Successful development and transfer of innovative tactile sensor technology

A 32.5 billion won deal involving the transfer of the ultra-small mouse and touch screen technology for mobile phones

Dr. Kim Jong-ho’s team at the Mechanical Metrology Center of the Division of Physical Metrology, KRISS successfully developed a ultra-small computer mouse and touch-screen technology for mobile devices equipped with tactile sensor. The technology has since been transferred to a partner for 32.5 billion won, which represents the single largest royalty ever received by a public research agency, after the royalty received by ETRI for the transfer of CDMA technology. Under the terms of this agreement, KRISS will be paid an initial cost of 4 billion won plus royalties of at least 32.5 billion over the next twenty years up until 2028, while receiving an ordinary royalty of 3% of total sales.

Dr. Kim Jong-ho said, “The ultra-small mouse and touch screen, which make three axes available, use flexible tactile-sensors composed of force sensors; and their size and depth can be freely controlled. This technology can be used in all mobile input devices including mobile phones, MP3 players, UM PCs, navigation devices, consumer electronics, and automobiles.”

[Tactile-sensor-based ultra-small mouse]

Unlike existing mouses, the ultra-small mouse using tactile sensor uses the principle of force instead of location technology. The ultra-small mouse enables users to move the mouse pointer in a small space such...
as on the screen of a mobile phone. It also allows users to freely move its pointer in a three-dimensional (X, Y, Z) space, while the existing mouse moves in only a two-dimensional space.

[Tactile-sensor-based force and location-sensing touch screen]

The newly developed touch screen uses tactile-sensor to detect the pressing force and a pure transparent substrate rather than the transparent electrode used in existing touch screens. Thus, compared with the capacitive overlay (90% transparency), the new touch screen offers improved transparency and reduced production costs.

The touch screen, which uses various force sensors, can detect touching position and force simultaneously. The new system is also capable of recognizing a multiplicity of touches by comparing each force component. This principle enables the user to perform diverse tasks on the screen. In case of Apple’s iPhone, if the user spreads or narrows a picture on the screen with two fingers, he can change its size. The touch screen developed by Dr. Kim enables the user to change a picture on the screen not only in size, but also in diverse angles and forms.

Furthermore, the new touch screen responds faster to touch. The existing capacitive overlay touch screen cannot properly recognize a momentary touch. However, the use of tactile sensor will enable fast position recognition according to the response speeds. The existing touch screen, if its surface is repeatedly touched, will sustain damage in its transparent electrode, leading to occasional malfunction. However, the new touch screen will not be damaged if the screen surface is pressed, making it outstandingly resistant to repeated touches and shocks.

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**Terms of technology transfer and licensing for KRISS**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Advance royalty</th>
<th>Ordinary royalty</th>
<th>Minimum royalty</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super-small mouse</td>
<td>1.5 billion won</td>
<td>3% of total sales of licensed technology modules</td>
<td>- 2009 : 500 million won</td>
<td>- 12 patents (8 in Korea and 4 overseas): the registration of domestic and PCT is being sought.</td>
</tr>
<tr>
<td>Touch screen</td>
<td>2.5 billion won</td>
<td></td>
<td>- 2011 : 1 billion won</td>
<td>- When the cumulative royalty revenue exceeds 30 billion won and 50 billion won, an ordinary royalty rate of 2% and 1% respectively will be applied.</td>
</tr>
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</table>

- **Exclusive licensing**: Except for the robot and medical service markets, an exclusive license will apply to the global mobile input device market (e.g.: mobile phones, MP3 players, UM PCs, navigation devices, IP TV remote controllers, notebooks, automobiles, consumer electronics, etc.)
- **Licensing period**: 20 years (until 2028) after concluding the agreement
10 Most Important News Items of KRISS 2007

KRISS’s selection for 2007 news items

01  KRISS selected as a superior research and innovation institute for eight consecutive years

KRISS has been selected as a superior institute for eight consecutive years in the evaluation of government-sponsored research institutes, marking the first such achievement of its kind. The evaluation was conducted by three research societies from the science and technology community, including basic, public and industrial research associations. KRISS earned recognition for its world-class measurement technologies based on the international key comparison of measurement standards and on the corresponding economic ripple effects. Furthermore, KRISS was rated as the second best innovative research institute.

