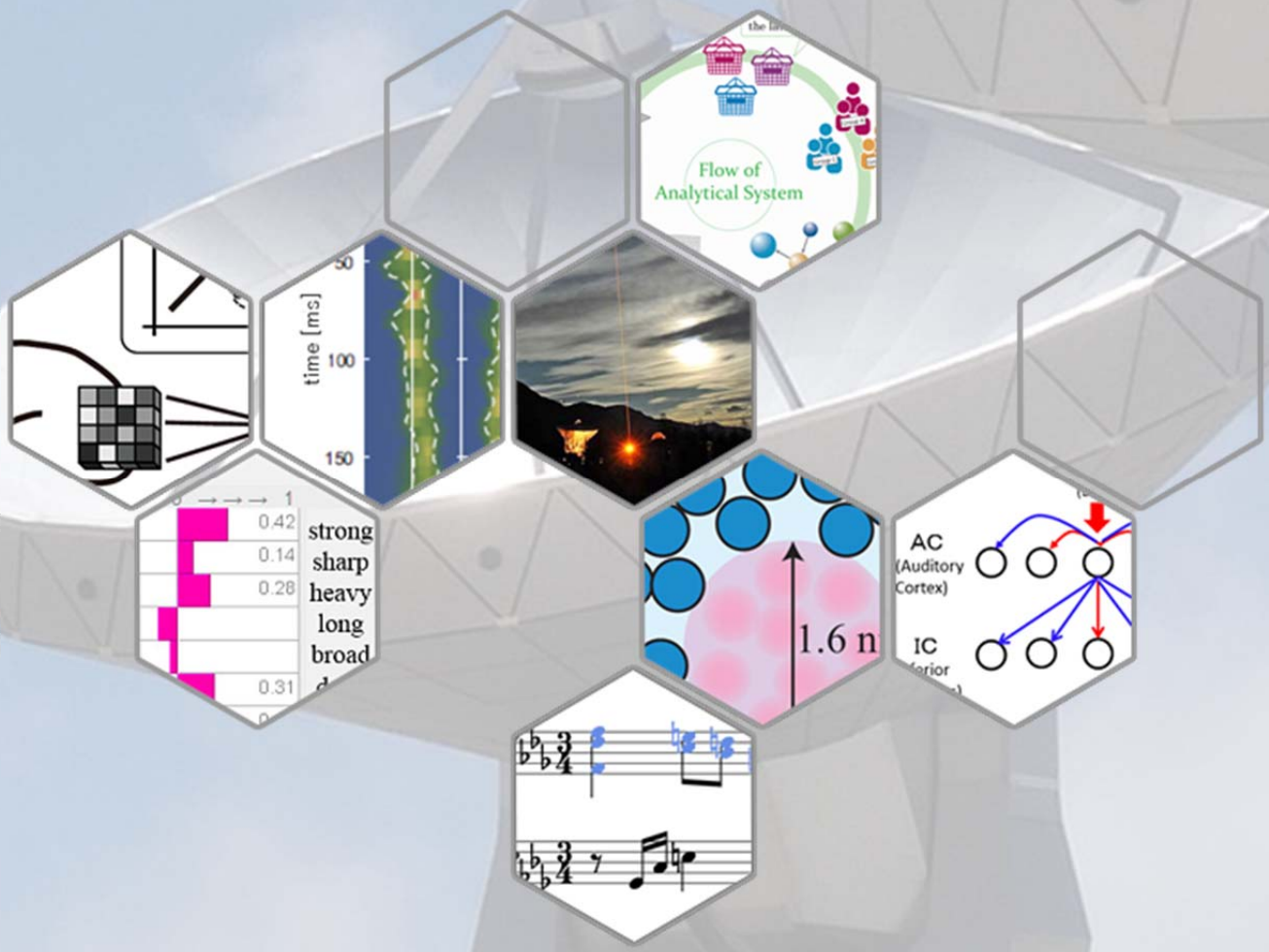
The University of Electro-Communications

UEC e-Bulletin

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

Vol.10, June 2016



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Feature

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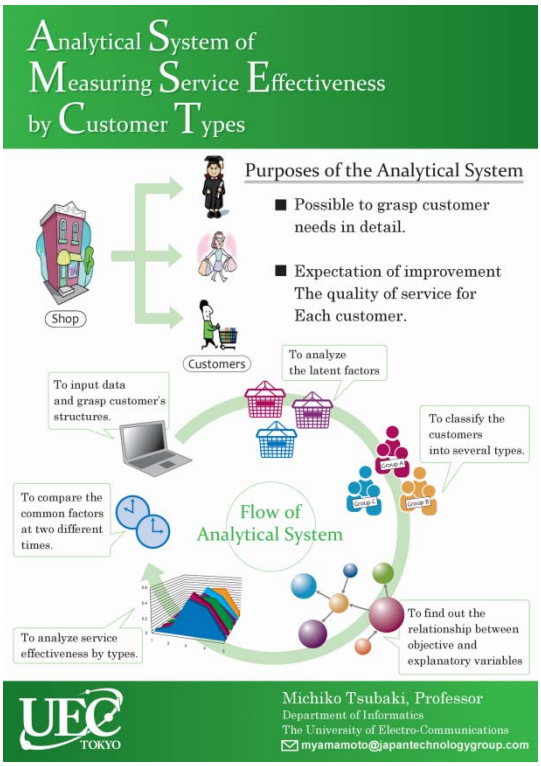
Advanced analytical service science based on big data

Integrating big data and statistical mathematics for an individual-priority-based approach to analyze and devise methods for improving the quality of business services and education environments.

Michiko Tsubaki is the UEC-vice-president responsible for public relations and an expert in statistical mathematics conducting research on innovative analytical approaches for improving the quality of service industries and education. "At junior high school I enjoyed both mathematics and Japanese literature," says Professor Tsubaki. "Inspiring teachers enabled me to excel in both subjects. I particularly enjoyed reading books by novelist Sōseki Natsume, whose classics include I am a Cat and Botchan. Later, having finished reading all of the works of Sōseki Natsume, I knew that he had the opportunity to read the book "the grammar of science" which was written by English statistician, Prof. Karl Pearson, in London. Sōseki ' s works on novels and "the theory of literature" affected by Karl Pearson, really left an impression on me. This experience was a major turning point in my life, and eventually led to my decision to go into the sciences, and applied mathematics."

