The University of Electro-Communications

UEC e-Bulletin

Updates on research, innovation, and events at UEC:
Unique and Exciting Campus in Tokyo

Vol.6, June 2015

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Feature

News and Events

Research Highlights

Topics

The University of Electro-Communications
UEC e-Bulletin Vol.6, June 2015

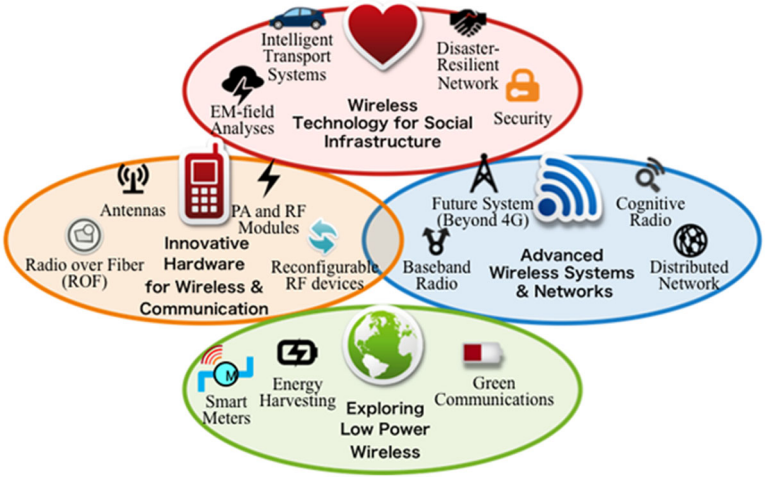
Advanced Wireless and Communication Research Center (AWCC), University of Electro-Communications, Tokyo.


Professor Yasushi Yamao, Director of AWCC

The Advanced Wireless Communication Research Center (AWCC) was launched in April 2005 with the aims of establishing a global hub for wireless communications; advancing education in wireless technology; industrial collaboration and technology transfer; and nurturing young engineers with strong emphasis on both theoretical and experimental aspects of wireless communications. In April 2015, the Center was re-launched as the Advanced Wireless and Communication Research Center with the same abbreviation, AWCC, to enhance its remarkable range of activities over the previous ten years. With funding of approximately 1000 million yen over nine years, the center consists of 3 full time, 6 concurrent, 18 cooperative, and 5 visiting professors. In addition there are 8 visiting professors from industry and more than 100 graduate students, post-doctoral and research fellows. The center actively contributes to academic societies and publishes more than 150 papers annually in top journals and proceedings of international conferences.

"The AWCC is harnessing UEC's strengths in education and research in radio communications," says Professor Yasushi Yamao, Director of AWCC. "We have staff with a wide range of expertise from both UEC and industry. Our vision is the realization of 'ambient wireless in connected community'."

The AWCC organizes regular seminars and workshops with the highlight of 2014 being the 'Tokyo Wireless Technology Summit' held in March 2014. The meeting focused on the next major phase of mobile telecommunications called 5th generation (5G) and attracted approximately 240 participants from all over the world.



The research activities of the AWCC

Research at AWCC is focused on four areas:

Wireless technology for social infrastructure with emphasis on intelligent transport systems, disaster resilient networks, analysis of electromagnetic fields, and security.

Innovative hardware for wireless and communication where the keywords are antennas, power amplifiers (PA) and radio frequency front-end (RF), radio over fiber (ROF), and reconfigurable RF devices.

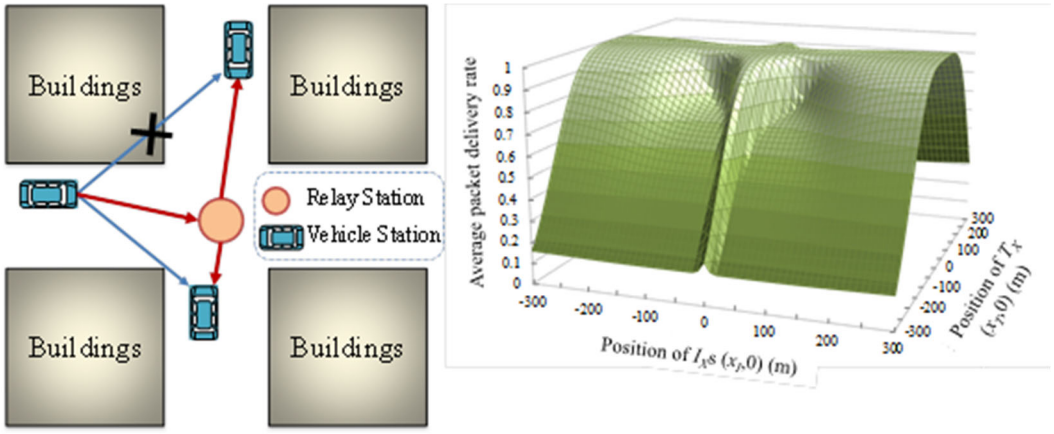
Advanced wireless systems and networks with specific themes of future systems and beyond 4G, cognitive radio for ultimate usage of radio spectrum, distributed networks for example sensors and automobiles, and baseband radio.

Exploring low power wireless systems for applications including green communications, energy harvesting, smart meters, and low power devices such as low power RF circuits and low power MCUs for sensor nodes in wireless sensor networks of IoT.

Specific projects

Intelligent transport systems (ITS) for vehicle to vehicle and vehicle to infrastructure (Lead by Professor Yasushi Yamao)

The goal is establishing highly reliable and low-delay wireless communications for safe and automated driving by resolving issue of severe propagation on dense urban road, including shadowing loss caused by surrounding buildings and large-sized vehicles, as well as hidden terminal problems due to heavy traffic.



Performance Analysis of Vehicle-to Vehicle communications

Large scale wireless price tag system

(Professor Yasushi Yamao)

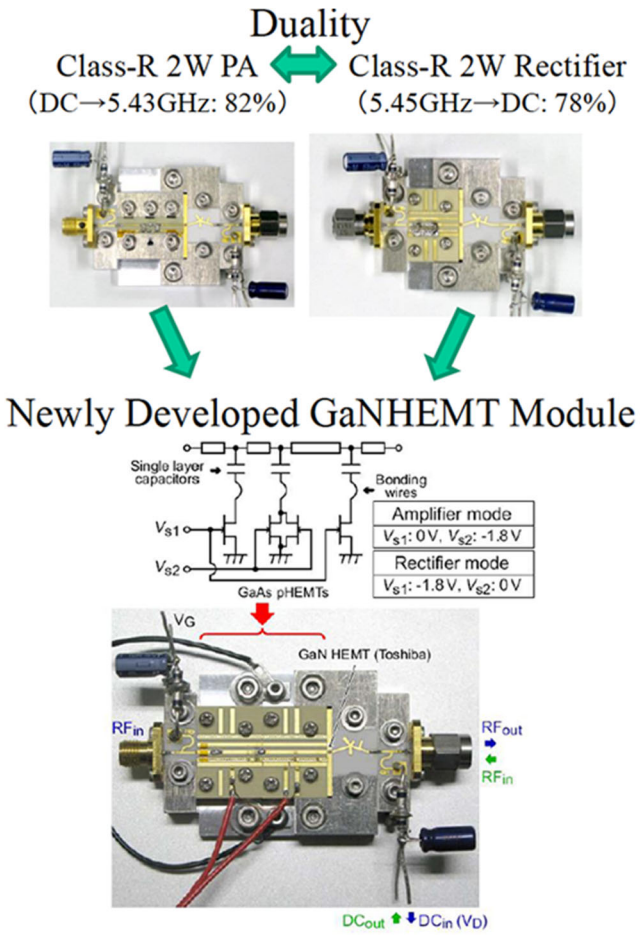
The ultimate aim of this project is to produce an ultra-low power wireless price tag system for supermarkets with more than 10,000 tags with batteries that can operate for seven years. Here, the main technological hurdle to overcome is synchronized intermittent operation in a distributed environment whilst preventing so-called 'packet collision' of intra and inter systems. A provisional system with 1000 tags has already been developed and commercialized by an industrial collaborator.

