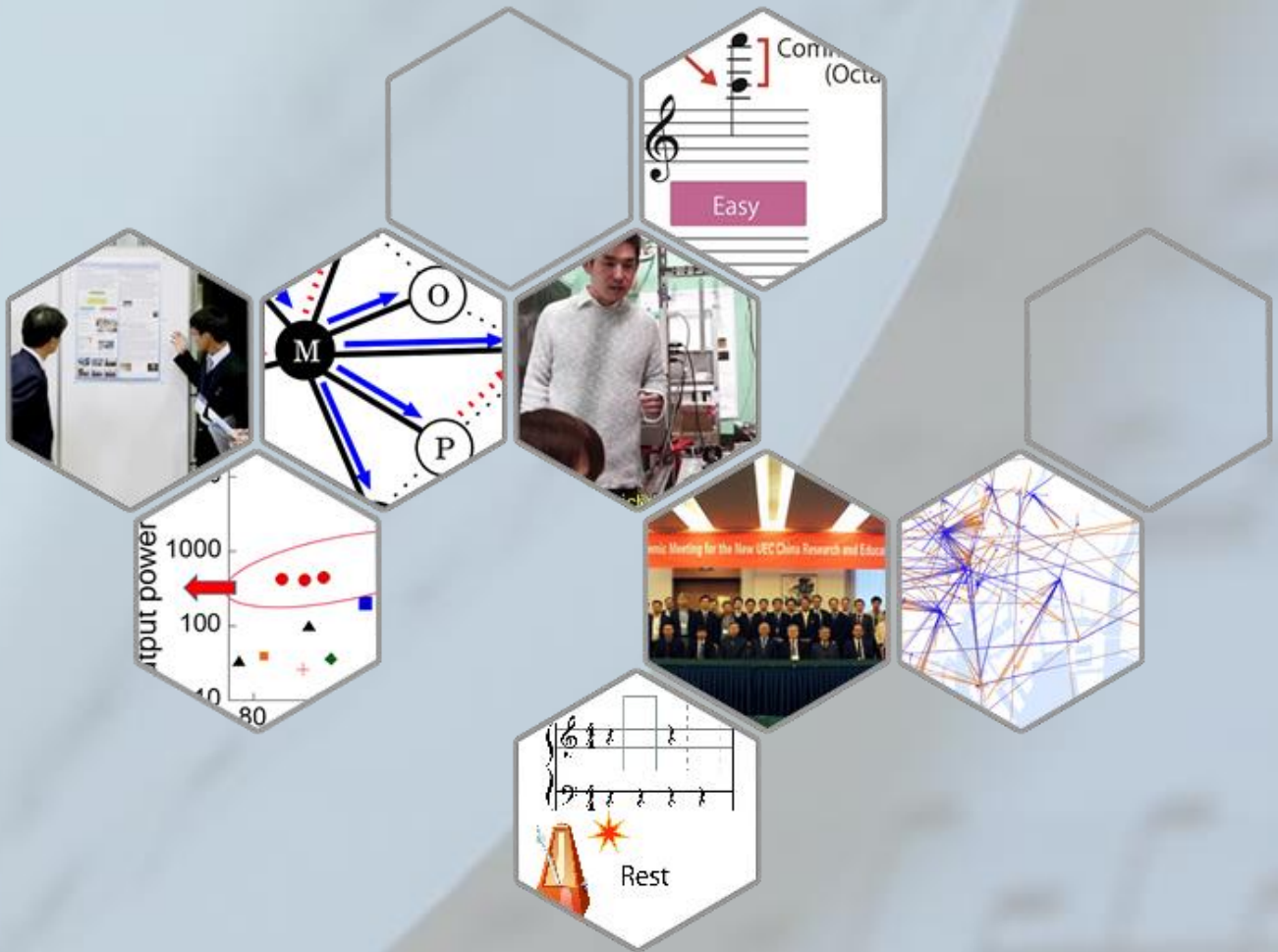


# UEC e-Bulletin

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

Vol.16, December 2017



## Research Highlights

---

- Hierarchical Opportunistic Routing with Moderate Clustering for Ad Hoc Networks
- Kerr-lens mode-locked Tm doped sesquioxides laser in-band pumped by an Er:Yb fiber MOPA 1.6  $\mu\text{m}$
- Geospatial information extraction from SNS: Who said what from where!
- Information science offers insights into the performance of pianist: Efficiently reading piano musical scores by analyzing geometrical information in musical notes