Professor Tsubaki is currently pursuing research into the improvement of the quality and co-creation of new values in service industries, as well as the education environment and learning capabilities of young people. This research reflects the fact that the service sector accounts for 70% of Japan's GDP. Notably, Professor Tsubaki's research is based on the application of her unique analytical system for measuring the effectiveness of a specific service based on individual customer types. "Our analytical system enables us to ascertain the individual needs of a wide range of customers," explains Professor Tsubaki. "The strength of our analysis lies in its ability to match the heterogeneous needs of both customers and service providers. We provide industrial partners with quantitative analysis on methods to improve customer satisfaction and the quality of services for individual customers with specific demands."

In the case of customers shopping in a supermarket, the analytical system classifies customers into several types; determines the relationship between the objective and explanatory variables; analyzes the effectiveness of service by type; and compares the common factors at two different times.



Research highlights

Emotion hierarchy diagram (EHD) for designing specific order-made service processes

Research shows that customers who receive high quality service at coffee shops are more likely to become regular customers--so called repeaters. Satisfied customers will spread the word of their experience--good or bad--by word of mouth. So needless to say, it is imperative for the success of such businesses to analysis customer preferences and design processes to provide highly valuable services.

Here, Professor Tsubaki and colleagues decompose and analyze abstract emotions such as 'excitement' to design specific, customer orientated high quality service processes. Examples of emotions and elements of excitement in a café include: excitement of studying/café where customers can work without being disturbed; excitement of using new things/ café where robots serve customers; and excitement of experiencing the extraordinary/ café with Indian décor and movies.

Big Data based analysis of relationships between customers and service providers

It's intuitive to think that customer satisfaction is an important factor affecting the sales of businesses. In order to analyze this premise, Professor Tsubaki is using 'big data' from a major Japanese company that specializes in providing carpet and other such cleaning services to determine whether company sales could be improved by assigning one company rep to one customer--that is, matching the needs of customers and service providers. Another goal of the research is to clarify the link between job satisfaction amongst company employees and company sales. Initial results based on data from one of the many branches of the cleaning company show that

both one-to-one customer-sales rep relationships and employee satisfaction do indeed lead to improvements in the sales of the company.

Education and learning

The analytical system is also being applied for improving education and teaching. In one project, Professor Tsubaki is looking into simultaneity and heterogeneity, with the assumption that teaching and learning occur simultaneously and that students are from diverse and wide ranging backgrounds. Initial findings show that the 'learning style' is an important factor for the improvement of learning ability. Now, we study the classification of Students into types based on the critical thinking skills, and Modeling for improvement of English abilities of elementary school students based on the analysis of log data of learning process.

Kazushi Okamoto[1], Hitoshi Asanuma[2], and Kazuhiko Kawamoto[3] A graph based data mining method for collaborative learning space in learning commons, *World Automation Congress* (2014) doi:10.1109/WAC.2014.6935976.

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Tsubaki,M., Gonda,S., Kato,N. and Maeda,Y.(2015): "A Study on Modeling and Verification for Improvement of English Abilities of Elementary School Students Based on the Analysis of Log Data of Learning Process using the Sound Pen," *Japanese Journal of Educational Information*, Vo.31,No.1, 43-54.

Haraga,S., Tsubaki, M.and Suzuki,T. (2014): "Expansion of the Analytical System of Measuring Service Effectiveness by Customer Type to Include Repeat Analysis," *International Journal of Social and Humanity*, Vol.4, No.2,194-200.

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Tsubaki,M., Oya,T. and Kobayashi,T.(2012):"Analysis for the Design of Effective Learning Activities Using Learning-Type PDCA and CAPD Cycles on the Basis of Characteristics of Individual Students," *International Journal of Knowledge and Learning*, Vol.8, No.1-2,150-165.

Michiko Tsubaki, Doctor of Engineering,
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http://www.uec.ac.jp/research/information/opal-ring/0000390.html

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Bose-Einstein condensates miscibility properties reveal surprises

Bose-Einstein condensates (BECs) are macroscopic systems that have quantum behaviour, and are useful for exploring fundamental physics. Now researchers at the Gakushuin University and the University of Electro-Communications have studied how the miscibility of multicomponent BECs affects their behaviour, with surprising results.

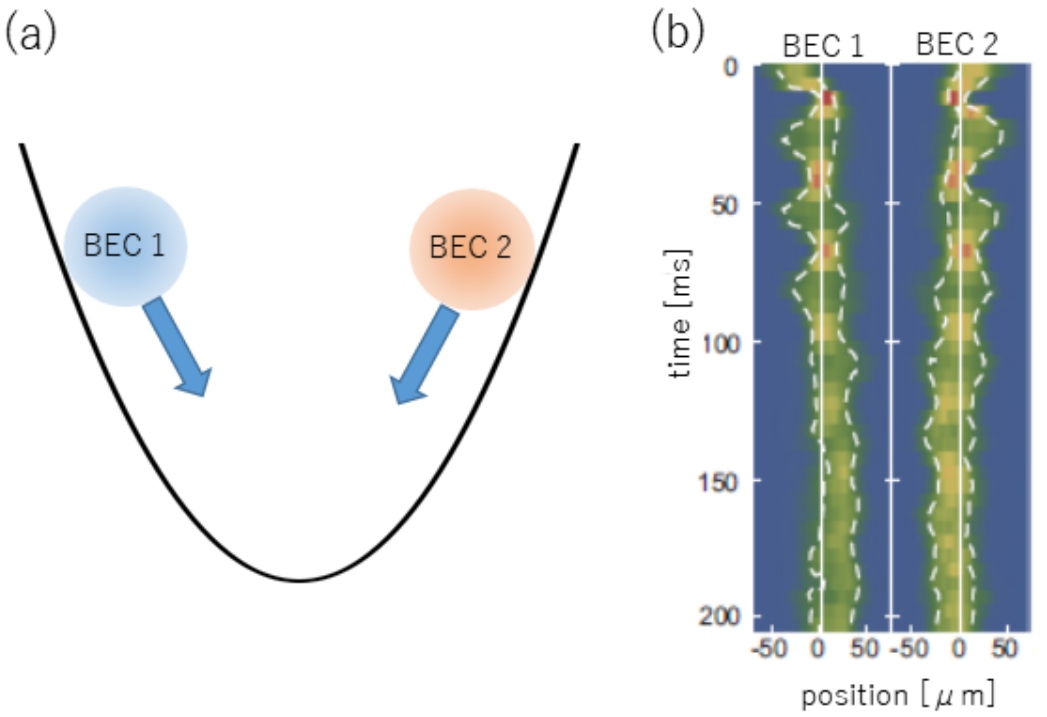
Fundamental particles have a property associated with angular momentum described as spin. Force particles - photons, gluons, and so on - have integer spin values and are called bosons; matter particles - electrons, neutrons, protons, and so on - have half integer values of spin and are called fermions. In composites of several fermions, as in atoms and nuclei, the total spin can be integer values so they can behave as bosons. While identical fermions cannot occupy the same state, bosons can, and if cooled to sufficiently low temperatures they will all occupy the lowest possible energy state - a Bose-Einstein condensate.