Cognitive radio (Professor Takeo Fujii)

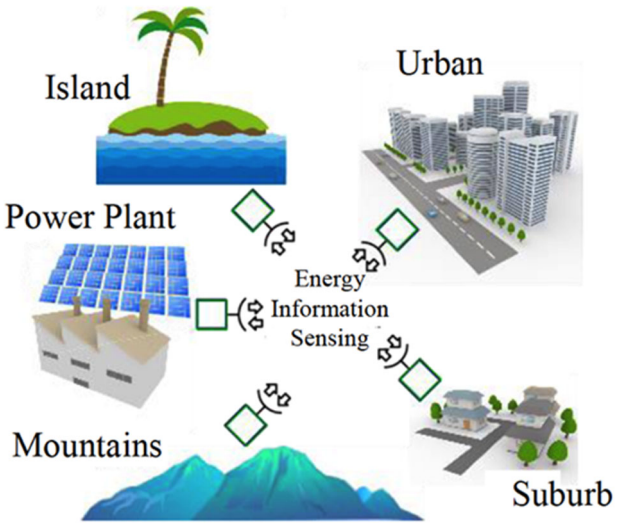
Development of new radio communication spectrum resources by recognition, sensing, and utilization of radio spectrum that are not being used by primary systems. This technology is expected to expand the sustainable future mobile communication by generating new spectrum resources. For example innovative vehicle to vehicle communication systems, advanced wireless sensor networks and broadband mobile network services.

Smart DC to RF and RF to DC double conversion module based on time reversal duality (Professor Kazuhiko Honjo)

Based on the time reversal duality principle, microwave high efficiency power amplifiers with harmonic reactive loads (Class-R amplifiers) can be used also as high-efficiency rectifiers. Bi-directional wireless power transfer and information transmission are realized by the smart wireless modules developed by AWCC. The smart modules will accelerate future developments of smart grid energy supply systems, sensor systems, and wireless communication systems.



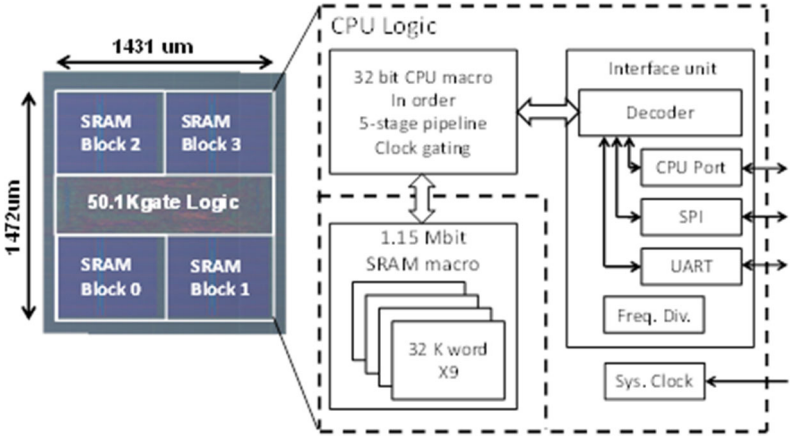
GaN HEMT Smart wireless module having both the amplifier function and the rectifier function



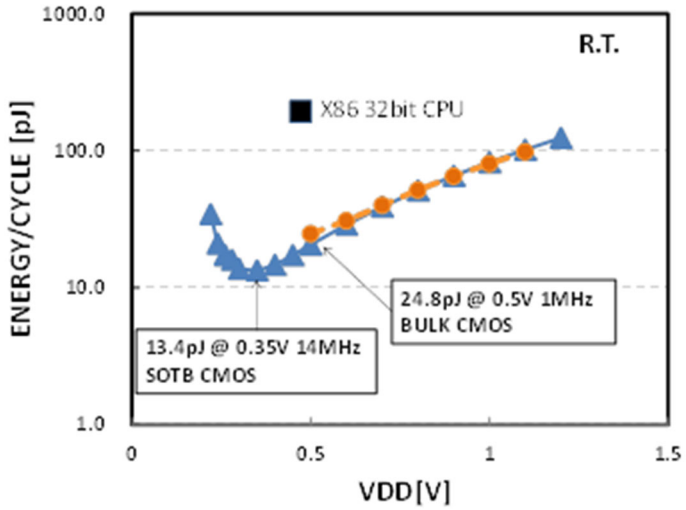
Future systems realized by the smart wireless modules

Development of Perpetuum mobile microcontroller unit (MCU) (Professor Koichiro Ishibashi)

Here, researchers have developed the 'Perpetuum mobile MCU' microcontroller with a 65 nm silicon on thin buried oxide (SOTB) structure that is capable of infinite operation. The Perpetuum mobile 32 bit CPU is expected to find applications in sensor networks and medical devices. The chip consumes only 13.4PJ/cycle at 0.35V, has a sleep current of 0.14 microamperes. The demonstration system using the MCU can operate for semi-permanently with a small solar cell illuminated inside a room.



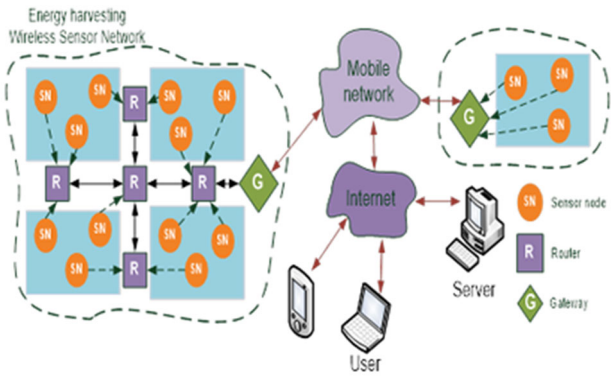
Perpetuum Mobile 32bit CPU chip and block diagram



Energy per cycle value hit 13.4pJ/cycle at a supply voltage of 0.35V

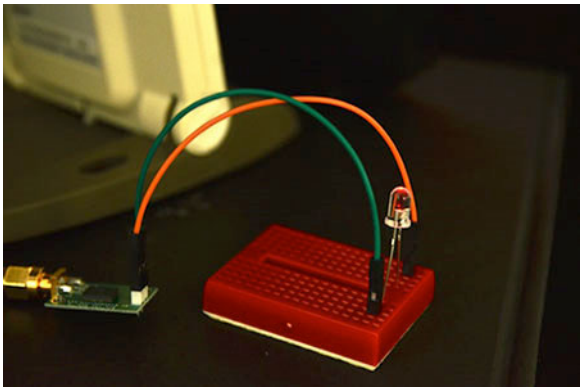
Water quality monitoring using sensor networks in Vietnam
(Professor Koichiro Ishibashi)

The aim is to develop an energy harvesting sensor network to monitor the quality of water in order to improve the yield of shrimp farming in Vietnam. The system consists of solar cells, 6 LowPAN low power wireless personal area networks, and 3G modem for transmitting emergency alarms.