02  Development of a slim mouse and touch screen based on tactile sensor for mobile devices

Dr. Jong-Ho Kim, at the Mechanical Metrology Center of the Division of Physical Metrology, developed a tactile-sensor-based ultra-slim mouse and touch screen for mobile devices. These devices use tactile-sensor based on the distribution of pressing force. The mouse is only 1 mm thick, thereby eliminating the conventionally perceived spatial limits of a mouse (Refer to the feature article for the full text).

03  Development of standard data on metallic materials mechanical properties, becoming No. 1 standard reference data

Dr. Seung-Hoon Nahm’s team at the Energy Infrastructure Center of the Division of Quality of Life, developed evaluation criteria and procedure for data on the mechanical properties of metallic materials with regard to the tensile properties of various steels. The National Center for Standard Reference Data registered the data as Korea’s No. 1 standard reference data (Refer to the research achievement section of this issue for the full text).
04 Development of an automatic processing system for large aspheric optical mirrors

Dr. Ho-Soon Yang’s team, at the Space Optics Research Center of the Division of Advanced Technology developed an automatic aspheric surface fabrication system, which is capable of automatically polishing an aspheric surface with a maximum diameter of 1 m (Refer to the research achievement section of this issue for the full text).

05 Use of home-grown technology, development of a scanning electron microscope capable of observing sample formations and detailed structures of an object

Dr. Yang-Koo Cho's team at the Advanced Instrumentation Center of the Division of Advanced Technology, successfully developed a scanning electron microscope equipped with resolving power of 3.5 nano-meters (1 nm = one-billionth, or one-100,000th of the thickness of a hair), using a home-grown technology. This microscope, which costs just half the price of an imported one, will be used widely for educational purposes at middle and high schools, contributing to the development of the nation’s science education.

06 Implementation of a distinguished fellows program including the designation of tenured researchers and KRISS fellows

KRISS currently implements a distinguished fellows program involving the appointment of tenured researchers and KRISS fellows. Nominated as tenured researchers were Dr. Yong-Ki Park at the Medical Metrology Center, Dr. Dae-Won Moon at the Nano-Bio Fusion Research Center, and Dr. Hwack-Joo Lee at the Advanced Instrumentation Center. Dr. Dae-Won Moon was nominated as a KRISS fellow as well. The tenured system guarantees lifetime employment for distinguished researchers. Under the KRISS fellowship system, key potential talents are selected or attracted to KRISS in order to contribute to its development as a world-class metrology institute, and they are given the necessary support to enable them to stably conduct their research activities and ultimately become global leaders.

07 Development of high-sensitivity measurement technology for protein activities

Dr. Tae-Geol Lee, who is based at the Nano-Bio Fusion Research Center of the Division of Advanced Technology, successfully developed a high-sensitivity technology to measure activities of proteins. This label free technology enables one to measure the degree of protein activation from the bio-chip surface as it is. The research achievement was accomplished jointly with the team led by Professor Hak-Sung Kim at the Department of Biological Science, KAIST, and was published under the title of A Method of Analyzing the Activation of Proteins Using a Secondary Ion Mass Spectrometry in an online issue dated August 1 of the authoritative Angewandte Chmie journal.
Establishment of the third research firm Jaewon Ceratech

KRISS established the research firm, Jaewon Ceratech Co., in order to commercialize its patented technologies. Jaewon is the country’s third research firm after Sun Biotech Co., which was established by the Korea Atomic Energy Research Institute, and Tems Co., which was established by the Korea Institute of Machinery and Materials. KRISS established Jaewon by investing its patents on a technology for strengthening the surface of oxide ceramics. Using KRISS’s technology, Jaewon will reduce production processes and costs, bolster heat-resistant and abrasion-resistant functions in ceramics, and thus secure competitiveness in a wide range of industries.