## Researcher Video Profiles

---

- Eriko Aiba, Assistant Professor, Department of Mechanical and Intelligent System Engineering
- Hideyuki Fujita, Assistant Professor, Graduate School Informatics and Computer Engineering
- Masaki Tokurakawa, Assistant Professor, Institute for Laser Science
- Ryo Yamamoto, Assistant Professor, School of Informatics and Engineering

## News and Events

---

- UEC signs general agreement with VNU-UET, Vietnam
- Opening Ceremony of the UEC China Research and Education Center
- The Irago Conference 2017 held at UEC, Tokyo

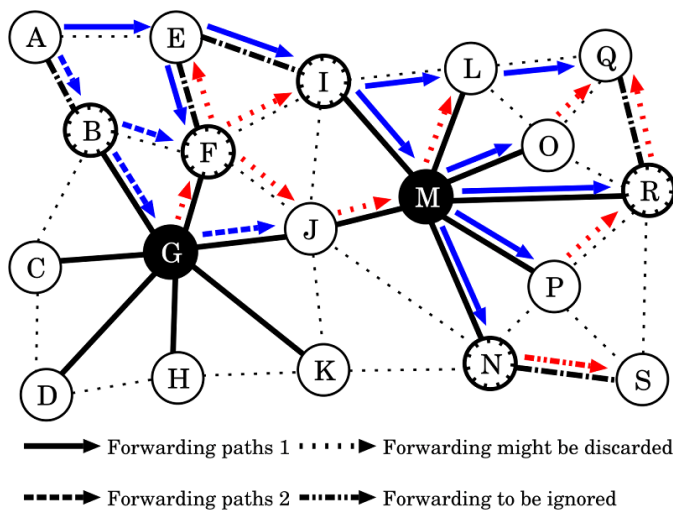
## Hierarchical Opportunistic Routing with Moderate Clustering for Ad Hoc Networks

The self-organizing nature of ad hoc networks generally has an advantage that the networks are free from fixed infrastructures such as APs (Access points). However, this also has a disadvantage that the networks are unstable and unreliable compared with wired and fixed communication.

Although there are a lot of routing protocols to overcome the drawbacks of ad hoc networks, route-based packet forwarding of the protocols suffer from the adaptation problem due to dynamic topology changes.

Ryo Yamamoto and colleagues at The University of Electro-Communications, Tokyo, describe a novel routing paradigm called Opportunistic Routing (OR), which is broadcast-based forwarding scheme and does not rely on a specific route to improve route diversity and end-to-end reliability.

The main difficulty of OR adaptation in ad hoc networks is its forwarding decision done by each node since the eligibility confirmation might be difficult in autonomous and distributed environment. Thus, we introduce a concept of clustering and hierarchization into OR to make Cluster Heads (CHs) as a guide to forward packets toward destination nodes.



Forwarding procedure of the proposed method (CHOR).

Computer simulations reveal that the proposed method could utilize the advantages of OR concept eliminating its drawbacks. Namely, it could achieve higher delivery ratio with less packet forwarding compared with existing conventional ORs.

The results also imply the proposed method could be utilized in various kinds of environment if the guide could be found properly.

## Reference



- Authors: Ryo Yamamoto, Satoshi Ohzahata, and Toshihiko Kato.
- Title of original paper: A Hierarchical Opportunistic Routing with Moderate Clustering for Ad Hoc Networks.
- Journal, volume, pages and year: IEICE Transaction on Communications, Vol.E100-B, No.1, pp.54-66, Jan. 2017.
- Digital Object Identifier (DOI): 10.1587/transcom.2016CQP0007
- Affiliations: Graduate School of Informatics and Engineering, The University of Electro-Communications.
- Department website: [http://kjk.office.uec.ac.jp/Profiles/67/0006622/prof\\_e.html](http://kjk.office.uec.ac.jp/Profiles/67/0006622/prof_e.html)

## Kerr-lens mode-locked Tm doped sesquioxides laser in-band pumped by an Er:Yb fiber MOPA 1.6 μm

Highly efficient high power short pulse lasers at the wavelength range of 2 μm based on Tm<sup>3+</sup> doped materials have a variety of applications such as material processing, LiDAR, mid-infrared OPOs for wavelengths up to 12 μm, or mid-infrared supercontinuum generation. They also would enable direct coherent soft X-ray generation by high order harmonics generation.