Radio frequency energy harvesting for batteryless wireless communications
(Associate Professor Koji Ishibashi)

The aim of this project is to literally realize wireless, namely batteryless wireless communications with ultimately high reliability. The key enabler of this project is an emerging antenna technology called rectenna that can harvest ambient radio frequency energy such as Wi-Fi signals and store it in a capacitor. The energy stored is then used to enhance the communication reliability and the power efficiency of the network. The researchers in this project are investigating theoretical limits of wireless communications with the rectenna technology and feasible protocols to achieve the limits.

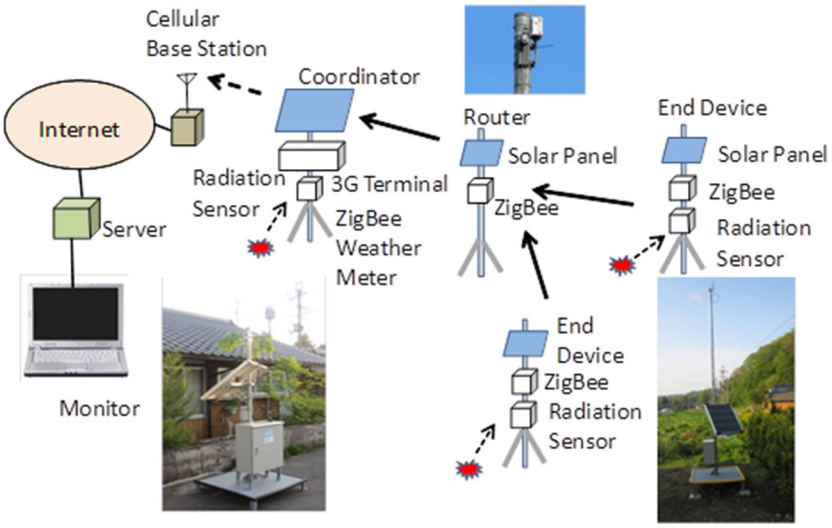


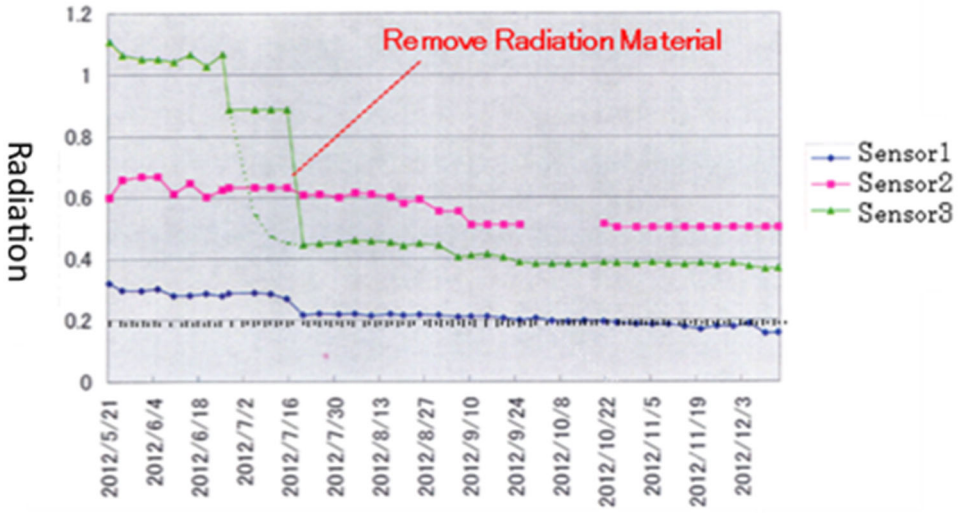
LED light blinks by means of energy from Wi-Fi signals

Sensor networks for measuring radiation in the environment

(Specially Appointed Professor Nobuo Nakajima)

Specific goal is to determine the distribution of temporal and spatial radiation levels in Kawauchi, Fukushima Prefecture to support decontamination operations and safety of the residents. ZigBee based sensors have been operating since May 2012 and transmitting radiation levels for three locations to UEC. Also, hand held radiation meters and sensors attached to drones have been used to produce 1D and 2D radiation distribution maps of Kawauchi since October 2012.





Tokyo Wireless Technology Summit 2014


More than 200 people attended the symposium


Coffee break

Presenters and committees

Further information
AWCC website: http://www.awcc.uec.ac.jp/awcceng/index.htm
Tokyo Wireless Technology Summit: http://www.awcc.uec.ac.jp/TokyoWirelessTech2014/Welcome.html

Recent publications

[1] Yuelin Ma, Yasushi Yamao, Yoshihiko Akaiwa and Koji Ishibashi, "Wideband Digital Predistortion Using Spectral Extrapolation of Band-Limited Feedback Signal," IEEE Transactions on Circuit and Systems-I, Vol. 61, No. 7, pp. 2088-2097, July 2014.(DOI:10.1109/TCSI.2013.2295897)
[2] Takeo Fujii, Kei Inage, Masayuki Kitamura, Onur Altintnas, Haris Kremo, Hideaki Tanaka, "Probing the Spectrum with Vehicles: Towards an Advanced Spectrum Database," in Porc. of 2013 IEEE Vehicular Networking Conference, pp. 226-229, Boston, MA, Dec. 2013. (DOI: 10.1109/ VNC.2013.6737619)
[3] Shintaro Watanabe, Yoichiro Takayama, Ryo Ishikawa, and Kazuhiko Honjo, "A Miniature Broadband Doherty Power Amplifier With a Series-Connected Load," IEEE Transactions on Microwave Theory and Techniques, Vol. 63, No. 2, pp. 572-579, Feb. 2015. (DOI: 10.1109/ TMTT.2014.2377725)
[4] Koichiro Ishibashi, Nobuyuki Sugii, Kimiyoshi Usami, Hideharu Amano, Kazutoshi Kobayashi, Cong-Kha Pham, Hideki Makiyama, Yoshiki Yamamoto, Hirofumi Shinohara, Toshiaki Iwamatsu, Yasuo Yamaguchi, Hidekazu Oda, Takumi Hasegawa, Shinobu Okanishi, Hiroshi Yanagita, Shiro Kamohara, Masaru Kadoshima, Keiichi Maekawa, Tomohiro Yamashita, Duc-Hung Le, Takumu Yomogita, Masaru Kudo, Kuniaki Kitamori, Shuya Kondo, Yuuki Manzawa, "A Perpetuum Mobile 32bit CPU with 13.4pJ/cycle, 0.14uA Sleep Current using Reverse Body Bias Assisted 65nm SOTB CMOS Technology," Cool Chips XVII, Yokohama, Japan, April 2014.

[5] Nobuo Nakajima, "Radiation Distribution Measurements in Fukushima Prefecture", IEICE Transactions on Communications, Vol. E97-B, No.9, pp.1752-1758, Sept. 2014. (DOI: 10.1587/transcom.E97.B.1752)

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MMR 2015, Tokyo

The 9th international conference on Mathematical Methods in Reliability, MMR2015, was held at the Tokyo Campus of the University of Tsukuba, from June 1st to June 4th 2015. The conference was organized by the University of Electro-Communications, Tokyo, in collaboration with the Institute of Statistical Mathematics, University of Tsukuba, and the Reliability Engineering Association of Japan. The conference exceeded expectations, welcoming more than 200 participants from a total of 27 countries. The participants enjoyed a wide variety of presentations by eminent researchers and scholars from across the world.