Development of heart disease diagnostic technology using the internally developed magnetocardiography

From device technology to diagnostic applications, the way has been paved for the use of 100% home-grown technologies that are capable of diagnosing heart diseases prevalent among the Korean people. Teaming up with the research team of Yonsei University Medical Center’s Cardiovascular Hospital, KRISS’s Medical Metrology Group used the magnetocardiography developed with KRISS’s own technology, and developed a technology to quickly and easily detect ischemic heart disease, a condition whose incidence has risen in recent years. KRISS is the only institute in Korea to possess world-class technologies capable of fabricating and analyzing magnetocardiograph equipment. The newly developed magnetocardiograph measurement equipment has been installed at Yonsei University Medical Center’s Cardiovascular Hospital for the purpose of joint research.

Bolstering international collaboration with overseas national metrology institutes

In 2007, KRISS played a leading role among relevant international organizations. KRISS also bolstered its international collaborative activities as the institute conducted joint research with the world’s leading national metrology institutes, and expanded its technical support projects for developing nations. In particular, KRISS benchmarked the advanced metrology institutes of the UK, Germany and Australia, among other advanced nations. KRISS thus explored strategic joint projects in areas in which these nations are strong, concluded a number of MoUs, and since then has been engaged in various joint research projects. In the meantime, KRISS concentrated its capabilities on the environmental measurement field. As such, KRISS has recently achieved superior research outcomes in the field of gas analysis, having most notably changed the world standard for air density by redefining argon density.
Research Highlights

Developing an automatic processing system for large aspheric optical mirrors
Cutting the optical mirror manufacturing period by half

Surveillance satellites played their greatest role in the USA’s arrest of former Iraqi president Saddam Hussein. Furthermore, since a 2.4 m-diameter Hubble telescope made possible the observation of even the dimmest stars - something a ground telescope was unable to do - it furthered research into the origins of life and the universe. As such, telescopes are used as essential items of equipment not only for military purposes, but for scientific research activities as well.

The key component of such equipment is an aspheric mirror with a diameter of more than 1 m; however, as it takes a long time to process large mirrors, the progress of satellite development has been severely hampered. To address this problem, Dr. Ho-Soon Yang at the Space Optics Research Center of KRISS, pursued certain initiatives. He developed automatic technology for processing and evaluation which is owned by only a few advanced nations such as the USA, Russia and Japan.

Dr. Yang developed an automatic aspheric surface fabrication system using a 1 m-diameter grinding machine, a 5 m-high testing tower, and an automatic alignment system. This automatic aspheric surface fabrication system is capable of automatically grinding an aspheric surface to a maximum of 1 m. This system has made it possible to secure super-high resolution images with a resolution of below 0.3 m when manufacturing a space telescope mirror (0.3 m resolution is the level of resolution which enables an observer to distinguish between a man and a woman on the Earth from outer space).

It takes over six months and considerable efforts involving hundreds of attempts at fabrication and measurement to precisely process a large, 1 m-diameter, aspheric mirror (weighing over 400 kg) for a space telescope or a ground telescope. To resolve the problem, Dr. Yang installed a testing tower and used an automatic equipment alignment method. This method enabled him to reduce the time required to process a 1 m-diameter mirror by more than half, and to achieve 15 nm (1 nm is one-billionth m) precision processing.