For these applications, a light source with much higher conversion efficiency, average power, pulse energy, and shorter pulse duration is desirable.

Now, Masaki Tokurakawa and colleagues at Institute for Laser Science, University of Electro-communications, Tokyo, have developed novel 2 μm high power short pulse lasers based on new technique of fiber laser in-band pumping and Kerr-lens mode locking with a new Tm doped gain medium provided from University of Hamburg, Dr. Christian Kränkel.

Pulses as short as 115 fs and output power of 420 mW with conversion efficiency of ~20% were obtained. Compared with prior SESAM mode-locked Tm doped lasers pumped by Ti:Al<sub>2</sub>O<sub>3</sub> lasers, this new method enabled generation of much higher output power and shorter pulse duration with higher conversion efficiency (Fig.1).

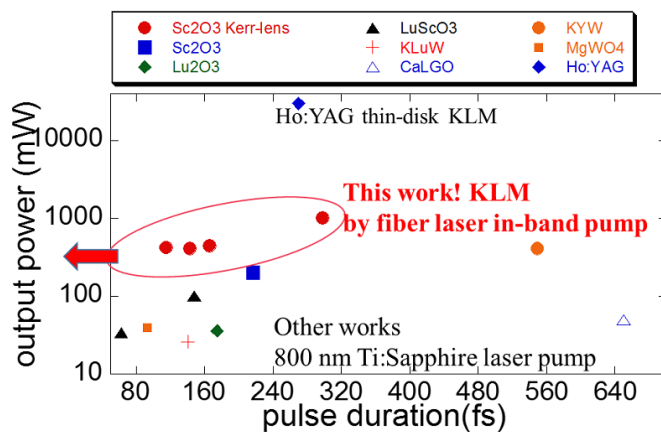


Fig.1. Output powers of Tm doped short pulse laser as a function of pulse duration.

This is the first Kerr-lens mode-locking at a wavelength of 2 μm and it opens up possibilities for new highly efficient high power short pulse lasers at 2 μm. In the future, sub 50 fs pulse generation at this wavelength range would be possible.

## Reference



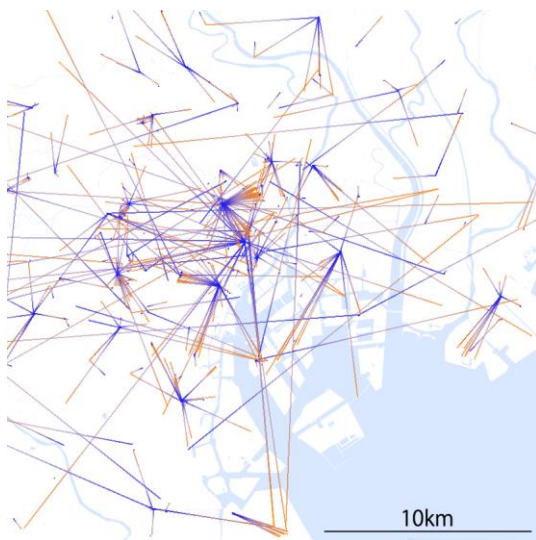
1. M. Tokurakawa, E. Fujita, and C. Kränkel, "Kerr-lens mode-locked  $\text{Tm}^{3+}:\text{Sc}_2\text{O}_3$  single-crystal laser in-band pumped by an Er:Yb fiber MOPA at 1611 nm," *Optics Letters*, 42, 3185-3188 (2017).
2. E. Fujita, Y. Mashiko, S. Asaya, M. Musha, and M. Tokurakawa, "High power narrow-linewidth linearly-polarized 1610 nm Er:Yb all-fiber MOPA," *Optics Express* 24, 26255-26260 (2016).

## Geospatial information extraction from SNS: Who said what from where!

Social media is expected to be a good source of data for analyzing human behavior and statuses of locations. It is possible to provide location-based information simply by geospatially filtering archived data.