The main theme of MMR2015 was exploring how to achieve reliability and safety in the rapidly evolving era of 'Big Data'. The conference explored a number of key processes which are vital in developing future computing systems: grasping both the latent and revealed needs of customers and society, establishing new product development processes, and ensuring the reliability and safety of such systems. In particular, due to the rapid development of ICT (information and communication technology) in recent years, Big Data can now be used as a resource in itself to validate new products in terms of their reliability and safety.

Yukio Hatoyama, former Prime Minister of Japan, and Way Kuo, eminent researcher at the City University of Hong Kong, China, were invited to share their perspectives at the opening ceremony. Five keynote lectures were also given by visiting professors: William Meeker (Department of Statistics, Iowa State University Ames, Iowa, USA), Narayanaswamy Balakrishnan (McMaster University, Hamilton, Ontario, Canada), Jerry Lawless (Department of Statistics and Actuarial Science, University of Waterloo, Canada), Catherine Huber (Department of Mathematics, University Paris Descartes, France), and Kazuyuki Suzuki (UEC-Tokyo, Japan). In total, 177 research papers were submitted for the conference, and each talk covered both theoretical and practical aspects of current research surrounding reliability in the era of Big Data.

The conference was highly successful, informative and productive, providing a great opportunity to exchange ideas and promote discussion. Future research will no doubt benefit greatly from new collaborations and contributions made at this conference.

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Visit to UEC by International College, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok

Office for Education for Practical Communication (OEPC)
Takeshi TARUI


Photo taken with the President of UEC in the President's office

Natthapong Jungteerapanich, associate dean of the International College (IC) at King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, together with nine undergraduate students, visited UEC on May 25th, 26th and 29th this year.


Photo taken in Hiroyuki Sato lab

IC-KMITL focuses its education and research on 'soft engineering'. All lectures are given in English, and in late May, at the end of the undergraduate 2nd year, selected students are given the chance to visit an overseas affiliated university in Japan, Germany or the UK. One of the main purposes for the visit is for students from both nations to build an awareness of cultural differences and similarities.

This year, the University of Electro-Communications was chosen as the Japanese destination for the IC-KMITL students. The Office for Education for Practical Communication (OEPC) organized their visit program together with a UEC student organized society; "International Cultural Exchange Society" (ICES), which supports the OEPC to promote the globalization of UEC students.


Photo taken during an Aikido seminar run by Cheow Keong

The program incorporated five main goals. As well as attending lectures and visiting the laboratories of Hiroyuki Kajimoto and Hiroyuki Sato in the Department of Informatics, all the students were given a brief introduction to IC-KMITL by Jungteerapanich. The students then experienced a brief introduction to culture and life in their respective countries through attending first- and second-year English-language classes, as well as seminars where students discussed different aspects of Thailand and Japan. UEC staff were heavily involved in the program, with a presentation about the UEC library, and a lecture on Japanese culture, or Rakugo, included. Finally, all the students were given an Aikido lesson with UEC Aikido Club members led by Cheow Keong Choo from the Center for International Programs and Exchange.

UEC Students, both ICES-related and others, were actively involved in accompanying the Thai students during their visits to places in Tokyo and Kamakura. Both during and after the visit, students from both universities exchanged ideas on a wide variety of topics. We hope the UEC students' experiences and subsequent communication with international students will help our students develop a truly 'global vision' of their future studies and later careers.

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UEC holds first joint seminar in Vietnam

Koichiro Ishibashi
UEC Office for International Cooperation

In May this year, UEC held its first ever seminar in Vietnam, in order to celebrate and cement its links with top tier universities throughout the country ahead of UEC's 100th anniversary in 2018. The seminar was held on 14-15 May 2015 at the main campus of Ho Chi Minh City University of Science (HCMUS).

Strong relations between Vietnamese universities and UEC have developed since HCMUS became a sister university of UEC in 2010. Vietnamese students represent the 3rd largest population at UEC (2nd largest being from China) thereby further enhancing the links between Vietnamese universities and UEC. A key aim of the seminar was to encourage more Vietnamese students to study at UEC.

Important members of key universities in Vietnam were invited to attend the seminar on behalf of their institutions. The seminar welcomed Nguyen Hoi Nghia, vice president of the Vietnam National University in Hoi Chi Minh City (VNU-HCM), together with Nguyen Thanh Thuy, vice rector of VNU's University of Engineering and Technology (VNU-UET). Also from VNU-HCM were vice president Vu Hai Quan, from University of Science (HCMUS), and Dean of the University of Technology, Tran Ngoc Thinh (HCMUT). Representing Hanoi University of Science and Technology (HUST) was vice president Tran Van Top, and from Le Quy Don Technical University, vice Dean Tran Xuan Nam.

More than 50 people, including the guests from all universities together with Vietnamese students, attended the seminar. Vu Hai Quan (HCMUS) began proceedings with a congratulatory message. This was followed by an introduction to UEC by UEC vice president Tetsuo Kirimoto. In the collaboration session, Tran Ngoc Thinh of HCMUT and Le Duc Hung of HCMUS introduced their current research projects in collaboration with UEC, which focus on sensor networks and the so-called 'Very Large Scale Integration' design of semiconductor chips. In a session focusing on the opportunities for study at UEC, participants learnt more about two of UEC's key research themes, namely optics science research and wireless and communication research. In the final session of the first day, alumni and collaborations with universities in the Association of South-East Asian Nations region were discussed.
On the second day, participants attended 'collaborative workshops' intended to forge new plans for collaborations between HCMUS and UEC over the next 5 years. A key focus of the workshops was to discuss the possibility of forming sister universities between UEC and HUST, Le Quy Don Technical University and VNU-UET, with the aim of launching collaborations focused on such topics as wireless communications.

Following the success of the seminar, UEC is determined to expand on collaborations with all top-tier Vietnamese universities, and looks forward to welcoming more students from Vietnam in future.

Further information

The full seminar program is available here: http://www.uec.ac.jp/news/event/2015/pdf/20150511-3.pdf

The seminar was hosted at the main campus of HCMUS

The first UEC Seminar in Vietnam 2015 was held toward 100th anniversary of UEC's founding in 2018. The sign is shown in front of

HCMUS Vice President, Vu Hai Quan and UEC Vice President, Tetsuo Kirimoto exchange the memorial gift.

Guests from Vietnamese universities and UEC members get together for the memorial photo.

Seminar attendees listen attentively to presentations.

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Star formation: Exotic chemistry

Stars are born in the dense and cold regions of the interstellar medium, where the conditions are just right for the formation of the first very simple and slightly more complex molecules. These stellar nurseries are called molecular clouds and the chemical reactions that take place there are key to the early stages in star formation. To understand this exotic astrochemistry Takeshi Sakai and collaborators in Japan and the US used the data from Atacama Large Millimeter/submillimeter Array (ALMA) to look at the spectral lines of certain molecules that provide clues about the physical conditions in the active star-forming regions just before star birth.