The researchers studied a BEC of rubidium atoms exploiting the element's rich spin states. They created optical traps containing around 3×10^5 atoms in two different spin states, and applied magnetic-field gradient pulses to separate condensates with different spins. The miscibility of different components of a BEC is determined by the strength of interactions between and within the atoms, which the researchers could tune to produce miscible and immiscible multicomponent BECs.

After removing the magnetic field they left the system to evolve before releasing from the trap and imaged the resulting condensate distribution. "The various counterintuitive effects such as mutual penetration in immiscible BECs, bouncing between miscible BECs, and domain formation in miscible BECs were observed," report the researchers. Numerical simulations of the system revealed further insights, showing that "the properties of penetration and bouncing can be tuned by slightly changing the atomic interaction strengths."

Reference

Yujiro Eto,[1] Masahiro Takahashi,[1] Keita Nabeta,[1] Ryotaro Okada,[1] Masaya Kunimi,[2] Hiroki Saito,[2] and Takuya Hirano[1] Bouncing motion and penetration dynamics in multicomponent Bose-Einstein condensates, *Phys Rev A*, **93**, 033615 (2015).



(a) Schematic illustration of the system. (b) Experimental result. The time evolution of the condensates shows clear bouncing, which are seemingly incompatible with the property of static miscible BECs, in which the ground state is spatially overlapped

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Brain diseases: Unlocking potential from MRI data

Magnetic resonance imaging (MRI) plays a vital role in medical and neuroscience research as a non-invasive, highly sensitive way of imaging both physical structures and activity inside the human brain. The data from each MRI scan contain a vast amount of information, which is divided up into a three-dimensional grid comprising individual 'voxels'.

Comparing individual voxel signals in a healthy subject with corresponding individual voxel signals in a patient can help uncover areas of the brain significant for specific diseases, for example. However, this 'univariate' analysis can lose valuable information stored in patterns between multiple voxels.

Yoichi Miyawaki at the University of Electro-Communications in Tokyo reviewed recent progress in the field of 'multivariate' MRI analysis, exploring its potential in the fields of medical imaging and neuroscience[1].

'Pattern classification models' can be trained to find signal patterns associated with specific diseases, such as Alzheimer's or autism, which have complex neural signatures. When presented with a new MRI signal, the model can classify it - an invaluable tool for medical diagnostics. Fine-tuning the models' ability to read dynamic neural signatures could revolutionise the study of highly complex conditions like schizophrenia.

The high sensitivity of pattern classifiers means that they pick up finer details at the sub-voxel level. Recent studies have shown that the models can reproduce visual images from signals generated in a person's brain when they look at a picture - this could one day be expanded to explore hallucinations in schizophrenia and post-traumatic stress disorder.

Advances in multivariate MRI analysis could also lead to better brain-machine interfaces for motor-paralysis patients.

Reference

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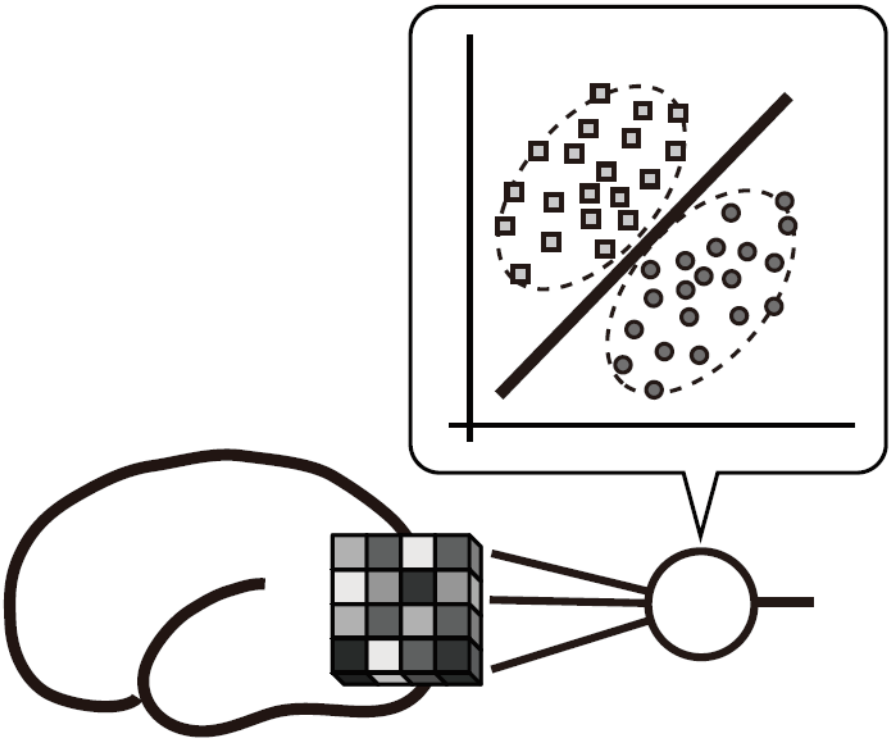

Multivariate pattern analysis of magnetic resonance imaging (MRI) signals.

