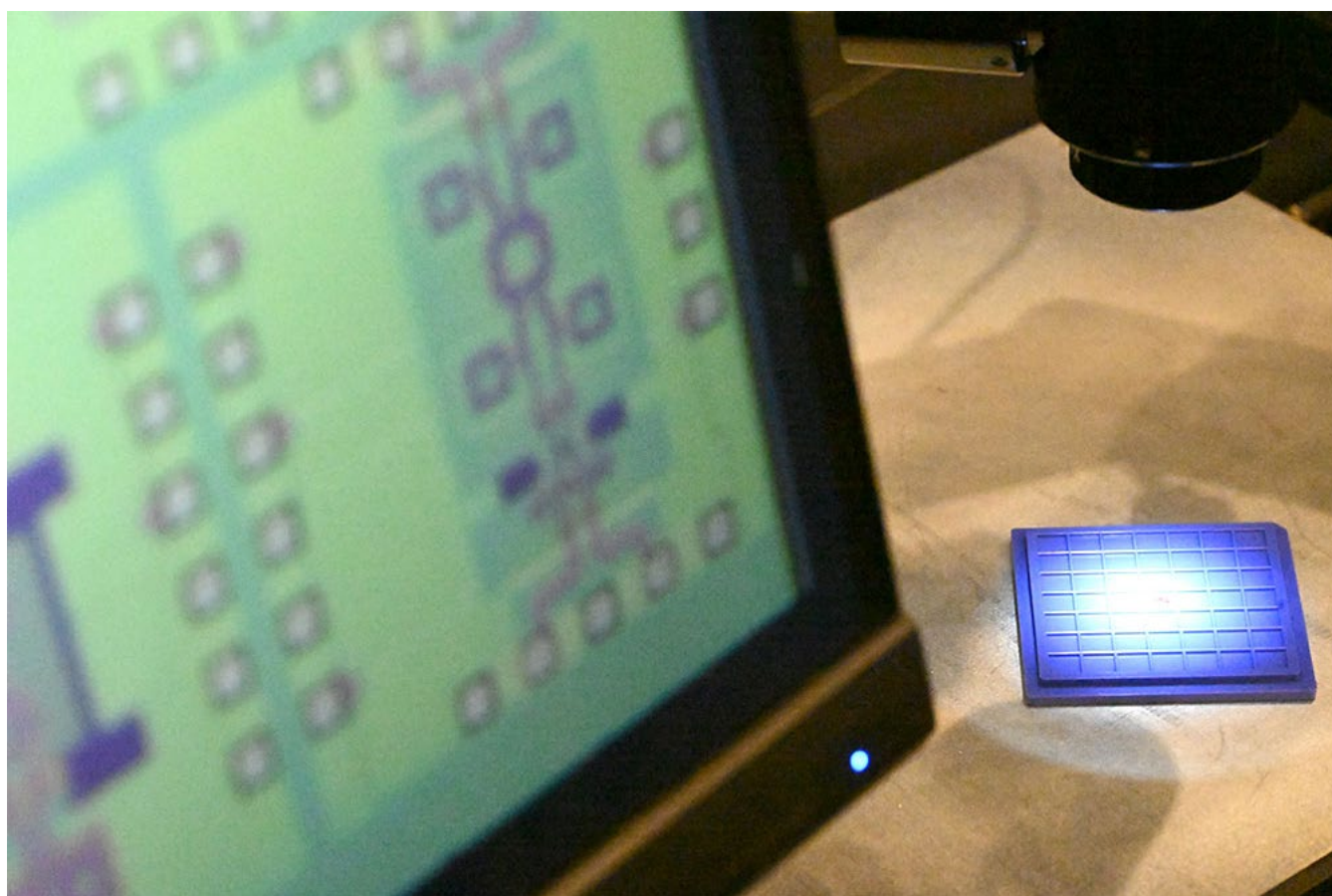
The self-developed array antenna RF chip used in the LEO Satellite Ground Communication Radio Frequency Subsystem.

V2X See Through

The patented V2X See Through offers drivers the perspective of the vehicle ahead with fused see-through images. This innovation integrates image recognition, image stitching technology, and V2X vehicle onboard communications through the 5.9 GHz ITS dedicated frequency band to enhance on-road safety.

The V2X See Through system can be applied to creating smart vehicle fleets.

Janus

Janus is a fully automated AI-powered solution that maximizes IoT security by establishing a network's behavior baseline, implementing firewall rules, micro-segmenting, and continuous monitoring for deviations. Several healthcare institutions, smart factories, and electric vehicle charging stations in Taiwan have embraced Janus to boost cyber security.