The deuterated hydrogen isocyanide to hydrogen isocyanide (DNC/HNC) abundance ratio remains almost the same even after the star is born providing information about the conditions in the pre-stellar phase. Previous single-dish telescope observations had shown unexpectedly low DNC/HNC ratios so Sakai and collaborators chose an infrared dark cloud with the lowest reported ratio to study with the enhanced resolution of ALMA.

Sakai and colleagues found that the emission of hydrogen isocyanide comes from the hot core of the region, whereas the deuterated hydrogen isocyanide emission is stronger and extends around the core. And the protonated nitrogen emission is weaker near the core, so all these signals trace the warm regions near protostars quite differently.

The team also found that the DNC/HNC ratio depends strongly on the density which explains why the ALMA DNC/HNC ratio was different from the single-dish one, single-dish telescopes having low filling factor for the high density regions. So these new results not only shed light on the relationship between the DNC/HNC abundance ratio and star formation, but also on previous observations.

Publication and Affiliation
Takeshi Sakai[1], Nami Sakai[2], Kenji Furuya[3], Yuri Aikawa[4], Tomoya Hirota[5,6], Jonathan B. Foster[7], Patricio Sanhueza[5], James M. Jackson[8], and Satoshi Yamamoto[2] ALMA observations of the IRDC clump G34.43+00.24 MM3: DNC/HNC ratio, The Astrophysical Journal, 803:70 (2015).
1. Graduate School of Informatics and Engineering, The University of Electro-Communications, Chofu, Tokyo 182-8585, Japan
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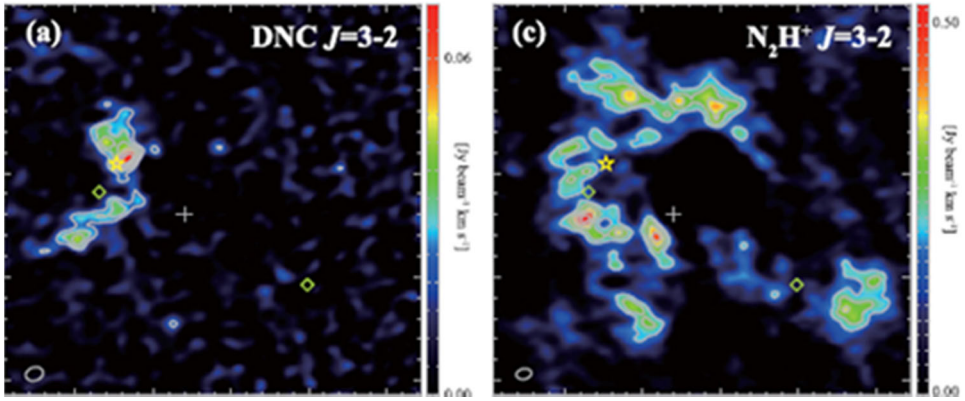
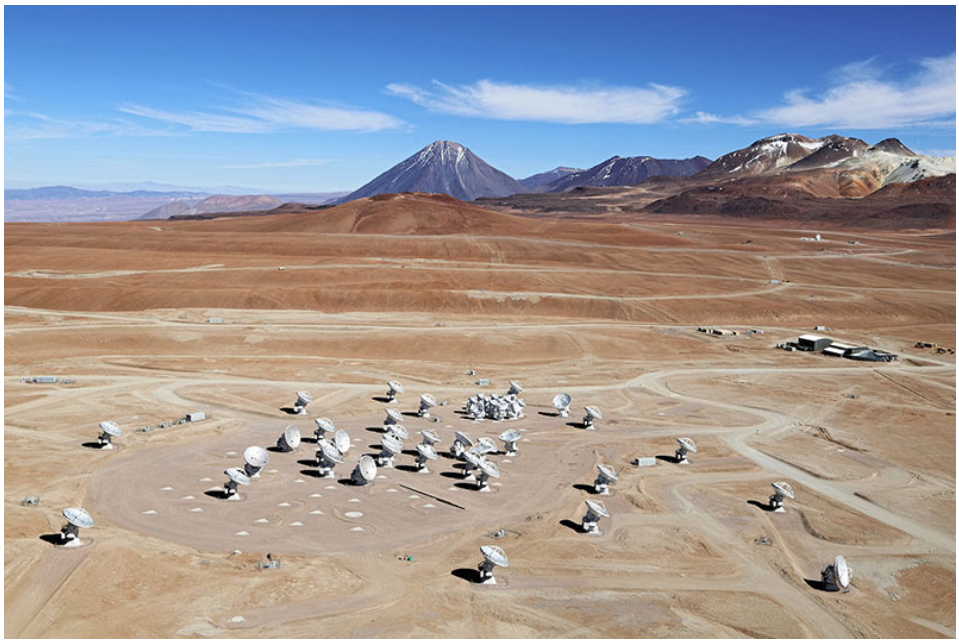
5. National Astronomical Observatory of Japan, Osawa, Mitaka, Tokyo 181-8588, Japan
6. Department of Astronomical Sciences, Graduate University for Advanced Studies, Mitaka, Tokyo 181-8588, Japan
7. Yale Center for Astronomy and Astrophysics, Yale University, New Haven, CT 06520, USA
8. Institute for Astrophysical Research, Boston University, Boston, MA 02215, USA



The integrated density maps of deuterated hydrogen isocyanide and protonated nitrogen in the infrared dark cloud clump G34.43+00.24 MM3.



The Atacama Large Millimeter/submillimeter Array (ALMA) is a radio interferometer array with 66 antennas, located on the Chajnantor plateau, 5000 meters altitude in Chile.
(Credit: Clem & Adri Bacri-Normier (wingsforscience.com)/ESO)

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Physics of semi-metals: Insights into electron transport in bismuth

Bismuth is a semi-metal which, in crystal form, exhibits unusual but important properties such as large 'diamagnetism', which stems from particular electronic states. These peculiarities can be exploited to create new spintronics and optical devices, yet the exact mechanisms behind electron transport and behavior in bismuth are not yet fully understood.

To consolidate progress in this field, Yuki Fuseya from the University of Electro-Communications, together with Masao Ogata at the University of Tokyo and Hidetoshi Fukuyama at Tokyo University of Science, studied theoretically the optical and electronic transport properties of bismuth.

A diamagnet produces a magnetization in the opposite direction to an external applied magnetic field, meaning it is repelled by the applied field. Diamagnetism in bismuth takes its maximum value when the chemical potential is located in the band gap, or its insulating state. This so-called 'interband' effect occurs in the presence of large spin-orbit coupling, and is a feature unique to bismuth.

The authors showed that this same mechanism gives rise to other important phenomena such as the weak-field Hall effect and spin Hall effect. These relationships could be exploited, with wide-reaching applications in spintronics - the development of new devices that make use of the intrinsic angular momentum of electrons as well as their charge. By using circularly polarised light and tuning its frequency in insulating states, for example, the team predicted a 100% spin-polarised magneto-optical current, which could have useful applications.

Such a comprehensive description of the physical properties of bismuth in terms of the electron dynamics provides an excellent basis for further studies on bismuth as well as other related materials.

Reference

Yuki Fuseya[1], Masao Ogata[2], and Hidetoshi Fukuyama[3], Transport Properties and Diamagnetism of Dirac Electrons in Bismuth, *Journal of the Physical Society of Japan*, **84**, 012001, (2015).