Associate Professor: Miyawaki Yoichi (Doctor of Engineering from The University of Tokyo 2001/03)
Current research areas: Neurophysiology / General neuroscience, Cognitive science, Brain biometrics
Current research subjects: Study on neural representation of sensory information and its applications, computational neuroscience
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Auditory systems: Modelling bats' information processing

An intriguing aspect of auditory signal processing is that certain creatures can tune in to specific frequencies relevant to behavior - such as for hunting or survival - while filtering out all other 'noise'. Scientists know that, while sensory information is transmitted from the ears to the cerebral cortex in a 'feedforward' manner, the information is also modulated by feedback from the cerebral cortex itself. Cortical neurons are excited by relevant signals, and tell the peripheral neurons to hone in on them while at the same time reducing signals from surrounding noise - a 'gating' mechanism, in other words. However, exactly how this process works is unclear.

Kazuhisa Fujita and Yoshiki Kashimori at the University of Electro-Communications in Tokyo, Japan, developed a neural network model of a bat's auditory system to examine how signal processing may be modulated by feedback from the cerebral cortex[1].

Bats hunt by echolocation, and this involves detecting the Doppler-shifted frequency of sound echoes (as prey moves). Following feedback from cortical neurons, certain neurons in the auditory cortex are electrically stimulated by Doppler-shifted frequencies while others are not. This stimulation evokes synaptic modulation in neurons in the inferior colliculus (an area in the midbrain).

Fujita and Kashimori's model shows how an injection of GABA antagonist bicuculline methidide, or BMI, suppresses signals from surrounding 'noise' picked up by other auditory neurons. The electrical stimulation from a relevant signal coupled with BMI enables the bats to balance activity in different neurons' receptive fields.

Their model could help understand how bats rapidly discriminate between signals from edible insects and surrounding background noise.

Reference

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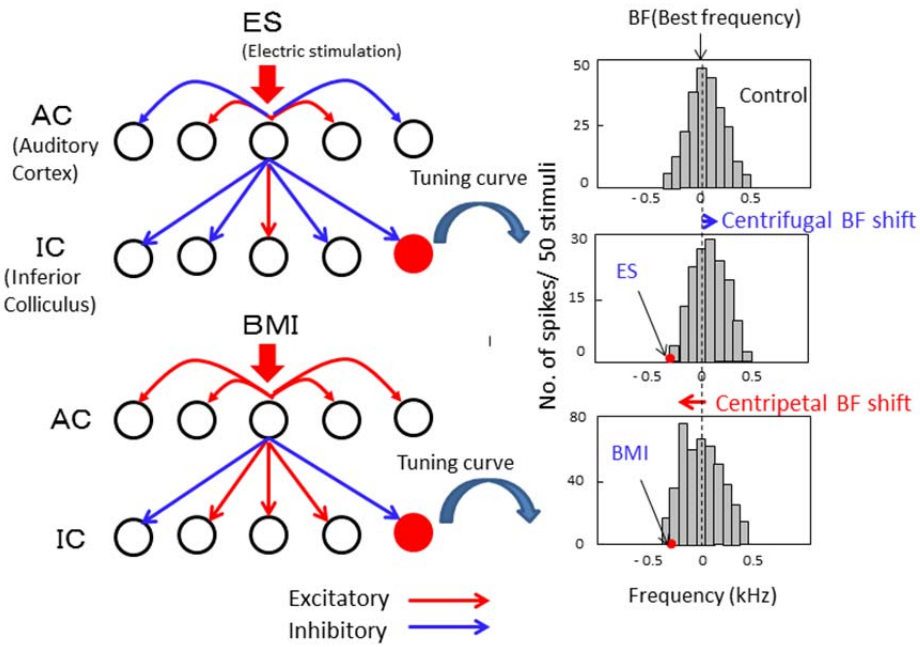

Left panel: Modulations of receptive fields of an ES-stimulated neuron and a BMI-injected one. Right panel: BF shifts evoked by ES and BMI.BECs.

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Mixing photophysics and information technology: Insights into holography based optical microscopy and information optics

"My interest in optics was triggered by the sight of a hologram when I was a student," says Eriko Watanabe, assistant professor at the Graduate School of Informatics and Engineering. "Now I have my own research group with projects on information optics, innovative microscopy, and 3D measurement systems. Optics is an exciting and dynamic area of research." Notably, Professor Watanabe has also launched a venture company to commercialize results of her innovative research.

Research highlights based on integrating photophysics and information technology

Developing a lens-less digital phase imaging holographic microscope with no moving parts for medical applications [1-2]. This unique and innovative microscope is only 22mm x 25m is size, with a heater (thermo-optic) to shift the phase. Initial measurements include distinguishing cancer cells from normal human cells.

An optical correlation system with a volume holographic optical disc memory for ultra-high speed, low power consumption 10 Tbps/1 TB computers. The holographic disk consists of a multilayer of glass/aluminum/photopolymer/glass irradiated with 650 nm servo light and 532 nm hologram writing and reading light [3].

Copyright management using FReCs (Fast Recognition Correlation System) for recognizing high capacity image data posted on websites such as YouTube without the owner's permission. FReCs is offered commercially by Photonics System Solutions Ltd., a UEC based venture company launched by Eriko Watanabe and Kashiko Kodate [4].

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2. E. Watanabe, K. Hoshino, S. Takeuchi, Portable digital holographic microscope using spherical reference beam, Optical Review, 22, 342, (2015).
3. K. Ikeda and E. Watanabe, High speed optical correlator with coaxial holographic system, JJAP 54, 09ME02, (2015).