This system can be applied to the manufacture of mirrors measuring over 1 m in diameter. In recent years, demand has been increasing both at home and abroad for 2 m-diameter mirrors; thus the research team, within this year, plans to install at KRISS a processing machine and an automatic fabrication system capable of manufacturing mirrors measuring up to 2 m in diameter. Using these facilities and home-grown technologies, Dr. Yang will manufacture aspheric optical mirrors for high-resolution satellite cameras, large optical mirrors for large astronomical telescopes, and optical components for semiconductors and flat panel display exposure systems.
Registering the No. 1 national standard reference data
Creating Korea’s standard reference data on the properties of metallic materials

The tragedy occurred at 6:05 pm on August 1, 2007, when many vehicles were rushing through the streets on their way home. The bridge, with four lanes on either side, which crosses the Mississippi River from Minneapolis, USA, was collapsed, sending dozens of cars crashing into the river. The steel bridge was constructed 40 years ago; the accident was attributable to fatigue damage caused by a strength inconsistency in the welding area due to design error and faulty welding.

To prevent such accidents, the team led by Dr. Seung-Hoon Nahm at the Energy Infrastructure Center of the Division of Quality of Life, KRISS, developed data on the mechanical properties of metallic materials with regard to the tensile properties of various steels. The National Center for Standard Reference Data registered the data as Korea’s No. 1 standard reference data after accrediting its accuracy and reliability through a series of analyses and evaluations conducted by the relevant experts.

Metallic materials are used in almost all key national industries including not only steel bridges, but also super-large steel-frame buildings, steel-making facilities, automobiles, ships, and aircrafts. However, these metallic materials, with the passage of time, inevitably degrade, leaving themselves vulnerable to diverse types of disaster. In other words, without the availability of information on the mechanical properties of metallic materials, over the years, these large facilities and structures will be exposed to the danger of accidents.

Korea has been lacking in reliable numerical data on major metallic materials for such large facilities, making it dependent on foreign information. In addition, overseas companies, which in the past supplied facilities and equipments to Korea, and disclosed information on mechanical properties, no longer provide the relevant information on such properties free of charge. This has a negative effect on the competitiveness of the relevant industries. Dr. Nam said, “This standard reference data will be very timely and instrumental in meeting the needs of the relevant industries.” This standard reference data service is available at NCSRD’s website [http://www.srd.re.kr] for domestic industries, universities, research institutes, and so forth.

Defining the last atomic defect on the surface of silicon wafers
Opening up an age of 100% defectless semiconductors

The research team led by Dr. Ja-Yong Koo at the Center for Atomic Control of Heteroepitaxy, KRISS successfully achieved an atomic-level definition of the surface defect in silicon wafers caused by residual moisture in the semiconductor process. This research outcome was published in the world’s most authoritative journal on physics papers, Physical Review Letters.

Dr. Koo’s team discovered the process by which water molecules spontaneously decompose on the surface of a silicon wafer to combine with silicon atoms, as well as the atomic structure after combination. For this research, the team used its own homemade scanning tunneling microscope (STM) to observe the individual water molecules adsorbed on the surface of a silicon wafer in a one-100 trillionth pressure high-vacuum environment, and conducted a super-precision measurement to compare the number of water molecules with the number of silicon atoms. Furthermore, the team proved the reliability of
this process through a large-scale theoretical calculation using a super-computer.

Dr. Koo explained, "In previous research, several other possible defects on the surface of the semiconductor raw material and the silicon wafer were defined. However, this research discovered an atomic point defect, which is caused by the presence of residual moisture in the super-high vacuum environment. In the light of such a discovery, this research is deemed to be profoundly meaningful."

This research has addressed the problem of the drop in yield of semiconductor devices, raising expectations for the greatly enhanced competitiveness of businesses that develop and produce high-performance semiconductor devices. In addition, Dr. Koo’s team is set to create a better-quality ultra-thin oxide layer over the atomic layer by discovering the layer formation process. The team will also continue with its research to improve the manufacturing process for nano-meter-sized, high-performance, high-quality semiconductor devices by defining the individual atomic behavior of the ‘essential impurities’ that are incorporated into the silicon wafer.