However, this naive approach causes problems for practical applications. For example, with Twitter, in general, the location from which a tweet is posted is attached to a geotagged tweet. Specifically, the location coordinates attached to the geotagged tweet, "Heavy rain in Miura Peninsula" by NHK (Japan's public broadcaster) are not those of the Miura Peninsula, but of Shibuya in Tokyo, where NHK is located. Therefore, the tweet is be found by a spatial search around the Miura Peninsula or even Kanagawa Prefecture, where the Miura Peninsula is located.

Hideyuki Fujita at the University of Electro-Communications, Tokyo has proposed a new framework that considers the relationships between data meaning and their spatial structures.



From where (orange) about what place (blue) people in Tokyo post.

In this research, Fujita particularly focused on the distinction between locations of interest (LoI) and locations of activity (LoA). In example above, Miura Peninsula is LoI and Shibuya is LoA. Fujita proposed a method for automatically classifying tweet locations into LoI and LoA.

The evaluation experiment that used 600,000 tweets showed good results about the precision and recall of the classification. The method was also successfully applied to extract frequently mentioned locations while classifying them into those which were globally mentioned and those locally mentioned.

The results imply that this method could be applied to analyzing the relationships between location names and the signified locations.

## Reference



- Authors: Hideyuki Fujita.
- Title of original paper: Information extraction and visualization from Twitter considering spatial structure.
- Journal, volume, pages and year: *Cartographica* **52-2**, 178 (2017).
- Digital Object Identifier (DOI): 10.3138/cart.52.2.3875
- Affiliations: Graduate School of Informatics and Engineering, The University of Electro-Communications.
- Department website: <http://www.uec.ac.jp/>



## Information science offers insights into the performance of pianist: Efficiently reading piano musical scores by analyzing geometrical information in musical notes

Musical scores for piano usually have a large number of notes and instructions, such as marks indicating expression, articulation, and accidentals. When pianists sight-read sheet music, they must decode such information instantly and transform it into finger actions and movement. However, it is still not clear how pianists are able to achieve such fast decoding.

Now, Eriko Aiba and Yutaka Sakaguchi at the University of Electrocommunications, Tokyo (UEC, Tokyo) have investigated the kinds of clues used by professional pianists for the efficient score reading that is necessary to play complex musical arrangements eloquently and without mistakes. Aiba and colleagues hypothesized that the common patterns of multiple notes--for example, octave, chord, scale and arpeggio--and geometrical information--distance between two notes--are more useful compared with logical information, such as the number of ledger lines (Figure 1).

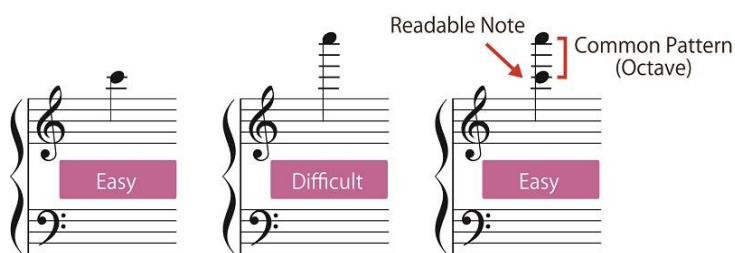


Figure 1: Example of the hypotheses.

Sixteen professional pianists participated in the experiment with the task of answering the target notes presented on a display by striking the corresponding keys on a hybrid piano. The target notes were of three types: a single note, an octave interval, and a seventh interval. The seventh interval played a role as a perturbation stimulus to avoid that the participants realize all target notes including two notes are the octave interval. The target notes were presented as quarter notes on a one-bar length grand staff at the second beat position of a four-four time measure (Figure 2).