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Insights into musicology: Role played by sensory information in the acquisition and execution of advanced skills.

"Experiences of entrance exams for music school, and learning and teaching the piano led me to realize that different people hear the same music in different ways," says Eriko Aiba, assistant professor at the Graduate School of Informatics and Engineering, UEC, Tokyo. "Our sensory interpretation of the sound of a chord of music is unique, with some people hearing specific notes clearly, whilst others sense more unified sounds. Understanding these sensory reactions to music is the main aim of my research activities.

This research is ongoing, and in the future the results of this research will be applied to devising methods of teaching children how to reach their full potential in many different fields including music.

Main topics of research

Development of auditory sense by learning from human physical skills

The goal of this research is to clarify the relationship between musical performance and processing of sensory information with emphasis on verifying the necessity of focusing on not only sound, but also training based on both sound and active exercise. This research is expected to lead to methods for improving word legibility in age-related hearing loss [1-2].

Movement strategy based on prioritization of sensory information

This project aims to elucidate how the brain processes information in response specific playing strategies. A major goal is to clarify the relationship between performance and memory when musicians play music [3-4].

Recent publications

1. Eriko Aiba, Minoru Tsuzaki, Yutaka Sakaguchi, "Temporal Information Processing at Auditory Periphery and its Relation to Cochlear Delays," *IEEE 2014 ICME International Conference on Complex Medical Engineering*, pp.132-133, Taipei, June 2014.
2. Eriko Aiba, "Sensitivity to onset asynchrony and its relation to cochlear delays," *Proceedings of 7th Forum Acusticum* 2014, pp.1-6, Krakow, Sep. 2014. (Invited).
3. Eriko Aiba, Toshie Matsui, "Music memory following short-term practice and its relationship with the sight-reading abilities of professional pianists," *Frontiers in Psychology*, 10 May 2016. DOI:http://dx.doi.org/10.3389/fpsyg.2016.00645
4. Eriko Aiba, Toshie Matsui, "Behavioral changes in professional pianists during a short period of practice for a new piece," Abstracts of the *International Symposium on Performance Science* 2015, pp.40-41, Kyoto, Sep. 2015.

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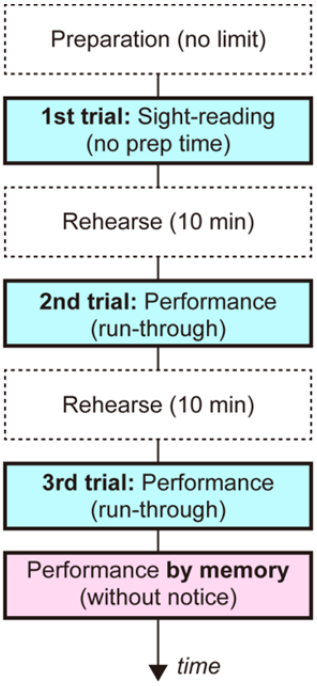

Fig.1 Experimental Procedure

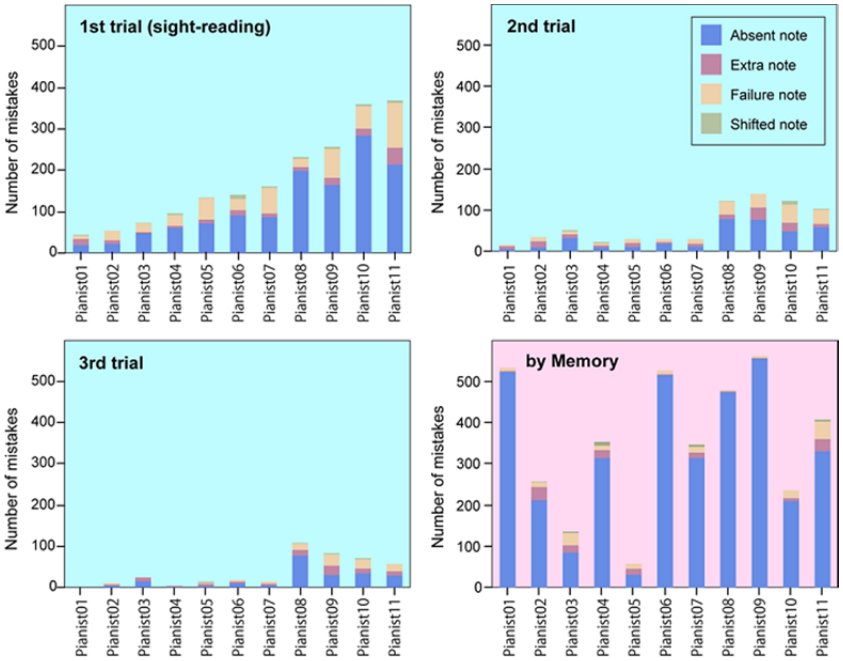

Fig.2 Results
Some pianists memorized almost the entire score, while others hardly remembered it despite demonstrating almost completely accurate performance just before memory trial performance.