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2. Department of Physics, University of Tokyo, Bunkyo, Tokyo 113-0033, Japan
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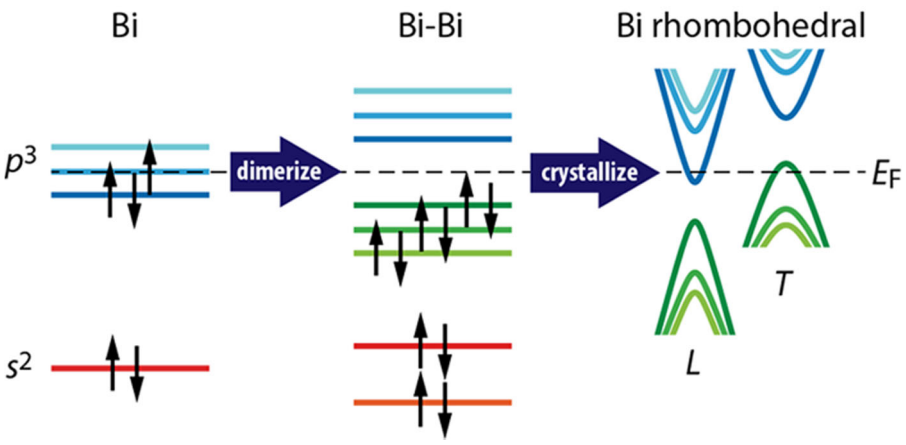

Schematic diagram of the energy spectrum of bismuth (a group V element). For the single atom, the p-band is half-filled. By dimerization, an energy gap opens, which lowers the total energy: the system becomes an insulator. The actual crystal structure of Bi is obtained by adding small lattice distortions. These distortions hybridize the conduction and valence bands, thus the system can gain the kinetic energy of carriers and further reduce its total energy, i.e., it undergoes the Peierls transition.

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Multiterminal source coding: deciphering noisy observations

Determining information of an event from a number of remote noisy observations poses a problem that has interested mathematicians since the 1970s. Active research on the topic has led to a proven theorem of tolerance boundaries for reconstructing the original source from indirect observations.

Now, Yasutada Oohama from the University of Electro-communications, Tokyo, has formulated boundaries for noisy observations from several sources.

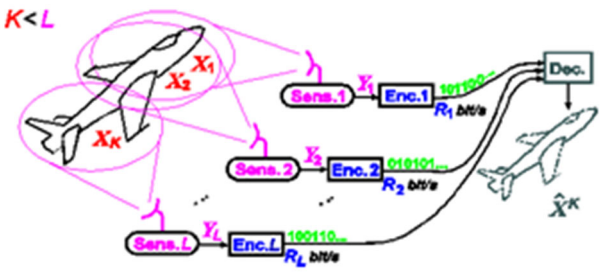
Systems of this kind are sometimes termed the 'CEO problem' as they mimic the challenge a CEO faces when making decisions based on reports of events he has not observed directly. The CEO will need to make decisions based on information of events reconstructed from the reports with the distortion to the original information confined within a tolerance margin or 'rate distortion region'.

Oohama considers a series of 'correlated' sources - events that are connected in a particular way. "We can consider a case where the distributed encoders cannot directly access the source outputs but can access their noisy observations," he explains. By formulating matrices of the sources and distortions he identifies a number of characteristics about the system. He considers three distortion criteria for the problem that stipulate boundaries for the errors estimating the source data and various characteristics of the distortion matrix.

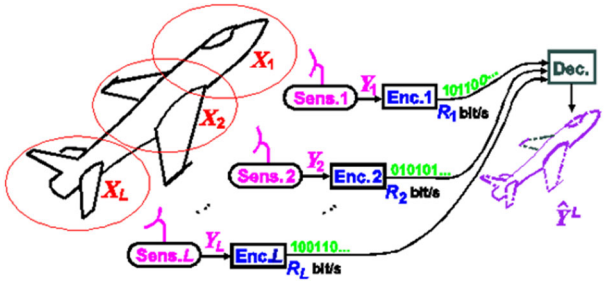
In investigating the multiterminal system Oohama shows how it is linked to the remote (single) source coding system. He also derives several new partial solutions to the multiterminal distributed source coding system.

Reference

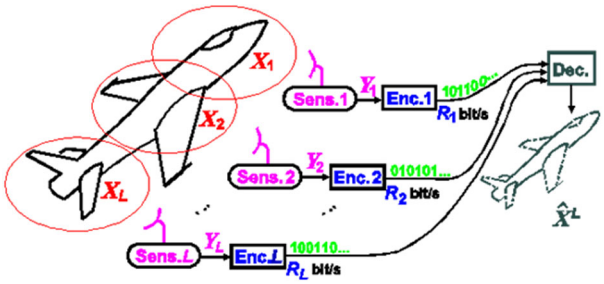
Y. Oohama, Indirect and direct Gaussian distributed source coding problems, *IEEE Transactions on Information Theory*, **60**, 7506-7539, (2014).



The CEO problem



Multiterminal source coding system



Remote source coding system

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Theoretical atomic, molecular, and optical physics: Insights into light-matter interaction on the atomic scale

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The beautiful colors of the rainbow are an everyday example of the results of light interacting with matter--sunlight with raindrops. Similar examples of light interacting with materials includes spectra produced by prisms and the deep orange and red hues of sunsets. The physics of these macroscopic light-matter interactions is well understood in terms of classical theories of the wave nature of light. But the interaction of ultrashort intense laser pulses with atoms and molecules such as hydrogen, helium, and carbon oxide is a new area of active research.

Toru Morishita, is a theoretician at UEC, who is collaborating with groups in Russia, Taiwan, Denmark, Switzerland, US, China, Vietnam, and Japan, is addressing these questions. "My research covers atomic and molecular dynamics under intense laser fields, ultrafast imaging of atomic and molecular dynamics in the attosecond (10^{-18} s) regime, and controlling correlated motions of electrons in atoms and molecules," explains Morishita. "It's of fundamental physics. Hopefully our findings are going to add pages to text books."

Indeed, the implications of atomic, molecular, and optical physics and chemistry have been recognized by the award of four Nobel Prizes in the last two decades: 1997, "development of methods to cool and trap atoms with laser light"; 1999, "transition states of chemical reactions using femtosecond spectroscopy"; 2001, "achievement of Bose-Einstein condensation in dilute gases of alkali atoms, and for early fundamental studies of the properties of the condensates"; 2005, "development of laser-based precision spectroscopy, including the optical frequency comb technique".

Morishita holds a regular series of international workshops "on the theory for attosecond quantum dynamics" (IWTAQD) at UEC [1]. "Our discussions during the workshops have led to the publications of many joint papers," says Morishita. "Papers that would most likely not have been possible if we had not met at the meeting. Such meetings are important for the advancement of science."