Exporting MEG equipment to Taiwan
Leading to the installation of the home-grown-technology-based MEG equipment at National Taiwan University Hospital

The team led by Dr. Yong-Ho Lee at Medical Metrology Center, KRISS developed next-generation magnetoencephalography (MEG) equipment, which is essential in researching and diagnosing brain functions. KRISS has since exported the MEG equipment to National Taiwan University Hospital.

The MEG equipment is designed to measure the magnetic field signals created by subtle electric currents in the cerebral nervous circuit to research brain functions and diagnose functional brain disorders. MEG can accurately measure electric currents created by cerebral activity without harming the human body. The technology can accurately locate the area of the brain in which epilepsy occurs, aid research into the individual functions of various parts of the brain, and diagnose changes in brain functions before and after surgical operations. It can also create up to 1,000 images of electric activity in the cerebral nerve system, thereby offering useful information on momentary change in cerebral nerve currents, and measure the cerebral recognition.

Furthermore, MEG is a contact-free, non-destructive diagnostic technology that is harmless to the human body and provides 3-dimensional information on the part of the brain in which momentary activity occurs. In particular, the performance of the SQUID sensors - the key to the MEG equipment - is world-class. The 128-channel MEG equipment consists of 128 SQUID sensors which can measure information deriving from the entire electrical activity of the brain at one time.
The MEG equipment involves second-generation SQUIDs which produce output signals over ten times bigger than those produced by the existing equipment used by advanced nations. The sensors have the function of removing environmental magnetic noise in order to catch quality magnetic signals emanating from the brain.

In 2005, Dr. Lee’s team signed an R&D agreement to sell and install MCG equipment at National Taiwan University Hospital, where research into clinical tests designed to improve accuracy in the diagnosis of ischemia and other heart disorders is being conducted. With the support of the Ministry of Knowledge Economy for next-generation technology initiatives, KRISS is set to develop and commercialize integrated examination equipment designed to diagnose both cerebral and heart disorders.

Friendly KRISS

Workshop Participant, Amal Abu Shindi

Dear all at KRISS:

I am writing this letter on behalf of the Jordanian people and myself to express our profound thanks to all of you at KRISS, for your warm and generous hospitality during our recent visit to your country. The comfortable house, the delicious cooking, the admirable Hyundai plants, especially the friendship of you and your colleagues, all give us lasting and heartwarming remembrance. Thank you very much for doing so much to make our visit comfortable and convenient. We deeply appreciate your delightful and helpful accompany in showing us round your country, plants, labs, and all the time during our visit.

I am looking forward to your visit to Jordan when I will be able to pay back some of the hospitality I received during my memorable stay in your beautiful country. Let’s keep in touch. Thank you again for your wonderful hospitality.

Yours sincerely,

Amal Abu Shindi
Activities and Events

Signing MoUs with NICT of Japan, and VNIIM and VNIOFI of Russia

KRISS signed MoUs with the National Institute of Information and Communications Technology (NICT), as well as with Russia’s two representative metrology institutes – VNIIM and VNIOFI - in an effort to strengthen research collaboration. On July 8, President Kwang-hwa Chung visited VNIIM, and made an agreement with the institute concerning technology transfer and consulting collaboration, joint research, and the appointment of visiting researchers. Two days later, on July 10, the president signed an MOU for collaboration between KRISS and VNIOFI in an effort to exchange human resources and cooperate on research into the high temperature standards field, including the introduction of high-temperature, black-body radiation.

Holding the third international reference standards symposium

On October 10, KRISS held the third international reference standards symposium in an effort to identify the scientific technical data management status of the Committee on Data for Science and Technology (CODATA) and the reference standards systems of advanced nations, and to discuss development strategies for reference standards in the major domestic industrial sectors.