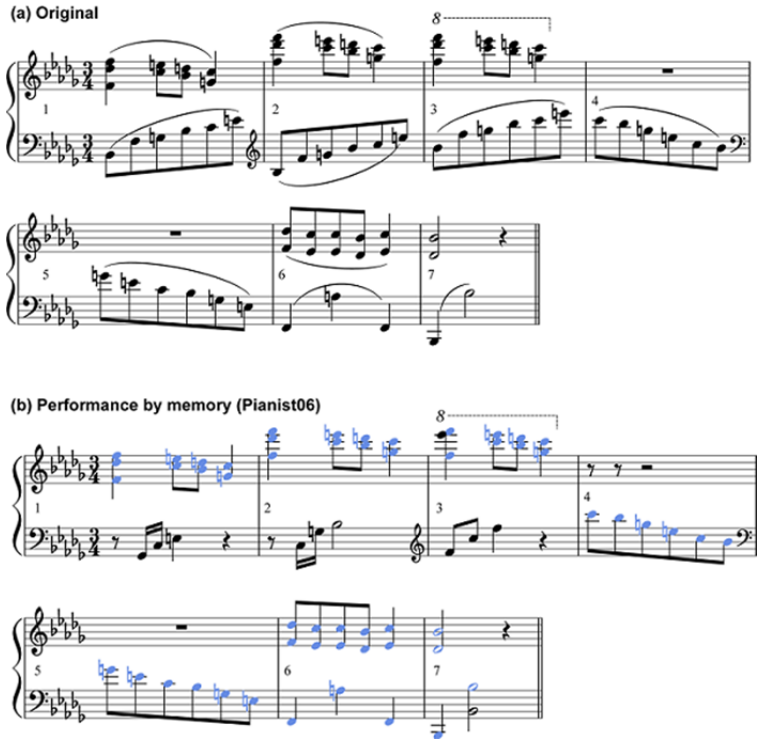

Fig.3 (a) Excerpt from the original score. (b) The score that was generated from Pianist06's memory performance of the same bars. Blue-colored notes indicate notes played correctly.

Assistant Professor: Eriko Aiba (Ph.D. in musicology from Kyoto City University of Arts 2009/03)
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Current research subjects: Auditory psychology, Instrumental performance
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Quantum physics: Superfluidity of helium in one dimension

"My fascination with physics was sparked by an excellent science teacher at school," says Junko Taniguchi, assistant professor at the Department of Engineering Science. "At university I was initially tempted to pursue chemistry, but I became interested in the concept of quantum physics, wave functions, and superfluidity that led to my current research, which is an experimental application of wave functions. One dimensional superfluity is a challenging and fascinating area of research. I am studying the mysterious changes in the state of helium (4He) at low temperatures when the substance is confined to move in only one dimension."

Recent research highlights

In the three dimensional macroscopic world, Helium (4He) shows strong quantum effects and does not freeze at absolute zero but instead changes from a gas, to a liquid, and finally a superfluid--a liquid state where it flows without viscosity. But what happens if 4He is confined to one dimensional? Theory predicts that the superfluidity should appear in 1D.

Here, Junko Taniguchi and her colleagues constructed dedicated 'double torsional oscillators' to experimentally test samples of 4He confined inside 2.8 nm diameter pores formed inside Folded Sheets Mesoporous materials (FSM). "Our so-called frequency dependent experiments agreed with theoretical predictions and we detected superfluidity in pore diameters larger than 2.8 nm," says Professor Taniguchi. "Our findings are a major breakthrough in superfluidity."

Future plans include verifying the theoretically predicted power-law frequency dependence of superfluidity using a new frequency variable torsional oscillator that is currently under construction, and the search for the origin of two stage growth, again using a specially designed 'superfluid detector that is composed of a Helmholtz resonator.

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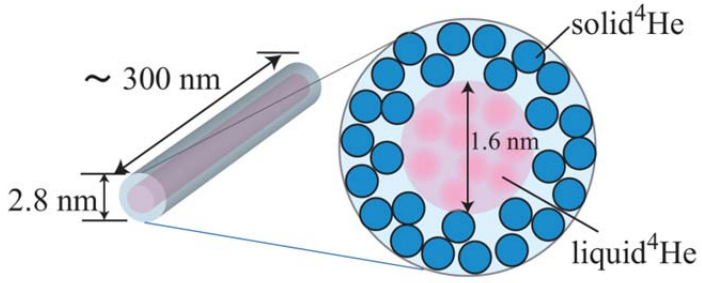
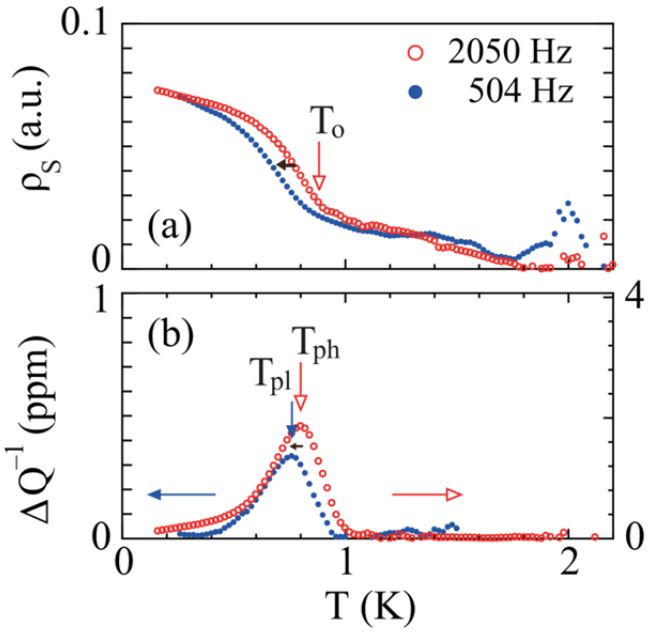
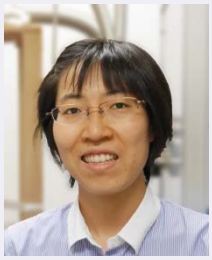


Solid and fluid states of 4He confined into 1D nano-pore.



Superfluid response of 4He confined in 2.8nm diameter pores. T_ph and T_pl show the dissipation peaks detected at 2050 and 504 Hz, respectively.



Assistant Professor: Junko Taniguchi (Doctor of Science from the University of Tokyo 2004/03)
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Current research subjects: Low Dimensional Quantum Fluid, Low Dimension Quantum Fluid, Interfacial friction of physisorped films, Nanotriborogy,
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Japanese onomatopoeia: Mathematical models to analyze Japanese phonemes and associated images

The Japanese language is a treasure trove of onomatopoeia, with words such as 'kira-kira' conjuring up vivid images of 'twinkling' objects. Here, Maki Sakamoto is analyzing links between Japanese onomatopoeia and sensory experiences.

Detailed introduction to this research:
http://www.ru.uec.ac.jp/e-bulletin/topics/2015/information-technology-to-analyze-onomatopoeia.html
UEC e-Bulletin, June 2015: Frontiers of interdisciplinary research: Information technology to analyze onomatopoeia.