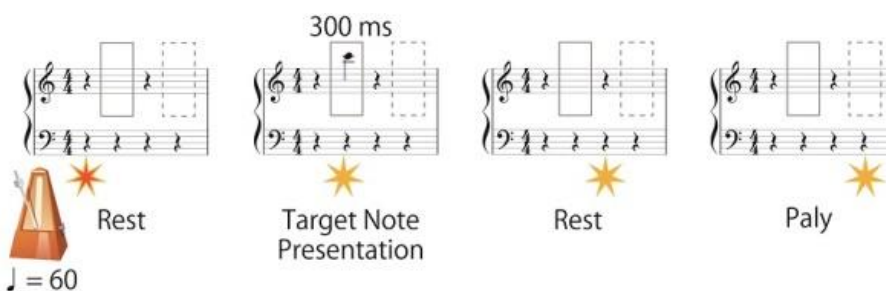


Figure 2: Experimental procedure in one trial.

The experiments showed that the pianists could read octave intervals for a wider range of key positions compared to single notes.

All the other results suggested the existence of a strong connection between the geometric information and pianists' actions, which may be presumably have been formed through long-term training.

## Reference



- Authors: Eriko Aiba, and Yutaka Sakaguchi.
- Title of original paper: Visual information for efficient score reading by pianists.
- Journal, volume, pages and year: *Proceedings of International Symposium on Performance Science 2017 (ISPS2017)*, 46, 2017.
- Digital Object Identifier (DOI):
- Affiliations: Department of Mechanical and Intelligent Systems Engineering, Graduate School of Informatics and Engineering, University of Electro-Communications..
- Department website: [http://www.uec.ac.jp/eng/education/ie\\_graduate/m/index.html](http://www.uec.ac.jp/eng/education/ie_graduate/m/index.html)

---

## Eriko Aiba, Assistant Professor, Department of Mechanical and Intelligent System Engineering

---

### How the brains of musicians work while playing musical instruments and multimodal information processing.

Eriko Aiba, Assistant Professor, Department of Mechanical and Intelligent System Engineering

Assistant Professor Aiba is studying how the brains of musicians work while playing musical instruments and their strategies for processing huge amounts of multimodal information in parallel. In particular, musicians who use sight reading must process enormous amounts of information. Specifically, they must read the score, interpret the music, and search for the correct keys to play while planning the motion and control of their fingers. So one of the important areas of research is understanding how professional musicians complete such complicated information processing.



Furthermore, musicians have their own strategy in playing, even though it may appear that they all playing the piano in the same way. Notably, Eriko Aiba thinks that the strategies of musicians are not completely different, because many musicians display common traits. "In the future I would like to categorize professional musicians based on the type of information processing strategy used by their brains," says Aiba. "It may help musicians to find their own suitable ways of learning to play musical instruments."

This research is expected to contribute to many areas of research areas in exploring expertise and performance.

#### Further information

Eriko Aiba, Assistant Professor, Ph. D. (Musicology)  
Department of Human Media Systems, Graduate School of Information Systems  
The University of Electro-Communications, Tokyo.

Website:

<https://sites.google.com/site/aebaeriko/>

Research Highlight:

<http://www.ru.uec.ac.jp/e-bulletin/research-highlights/2017/information-science-offers-insights-into-the-performance-of-pianist.html>

---

## Hideyuki Fujita, Assistant Professor, Graduate School Informatics and Computer Engineering.

---

### Development of interactive software using geospatial information

Hideyuki Fujita, Assistant Professor, Graduate School Informatics and Computer Engineering.

Hideyuki Fujita is an expert on the development of interactive software using geospatial information. His motivation is to analyze data from consumer generated media to understand locations and human behavior.

In a recent project, he has mapped geotagged photographs to arrows indicating from where to where each photo was taken. In this framework, he has proposed new methods for creating street view animation, spatial search based on spatial relationships, and geospatial storytelling environment. "We will put more focus on the spatial and semantic structures of geospatial information," says Fujita.



### Further information

Hideyuki Fujita

Assistant Professor, Graduate School Informatics and Computer Engineering.

The University of Electro-Communications, Tokyo.

Website:

<http://www.is.uec.ac.jp/staff/list/fs/fujita-hideyuki.html>

Research Highlight:

<http://www.ru.uec.ac.jp/e-bulletin/research-highlights/2017/geospatial-information-extraction-from-sns.html>

---

**Masaki Tokurakawa, Assistant Professor, Institute for Laser Science.**

---

**Controlling light and atoms: Development of new short pulse lasers in the wavelength range of two micrometers**

Masaki Tokurakawa, Assistant Professor, Institute for Laser Science.