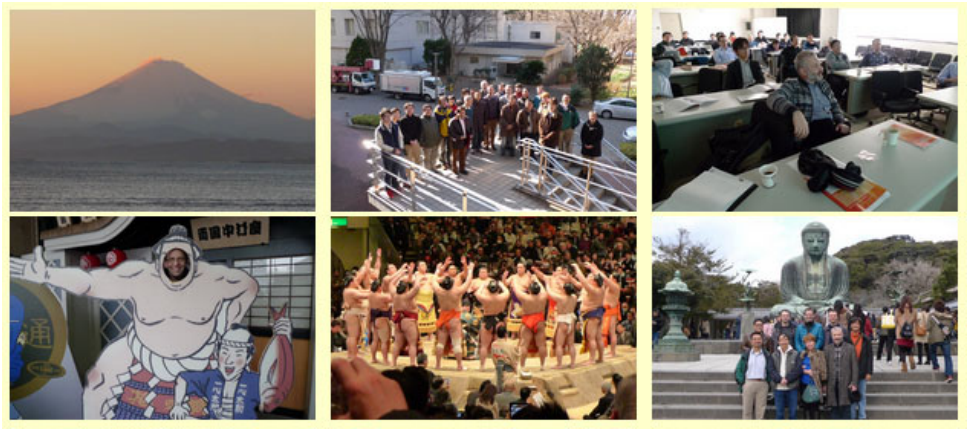
As Morishita empathizes, this area of research is focused on gaining deeper understanding of atomic and molecular dynamics by theoretical explanations for experimental observations. But there are also practical applications, including controlling chemical reactions, and ultrafast imaging of electronic structure in a single molecule.

Recent research highlights

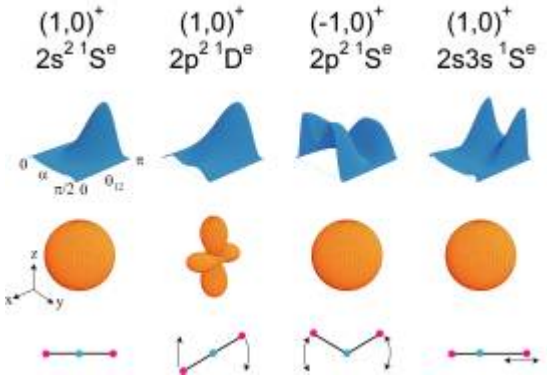
- Theoretical study of the "two-electron dynamics in nonlinear double excitation of helium by intense ultrashort extreme-ultraviolet pulses" [2]. This research identified the mechanism governing the experimentally observed enhancement of three-photon absorption induced by two-electron irradiation. These findings are expected to find applications for determining the structure of proteins and the mechanisms underlying the action of drugs at the atomic scale.
- Pulsed femtosecond (10^{-15} s) intense lasers are widely used to study structure and electron dynamics of molecules. Surprisingly, the effect of the lasers on the electronic structures of samples during measurements is not well understood. Morishita and colleagues have been developing new theories [3], and addressed this issue by experimentally measuring the effect of powerful lasers on the structure of methyl fluoride and methyl bromide-general examples of so-called orientated polyatomic molecules. The laser caused substantial changes in the electronic structure of the molecules in the attosecond (10^{-18} s) time scale. The findings shed light on the complexities of strong-field attosecond spectroscopies [4].

References and further information

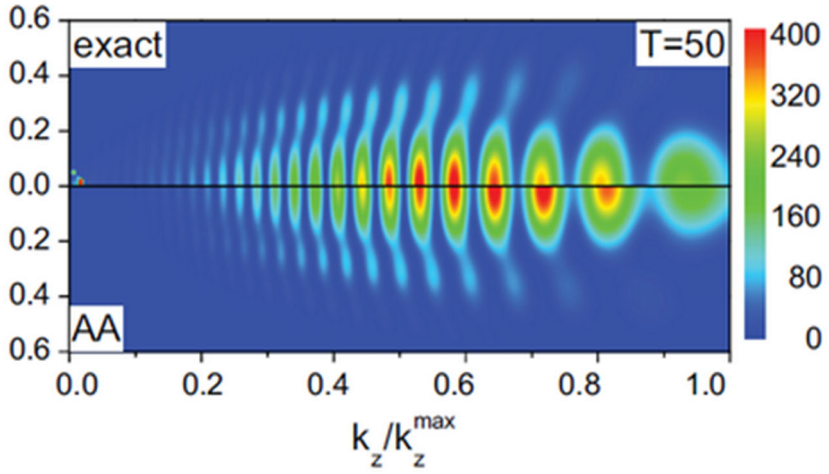
[1] International workshop on theory for attosecond quantum dynamics (IWTAQD) 2015:
http://power1.pc.uec.ac.jp/~toru/iwtaqd/iwtaqd13.html
The model developed by Sakamoto and her group has unique features including the ability to deal with a wide range of phenomes; account for the order of specific sounds; and handle expressions with any number of syllables.
[2] Two-electron dynamics in nonlinear double excitation of helium by intense ultrashort extreme-ultraviolet pulses
Chien-Nan Liu, Akiyoshi Hishikawa, and Toru Morishita
Phys. Rev. A 86, 053426 - Published 30 November 2012
[3] Adiabatic theory of ionization by intense laser pulses: Finite-range potentials
Oleg I. Tolstikhin and Toru Morishita,
Phys. Rev. A 86, 043107 - Published 11 October 2012
Some results include the image of 'huwa-huwa' being soft, light, and fluffy like a cloud; 'mohu-mohu' as soft, fluffy, and warm and comfortable like a blanket.
[4] Observation of laser-induced electronic structure in oriented polyatomic molecules P. M. Kraus, O. I. Tolstikhin, D. Baykusheva, A. Rupenyan, J. Schneider, C. Z. Bisgaard, T. Morishita, F. Jensen, L. B. Madsen, and H. J. Wörner.
Nature Communications 6, Article number: 7039 doi:10.1038/ncomms8039
Published 05 May 2015



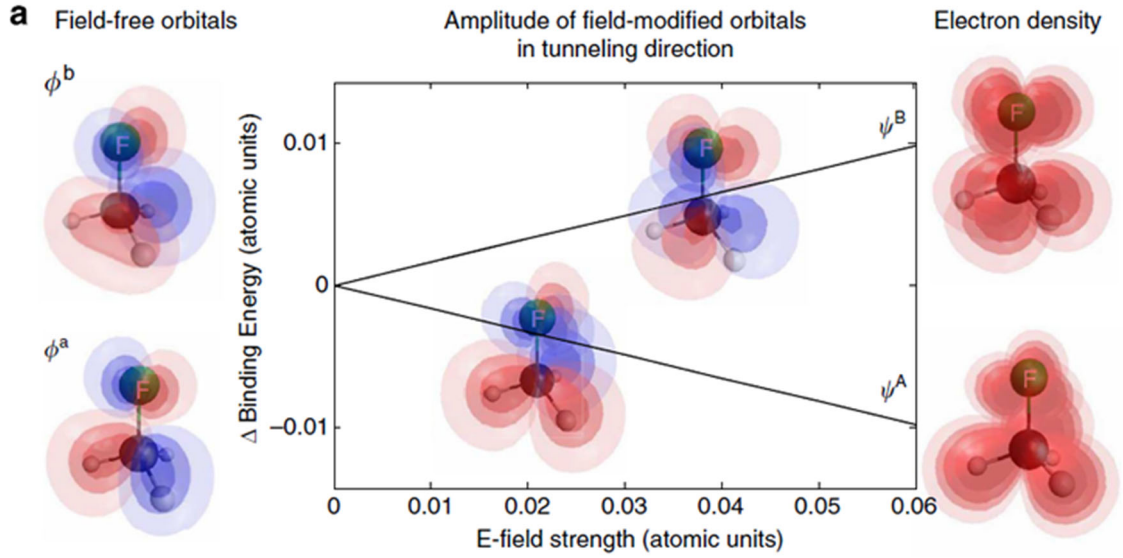
Some photos taken at IWTAQD. See reference [1].