Research highlights

Vision and sound symbolism

Could onomatopoeia be used to evaluate the texture of metals and differentiate between real and imitation metal textures? Participants are shown real and imitation metals and asked to describe the nature of the materials they see using words from a list of onomatopoeia Clear differences in onomatopoeia for real and imitation metals were found. Applications of this research include the design of metal textures for automobiles and other such industrial areas [1].

Taste and sound symbolism

The goal is to quantify relationships between onomatopoeia and taste/texture. In experiments, participants express their sense of taste of liquids including milk and sports drinks, using Japanese onomatopoeia. Results show the sensation of tasting to result in primarily of 'clusters' of words like pleasant/unpleasant [2].

Medicine and sound symbolism

Medical doctors and patients in Japan use onomatopoeia to communicate. Here, the aim is to develop a system that automatically suggests metaphors related to onomatopoeia selected by patients [3].

Launch of the "Innovative SHITSUKAN science and technology (ISST)" project

FY 2015 to FY 2019, with a research grant of 1,086,200 thousand JPY.
Project title: "Shitsukan Information Based on Correspondences of Physics, Perception, and Affective Evaluations"

SHITSUKAN science and technology website:
http://shitsukan.jp/ISST/en/researches/index.html

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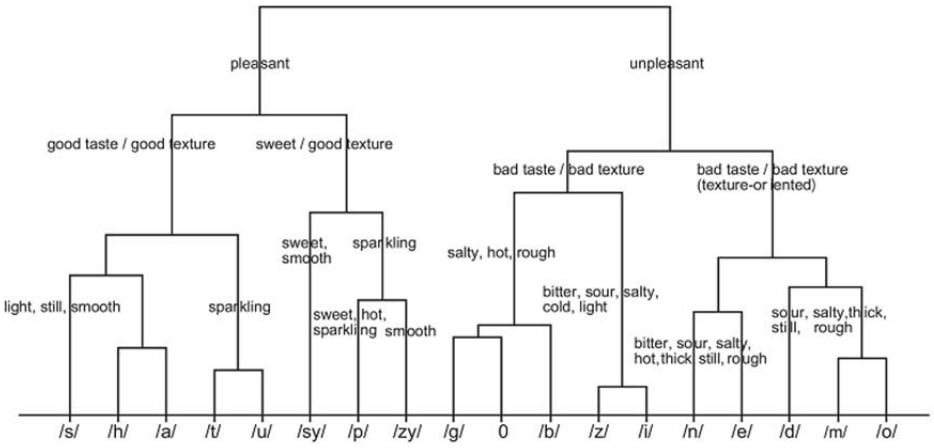
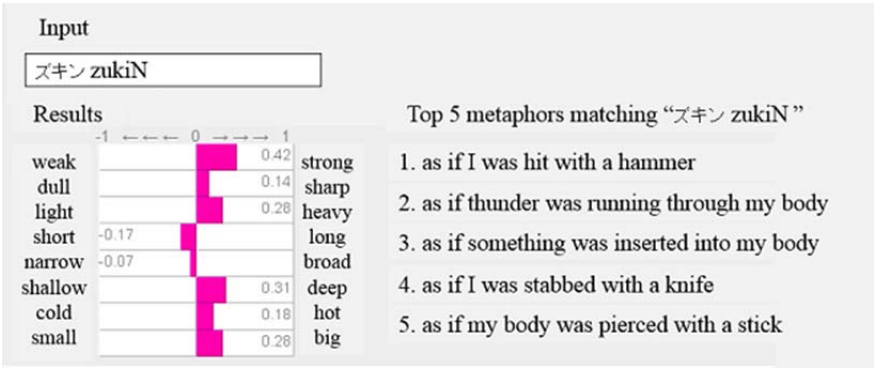


A cluster of phonemes related to the sensation of tasting.



An output of the system that automatically suggests metaphors related to onomatopoeia.

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Biophotonics: Using light sensitive proteins as artificial retinas

The light sensitive receptor protein, bacteriorhodopsin (bR) is readily extracted from the cell membrane of *Halobacterium salinarum*--rod shaped organisms that give the purple color to the water of salty lakes. Since the discovery of bR pigments in the early 1970s, it has been used by scientists for studying the functions of cells, as well applications in nanophotonics.

Now, Yoshiko Okada-Shudo, associate professor at the Graduate School of Informatics and Engineering, is exploiting the optical properties of bR for the development of biophotonic devices and systems for real-life applications.

Future plans include combining bR based optical filters and high speed image processing for detecting defects in electronic circuits and quality control in industrial manufacturing.

Research highlights

Bacteriorhodopsin based artificial retina-motion sensors for robot vision

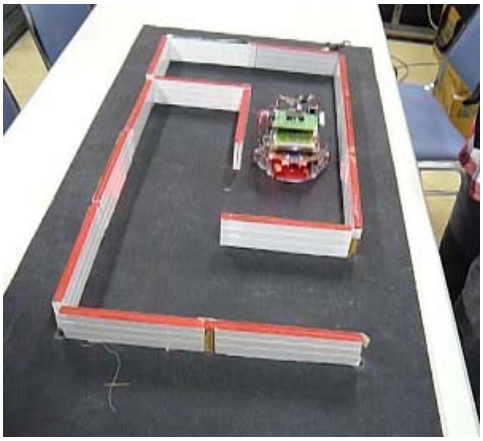
This project is focused on the development of single element human-eye-like photocell based systems for motion detection. Initial tests with autonomous maze-navigating robots showed promise for robot vision applications with a robust response to rapidly moving objects [1].