Masaki Tokurakawa is aiming to control 'light and atoms'. His research is focused on laser physics, laser engineering and atomic optics, with one specific research topic being the development of new short pulse lasers in the wavelength range of two micrometers. This wavelength range of short pulse lasers have potential applications including laser welding of polymer materials, three dimensional processing of silicon materials, generation of mid-infra-red coherent pulses by nonlinear frequency conversion, and generation of coherent soft X-rays by high order harmonics generation. For these applications it is necessary to improve the conversion efficiency, average power, and pulse duration of the lasers. "Recently, we have developed a new thulium (Tm) doped solid state laser with a new laser gain medium and Kerr-lens mode-locking," says Tokurakawa. "This device has a much shorter pulse duration and higher output power than previous reports."

**Further information**

Masaki Tokurakawa, Assistant Professor, Institute for Laser Science,  
The University of Electro-Communications, Tokyo.

Website:

<http://www.ils.uec.ac.jp/~tokura/index.html>

Research Highlight:

<http://www.ru.uec.ac.jp/e-bulletin/research-highlights/2017/kerr-lens-mode-locked-tm-doped-sesquioxides-laser-in-band-pumped-by-an-er.html>

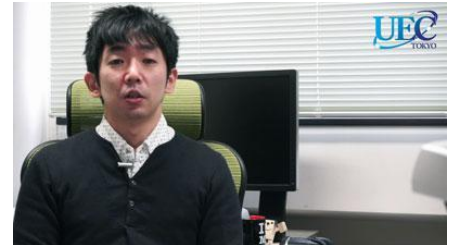
---

## Ryo Yamamoto, Assistant Professor, School of Informatics and Engineering

---

### Wireless communication and wireless multi-hop networks with inter-device communication to deliver messages to destinations

Ryo Yamamoto, Assistant Professor, School of Informatics and Engineering



Ryo Yamamoto's research is centered on wireless communication, with emphasis on so-called wireless multi-hop networks. Generally, wireless communication is considered to be communicating by connecting via an access point or base station like wifi, wireless LAN, or cell phone. However, in Yamamoto's research on wireless multi-hop networks, devices relay communications with each other, and deliver them to the destination. "I think that most people are not familiar with this form of communication. However, it is considered very useful for technology such as internet of things IoT," says Yamamoto. Yamamoto is mainly studying routing technology, in particular how to make a route, who will relay it and so on.

#### Further information

Ryo Yamamoto, Assistant Professor, School of Informatics and Engineering,  
The University of Electro-Communications, Tokyo.

Website:

<http://www.is.uec.ac.jp/staff/list/ns/yamamoto-ryo.html>

Research Highlight:

<http://www.ru.uec.ac.jp/e-bulletin/research-highlights/2017/hierarchical-opportunistic-routing-with-moderate-clustering-for-ad-hoc-networks.html>

## UEC signs general agreement with VNU-UET, Vietnam

On 29 November, 2017, The University of Electro-Communications (UEC) signed general agreement with VNU University of Engineering and Technology (VNU-UET), Vietnam to promote further international collaboration.

The signing ceremony took place at UEC and Prof. Nguyen Viet Ha, the Rector of VNU-UET, Dr. Fukuda, the President of UEC, Dr. Nakano and Dr. Tanaka, the executive board members of UEC, Prof. Abe, the vice president, Prof. Ishibashi, and Prof. Pham the professors of UEC attended the ceremony. The meeting was initiated by the welcome speech of President Fukuda. Followed by Prof. Ishibashi's research presentation, the active discussions were made on that topic and on promoting research collaboration and student exchange between the two universities.

VNU-UET is one the seven universities of VNU which has affirmed its position as Vietnam's top comprehensive multi-disciplinary academic and research center of excellence based on international standards.

UEC believes the conclusion of the agreement is a valuable opportunity to promote deeper and wider cooperation with excellent researchers of VNU-UET leading UEC to further internationalization and strengthening the quality of its education and research.