Janus employs a distinctive IoT behavior pattern identification technology to detect anomaly behavior of interconnected devices.

5G O-RAN Micro-Cell Technology

This Open Radio Access Network (O-RAN) micro-cell base station system is equipped with core technologies including massive multiple-input multiple-output (massive MIMO) technology and high radio power transmission. Overcoming limitations in heat dissipation, signal distortion, and beamforming, this technology caters to market demands for large coverage areas, high capacity, high interoperability, and integration in public infrastructure and private networks. It has been transferred to local companies for production targeting the global market.
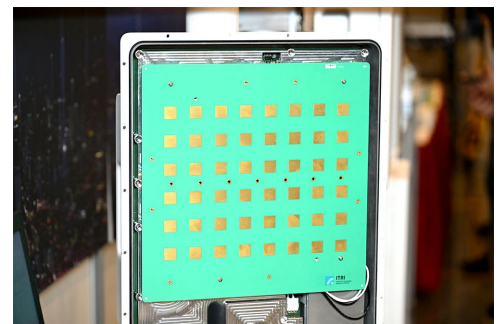
ITRI's 5G O-RAN Massive MIMO Micro-cell Technology overcomes previous limitations in heat dissipation, signal distortion, and beamforming.

FAST AI One-Stop System

The Fast AI One-Stop System was introduced as a powerful tool to accelerate enterprises' AI applications without requiring advanced programming skills. Through intuitive drop-down menus, users can complete data preparation, federated learning, and automated rapid modeling, simplifying the process of building AI models without in-depth coding knowledge.

The Fast AI One-Stop System excels in rapid and automatic annotation, facilitating swift model construction.

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Empowering Futures: STEAM Drone Camp in Hualien

ITRI, in collaboration with the American Institute in Taiwan (AIT), the Hualien County Government, and the Tzu Chi Charity Foundation, orchestrated an educational drone camp for disadvantaged, Indigenous, and new immigrant children in Hualien. This initiative provided local children with hands-on training sessions that encompass drone programming, aerial video shooting, aerial typography art, and search and rescue applications.

Children learn to operate the drones they assemble in an engaging hands-on course.

ITRI's Deputy Operating Officer and Public Welfare Committee Chairman, Ta-An Ho, expressed her enthusiasm towards this year's event, as this is the first time to fully incorporate AIT's STEAM resources—comprising curriculum centered around science, technology, engineering, art, and mathematics—into ITRI's annual technology camp program. "ITRI's

longstanding commitment to ensuring equitable access to quality education for all, which aligns with the UN's Sustainable Development Goal 4, focuses on presenting innovative technologies in inclusive and engaging forms, fostering the creativity and innovation of our youth," she said.

AIT Cultural Affairs Officer John Dow shared his delight in collaborating with ITRI to advance STEAM education in eastern Taiwan. "We share a firm belief in education's power to transform lives and promote students' well-being. We sincerely believe that technology, when harnessed effectively, can yield positive outcomes to drive beneficial changes."

Children assemble drones under instructions.

Shu-Min Weng, Deputy Director of the Department of Education under the Hualien County Government, highlighted the government's active support in integrating technology into local education, stating, "Despite Hualien's remote location, the educational quality for children here is never compromised." She also expressed gratitude for organizing the drone-themed camp: "We appreciate ITRI for nurturing the growth of these school children, equipping them with skills that align with the technological demands of the future."

Deputy CEO of the Tzu Chi Charity Foundation Liu Jiyu stated, "Considering the geographical environment of Hualien, it is highly beneficial for these children to gain access to technology-related knowledge and resources, which can enhance their grasp of and adaptability to a technology-driven world. Our heartfelt gratitude to all participants for supporting Hualien's school children and contributing to a better educational experience."

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» **About Us**

Industrial Technology Research Institute (ITRI) is one of the world's leading technology R&D institutions aiming to innovate a better future for society. Founded in 1973, ITRI has played a vital role in transforming Taiwan's industries from labor-intensive into innovation-driven. To address market needs and global trends, ITRI has launched its 2035 Technology Strategy and Roadmap that focuses on innovation development in Smart Living, Quality Health, Sustainable Environment, and Resilient Society.

Over the years, ITRI has been dedicated

to incubating startups and spinoffs, including well-known names such as UMC and TSMC. In addition to its headquarters in Taiwan, ITRI has branch offices in the U.S., Europe, and Japan in an effort to extend its R&D scope and promote international cooperation across the globe. For more information, please visit https://www.itri.org/eng.

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