Bacteriorhodopsin proteins for innovative filters for receptive fields

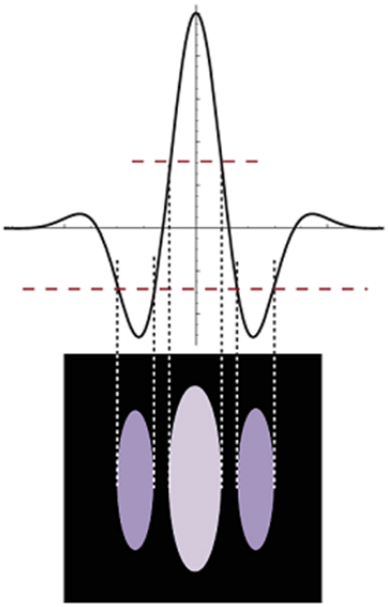
The goal of this research is the development of patterned Gabor and DOG optical filters for improving the image processing performance of receptive fields. Notably, the low cost and simplicity of fabricating single element bR filters, and no requirement for external connections are two of the major advantages over conventional silicon semiconductor technology [2].

References

[1] Yoshiko Okada-Shudo, Daiki Kawamoto, Yun Zhang, Masayoshi Watanabe, Katsuyuki Kasai and Kazuo Tanaka, Robot vision using biological pigments, 27 December 2012, *SPIE Newsroom*.
DOI: 10.1117/2.1201212.004599
[2] Yoshiko Okada-Shudo, Tokimasa Tanabe, Takayuki Mukai, Takuma Motoi and Katsuyuki Kasai, Protein-based optical filters for image processing, 7 October 2015, *SPIE Newsroom*.
DOI: 10.1117/2.1201509.006132



Autonomous maze-navigation robot with two biophotosensors based on the



The structure of an on-center Gabor filter that mimics a simple cell receptive

Associate Professor: Yoshiko Okada-Shudo (Doctor of Engineering from Yokohama National University 1990/03)
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The University of Electro-Communications
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Special seminar on atmospheric physics by Dr Chiao-Yao She, Emeritus Professor of Colorado State University, USA.

Dr Chiao-Yao She shared his insights into the measurement and implications of atmospheric temperature and wind velocities in his seminar entitled, "LIDAR capability for atmospheric temperature and wind measurements and enabled MLT science studies".

In Lidar (Light Detection and Ranging) a powerful laser light is irradiated upwards into the earth's atmosphere and the scattered light collected by sensitive detectors on earth to analyze the metallic composition, temperature, and wind velocity of specific layers of the atmosphere. Notably, UECs Takuo Tsuda, assistant professor at the Department of Computer and Network Engineering, who organized the seminar, is an expert on Lidar studies of the properties of metals such as sodium and potassium found at around 100 km above the earth's surface due to meteors breaking apart as they enter the atmosphere.

Dr She explained the physical principles of Lidar highlighting his own approach in the development of his own unique Lidar systems for the analysis of light scattering spectra for the measurement of atmospheric temperature and wind velocity.

According to Dr She, in the early days of his research it was only possible to detect scattered light at night but development of methods based on narrow band filters for exclusion of optical noise from sunlight led to the realization of continuous measurements over 24 hours at regions between 80 km to 105 km.

Dr She finished his seminar by giving his vision of future trends in atmospheric research. After the seminar Dr She joined the audience for a lively discussion about the topics covered during the seminar.

Related information on research by Takuo Tsuda, Department of Computer and Network Engineering, UEC, Tokyo.

UEC e-Bulletin article about Takuo Tsuda's research on Lidar and analysis of metals in the earth's atmosphere: "Geophysics: Insights into the origins of sodium and other metallic layers in the Earth's upper atmosphere"
http://www.ru.uec.ac.jp/e-bulletin/topics/2015/geophysics.html

UEC Tenure Track Program Meeting including research by Takuo Tsuda: "2015 Tenure Track Research Reports Meeting"
http://www.ru.uec.ac.jp/e-bulletin/topics/2016/2015-tenure-track-research-reports-meeting.html

Recent publications by Takuo Tsuda:

1. S.-i. Oyama, K. Shiokawa, Y. Miyoshi, K. Hosokawa, B. J. Watkins, J. Kurihara, T. T. Tsuda, and C. T. Fallen, Lower thermospheric wind variations in auroral patches during the substorm recovery phase, J. Geophys. Res. Space Physics, 121, doi:10.1002/2015JA022129, 2016.
2. T. T. Tsuda, S. Nozawa, T. D. Kawahara, T. Kawabata, N. Saito, S. Wada, C. M. Hall, M. Tsutsumi, Y. Ogawa, S. Oyama, T. Takahashi, M. K. Ejiri, T. Nishiyama, T. Nakamura, and A. Brekke, A sporadic sodium layer event detected with five-directional lidar and simultaneous wind, electron density, and electric field observation at Tromsø, Norway, Geophys. Res. Lett., 42, 9190-9196, doi:10.1002/2015GL066411, 2015.
3. T. T. Tsuda, X. Chu, T. Nakamura, M. K. Ejiri, T. D. Kawahara, A. S. Yukimatu, and K. Hosokawa, A thermospheric Na layer event observed up to 140 km over Syowa Station (69.0ºS, 39.6ºE) in Antarctica, Geophys. Res. Lett., 42, 3647-3653, doi:10.1002/2015GL064101, 2015.

Assistant Professor: Takuo TSUDA (Doctor of Science from Nagoya University 2009/03)
Takuo Tsuda's website: http://ttt01.cei.uec.ac.jp/

Takuo Tsuda and colleagues conduct Lidar measurements of the atmosphere in the arctic circle.

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Masumi Taki edits special issue of Current Topics in Medicinal Chemistry

Masumi Taki, an associate professor at the Department of Engineering Science, UEC, Tokyo, has completed editing and publication of a special edition of the journal *Current Topics in Medicinal Chemistry (CTMC)*.

The contents focus on research being conducted at UEC, Tokyo on "Chemical and Biological Technology for in-Vivo and Molecular Imaging". The full contents will be available on line soon.

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Associate Professor: Masumi Taki (Doctor of Engineering from Gunma University, 1998/03)
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Current research subjects: Artificial-molecule evolution on T7 bacteriophage (10BASEd-T), phage display, cyclic peptide, artificial antibody, artificial molecule, evolution.
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Current Topics in Medicinal Chemistry (CTMC):
http://benthamscience.com/journals/current-topics-in-medicinal-chemistry/

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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