## Opening Ceremony of the UEC China Research and Education Center

On October 1,2017, UEC opened the UEC China Research and Education Center in Beijing to consolidate and further strengthen the education and research collaboration with universities, institutions and companies in China. We held an opening ceremony at the Beijing Friendship Hotel on October 19, and had distinguished guests from Shanghai Jiao Tong University (SJTU), Shenyang University of Institute (SUT), Beijing Institute of Technology (BIT), Nankai University (NKU), Chinese Academy of Sciences and the UEC Alumni Association MEGUROKAI. The roles of this Center are as followings;

- Promote the Joint Education Projects
- Invite excellent students and researches
- Organize researcher and student exchanges
- Promote for Collaborative Project
- Provide support to apply for exchange programs among China and

Japan



At the Academic Meeting



President Fukuda at the UEC China Research and Education Center

The meeting call of this opening ceremony was initiated by the Member of the Board of directors of UEC, Dr. Nakano, and President of UEC, Dr. Fukuda gave a greeting address. Then, our honored guest Prof. Zhihong YANG from BIT gave a congratulatory address and Prof. Yokoi presented histories and results of our collaboration and explained about the purpose and works of this center. Prof. Shi from BIT gave explanation about the Beijing Advanced Innovation Center for Intelligent Robots and Systems (BAICIRS) where this center is located. After this, the Vice President of UEC Prof. Abe gave a closing talk.

In the Reception, President Prof. Fukuda gave opening remarks, and Deputy Director of BAICIRS Prof. Huang gave a congratulatory speech from the guest of honor, and the Director of R&D Center for Green Energy Automotive Electronics, Prof. Chen gave a toast. Furthermore, The Chairman of the UEC Alumni Association MEGUROKAI Mr. Nonomura gave an introduction of Megurokai and expressed support for this center. The reception was closed by a speech from Dr. Tanaka, the Member of the Board of directors and the Vice President of UEC.



## The Irago Conference 2017 held at UEC, Tokyo

The Irago Conference 2017 was held 1-2 November 2017 at the UEC, Tokyo Auditorium. This was the 7th in this series of conferences focused on providing a platform for networking between scientists, graduate students, and policy makers to interact and share ideas to find solutions for some the major issues of the 21st century.

This core theme of this year's conference was "Challenges in Materials Science", and the proceedings included 16 invited speakers; 5 contributed oral talks; short, 5 minute talks by the 9 participants of the Premium Poster Session; 17 talks during the lunch time Graduate Student Session; and 77 poster presentations. A total of 150 participants attended the conference over the two days including the invited speakers from Beijing, Germany, Italy, UK, Singapore, and Japan.

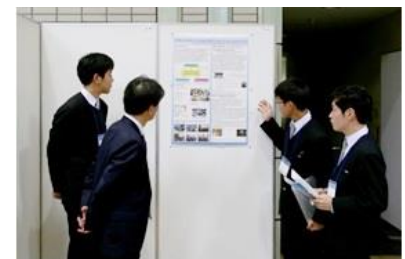
In addition to the scientists and graduate students, high students from Seiko Gakuin High School in Kanagawa Prefecture, also participated in the conference, giving a poster presentation and actively asking questions during the sessions.

During the evening of the 1st November, the participants moved to the Keio Plaza Hotel in Shinjuku, for the "AAAS Science Fall Meeting 2017/Irago Conference 2017 Evening Session". This session included talks by guests from MEXT, the headmaster of Seiko Gakuin High School, representatives from Science Magazine, and the director of a sake brewer from Akita who described the process of producing fine Japanese sake.

Irago Conference 2018 is schedule for 1-2 November 2018 at the UEC, Tokyo Auditorium.



Group photograph of participants during the morning session on 1 November 2017.



Students from Seiko Gakuin High School describing their research during the poster session.



Takashi FUKUDA, President of UEC, Tokyo gives a speech at the "AAAS Science Fall Meeting 2017/The Irago Conference 2017 Evening Session".

## The University of Electro-Communications (UEC) in Tokyo

is a small, luminous university at the forefront of pure and applied sciences, engineering, and technology research. Its roots go back to the Technical Institute for Wireless Communications, 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.

International Public Relations

The University of Electro-Communications

1-5-1 Chofugaoka, Chofu, Tokyo 182-8585

E-mail : [kokusai-k@office.uec.ac.jp](mailto:kokusai-k@office.uec.ac.jp)

Website : <http://www.uec.ac.jp/eng/>

U . E . C .