Molecule like modes in doubly excited states of He: We try to probe these modes by using attosecond laser pulses. See reference [2].



"Trilobite structure" in a photoelectron spectrum of an atom irradiated by an intense ultrashort laser pulse. We try to extract target atomic information during the laser pulse irradiation. See reference [3].



Laser-induced electronic-structure effects. This shows how the electronic structure of CH3F molecule evolves in an intense laser field. See Reference [4].

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Frontiers of interdisciplinary research: Information technology to analyze onomatopoeia

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"Onomatopoeias are powerful sounds used by writers to convey feeling, sensation, and intimacy as they paint their pages with words. It would not be an overstatement to say that the Japanese language has an even larger selection of diverse and rich 'sound devices' than their equivalents in English. Heavy rain and lightning is "zah-zah" and "goro-goro"; pain is "zuku-zuku" or "chiku-chiku"; and glitter and sparkle is "kira-kira".

But can these magical 'sounds words' be quantified, and perhaps even be used for industrial applications?

Maki Sakamoto, an arts major specializing in linguists, is mixing here expertise in languages with information science to address these questions. She has found some intriguing answers.

"In 2011 my group at UEC first initiated experiments to analyze images associated with Japanese onomatopoeia," says Sakamoto. "For "pika-pika" we obtained an image of "clear" and "sharp". Our results are reproducible and consistent."

Based on these early findings, Sakamoto and her colleagues extended their research and developed their 'sound imaging system' for estimating texture feelings as expressed by onomatopoeia. "The participants selected 312 onomatopoeic words from a choice of 14,584 that we had created to express texture," explains Sakamoto. "Our sound symbolic database used these 312 words that covered a wide range of phonemes, namely, single units of the sound that had a meaning. We developed a theoretical model to link a specific image with each phoneme. "

The model developed by Sakamoto and her group has unique features including the ability to deal with a wide range of phenomes; account for the order of specific sounds; and handle expressions with any number of syllables.

Some results include the image of 'huwa-huwa' being soft, light, and fluffy like a cloud; 'mohu-mohu' as soft, fluffy, and warm and comfortable like a blanket.

"We are also working on generating Japanese onomatopoeia based on images," says Sakamoto. "We expect these words to be useful for naming products. My research is interdisciplinary. It's based on my perceptions

and sensibilities as a Japanese female who mixed her expertise in modern languages with information science and technology. This is an exciting area of research."

Further information

UEC Sakamoto Lab website: http://www.sakamoto-lab.hc.uec.ac.jp/en-3index.html

Recent publications

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4. Maki Sakamoto, Yuya Ueda, Ryuichi Doizaki, and Yuichiro Shimizu：Communication Support System between Japanese Patients and Foreign Doctors Using Onomatopoeia to Express Pain Symptoms, Journal of Advanced Computational Intelligence and Intelligent Informatics, 18(6), pp.1020-1025 (2014) (Best Application Award)
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7. Maki Sakamoto: Principles of Onomatopoeia Increasing the Value of Women (Rittor Music Inc., 2013)
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Commercial products: http://www.sakamoto-lab.hc.uec.ac.jp/9index.html

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Letter from Alumni

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I came to UEC in 2000 as a doctorate student under a Monbukagakusho scholarship, awarded by the Japanese government. I spent 6 years studying and working at UEC, which was a great experience for me and enabled me to build up my academic career as well as exploring Japanese culture.

Before joining the doctorate course, I was lucky to spend time learning Japanese language and culture at the Center for International Students. This intensive course helped me to learn how to communicate in Japanese, and gave me the chance to learn how to talk with friends as well as discuss my studies with my supervisor and other laboratory staff. The staff at the Center for International Students were really helpful and friendly. I still remembered how carefully they taught us to use each Japanese word or Kanji character. I also had a good time chatting with them about Japanese culture after class. Coming to the intensive Japanese class was always useful and enjoyable for me.

After the Japanese class I started my research in the Karasawa Laboratory under the supervision of Yoshio Karasawa in the Department of Electronic Engineering. My research topic was based on 'subband adaptive arrays for wireless communications'. The Nishi-2 building where I did my research was a very comfortable working facility. All students were given a computer with all the necessary simulation software. Direct access to almost all the databases for academic journals and conference proceedings was always easy through the laboratory computer or at the university library. The laboratory environment was open and friendly.

I was the first doctorate student in the laboratory so my main discussions were with my supervisor, who was a very kind and helpful person. Yoshio Karasawa inspired me with new research topics and helped me stay on the right path during my studies. Working under his supervision was a fantastic opportunity for me. Since then, I have continued collaborating with him on joint research projects, and I recently published a paper with him. I was surprised and impressed to discover that this was his 200th research paper, and it was accepted just before his official retirement from UEC.

After I graduated, I continued working at UEC as a research associate at the Fujino Laboratory in the Department of Information and Communications Engineering (ICE). Working with Tadashi Fujino was a great opportunity for me to widen my area of research and focus on space-time signal processing for wireless communications. This research area is still active now, due to its wide applications in advanced wireless communications systems such as 3G and 4G mobile networks. During my time at UEC, I was given several chances to attend IEEE international conferences, an invaluable experience for my research career.

I returned to Vietnam in 2006 and joined Le Quy Don Technical University in Hanoi where I am currently an associate professor and a vice dean of the Faculty of Radio-Electronics. Since returning to Vietnam, I have been trying to facilitate connections between Vietnamese universities, UEC and other Japanese universities. I have organized several international conferences in Vietnam and invited Japanese professors to deliver keynote speeches. Recently, I collaborated with the Institute of Electronics, Information and Communication Engineers (IEICE), Japan, to successfully organize the 2014 Vietnam-Japan International Symposium on Antennas and Propagation at my university. In 2014 I worked together with other former Vietnamese students of UEC to establish the Megurokai branch in Vietnam and I was nominated to become chairman of the branch. The inauguration ceremony and the first general meeting of the branch was organized at my university. On this occasion we welcomed Makoto Kajitani, the former president of UEC, to open our branch. This year we were also happy to welcome Takashi Fukuda, the current president of UEC, to the second general meeting of our branch.

It is now almost 10 years since I left UEC, yet I continue to have strong links with the university. I am so proud to hear that UEC has recently been selected as one of 19 universities to receive support from "The Program for Promoting the Enhancement of Research Universities", funded by the Japanese Ministry of Education, Culture, Sports, Science and Technology. I do hope that UEC will become a leading research university ahead of its 100th anniversary in 2018.

The University of Electro-Communications (UEC) in Tokyo

is a small, luminous university at the forefront of applied sciences, engineering, and technology research. Its roots go back to the Technical Institute for Wireless Commutations, which was established in 1918 by the Wireless Association to train so-called wireless engineers in maritime communications in response to the Titanic disaster in 1912. In 1949, the UEC was established as a national university by the Japanese Ministry of Education, and moved in 1957 from Meguro to its current Chofu campus Tokyo.

With approximately 4,000 students and 350 faculty, UEC is regarded as a small university, but with particular expertise in wireless communications, laser science, robotics, informatics, and material science, to name just a few areas of research.

The UEC was selected for the Ministry of Education, Culture, Sports, Science and Technology (MEXT) Program for Promoting the Enhancement of Research Universities as a result of its strengths in three main areas: optics and photonics research, where we are number one for the number of joint publications with foreign researchers; wireless communications, which reflects our roots; and materials-based research, particularly on fuel cells.

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