Performing projects to modernize COSQC in Baghdad and QCL in Arbil

KRISS, with the sponsorship of the Korea International Cooperation Agency (KOICA), offered education on working-level measurement analysis to 30 people from COSQC in Baghdad (September 7-19), as well as education on international standards systems and precision measurement to 12 people from QCL in Arbil (September 29 - October 25), Iraq. Since 2006, KRISS has been providing equipment and education to the war-torn country’s two metrology institutes in order to bolster their capabilities.

KRISS President Kwang-Hwa Chung sworn in as the Chair of the APMP and signed MoUs with NMIA and KIM-LIPI

KRISS took office for a two-year term as the chair of the Asia Pacific Metrology Programme (APMP) at the 23d General Assembly, which was held in Sydney, Australia from October 27 to November 3. President Chung then signed MoUs with the National Measurement Institute, Australia (NMIA) and KIM-LIPI of Indonesia in a bid to promote research collaboration, human resources exchanges, mutual measurement recognition, and so forth.

Appointment of a Vice Chairman of Technical Committee for IMEKO

Dr. Jong-Oh Choi at the Standards and Quality Management team of the Division of Standards Services, and Dr. Sam-Yong Woo at the Mechanical Metrology Center of the Division of Physical Metrology were appointed as the vice chairpersons of Traceability in Metrology (TC-8) and Measurement of Pressure & Vacuum (TC-16), respectively, at the 18th International Measurement Confederation (IMEKO) held in Rio de Janeiro, Brazil.
24th Workshop on the National Standards System and Precision Measurement

KRISS, under the sponsorship of KOICA, held a workshop on the National Standards System and Precision Measurement Workshop on November 12-23 for 13 measurement experts from 13 nations including the Philippines, Jordan, and Kyrgyzstan.

The visitors attended lectures on Korea’s national standards system and accreditation system, as well as lectures and experiments on six measurement fields including length and electricity.

Dr. Yun-Woo Lee was presented with the KRISS Person of the Year Award

The 2007 KRISS Award, the top award for KRISS staff, went to Dr. Yun-Woo Lee at the Space Optics Research Center of the Division of Advanced Technology. Dr. Lee earned recognition for his efforts to heighten the profile of researchers through the development of ultra-precision, automatic aspheric polishing technology and the use of technology for manufacturing and evaluating large-diameter satellite cameras. He was also recognized for his accomplishments in winning a series of large project orders, thereby allowing KRISS’s precision technologies to make a great contribution to the development of new industries and the nation as a whole.

Upcoming Events

- **6th Workshop of APMP/TCQM Gas Analysis Working Group on ‘Present Progress in Gas Metrology’**
  - May 19 - 23, 2008
  - Contact : Dr. Jeongsoon Lee [leejs@kriss.re.kr]

- **World Metrology Day 2008 - ‘Measurements in Sports’**
  - May 20, 2008
  - Contact : Ms. Jeonghwa Lee [jhy@kriss.re.kr]

- **7th Measurement Club Workshop**
  - May 22 - 23, 2008
  - Contact : Dr. Hyun-Soo Nam [nhs@kriss.re.kr]

- **Baghdad COSQC Quality Management System Workshop**
  - May 17 - 29, 2008
  - Contact : Mr. Sangwook Seo [swseo@kriss.re.kr]

- **25th Workshop on the National Standards System and Precision Measurement**
  - June 9 - 29, 2008
  - Contact : Ms. Mi Hong [mihong@kriss.re.kr]
Four Seasons of KRISS - Spring

Scenic beauty of KRISS in April  Messengers of Spring

1. Malus halliana koehne fluttering in the gentle spring breeze
2. Rhododendron singing for joy of spring on a sunny slope of KRISS garden
3. Sprouts of rhodohypoxis brining the hope of spring
4. Zelkova trees wrapped in a vibrant fresh green
5. A Playful rabbit celebrating spring with a hyacinth

To subscribe, please contact: Ms. Mi Hong

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