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TOYOHASHI UNIVERSITY of TECHNOLOGY
e-Newsletter
News and views from one of Japan's most innovative and dynamic science and technology-based academic institutes

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Features 2

Toyohashi Tech's Overseas Education Base in Penang, Malaysia

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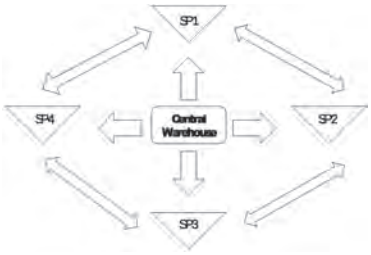
News



Research Highlights

Tech-Overtures

Club Activities

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Toyohashi Tech's Overseas Education Base in Penang, Malaysia

Atsunori Matsuda, Director of International Education Center.

Toyohashi Tech has recently established an overseas education base in Penang, Malaysia in co-operation with Universiti Sains Malaysia (USM). The educational facilities—housed in a refurbished heritage-looking mansion in Penang—were officially opened in December 2013. Toyohashi Tech is entrusted to implement the Globally-Oriented Human Resources Development Program within the framework of the government-sponsored "Tri-Institutional Collaborative Educational Reform Project" in partnership with Nagaoka University of Technology (NUT) and National Institute of Technology (KOSEN). Malaysia is multi-cultural country with multi-national companies, including many globally orientated Japanese companies within easy reach of the campus.

The project offers many opportunities to initiate academic collaboration and the development of a wide range of international programs with governmental organizations, local public and private tertiary educational institutions in Penang. Moreover, Penang is the perfect place not only for the students but also staff to experience a multi-ethnical environment. Toyohashi Tech has been welcomed by the people of Penang with high expectations in terms of initiating educational programs to support Malaysia's needs for advanced engineering, technology management, and efficient utilization of human resources.

Atsunori Matsuda is the Director of International Education Center (CIE) and presidential advisor on international affairs. CIE is one of three international centers, established under the Global Network Innovation of Technology Education (IGNITE) of Toyohashi Tech. The mission of the CIE is to manage the education base in Penang (Toyohashi Tech Penang) and implement global programs in Penang. "All support from the partners of Toyohashi Tech is indispensable to forge a strong collaborative partnership with organizations in Malaysia and Japan," says Matsuda.

Activities at Toyohashi Tech Penang

1) Annual IGNITE conference collaboratively held with USM. The 2nd IGNITE conference will be held on 14-16 Dec 2014.

2) As part of the International Internship Program the first batch of 21 students (16 Japanese and 5 Malaysians) were dispatched to Japanese and multi-national companies Jan-Feb 2014. Also plans for an initiative for longer internship period of 6 months are on-going.

3) International Summer School Program (August 31st - September 6th), where 14 Japanese students had participated in this program utilizing Toyohashi Tech Penang to have exposure and opinion exchange with USM students based on environmental life science themes.

4) TUT-USM Global Summer School (Leading Program, September 9th - 21th) where 16 students had participated in this program (8 TUT and 8 USM medical school students. The photograph shows participants from TUT and USM at the summer school.

5) TUT-USM Collaborative meetings to assess collaborative projects and future plans.

6) Collaborative research hub not only with academic institutions but also industry.

Future plans for Toyohashi Tech Penang

With the establishment of Toyohashi Tech Penang is expected to lead to more research collaboration with academic institutions and industrial companies, global education and international internship. Furthermore, the selection of Toyohashi Tech for the Top Global University Project by MEXT will propel Toyohashi Tech Penang towards achieving its global status as a global education Hub in South-East Asia. Prior to IGNITE 2014 conference on December 15-16, an alumni meeting and gathering co-hosted with Tri-Institutional University reform will be held on December 13 at Toyohashi Tech Penang. Also Toyohashi Tech Penang is proposed to be an educational platform through twinning degree program in collaboration with local universities in Malaysia.

As for industrial collaboration, Toyohashi Tech Penang serves as a hub for its continuously expanding research collaborations with not only Japanese companies but also multi-national companies in Penang. TUT is looking to extend the internship period to 6 months from the current 2 months.

These activities underline the importance and the active role of Toyohashi Tech Penang. This education base is set to be the focus hub for more activities in near future.

Toyohashi Tech's Education Base in Penang, Malaysia

Toyohashi Tech was selected as one of 37 Japanese universities to participate in MEXT's "Top Global University Project"

Toyohashi Tech has been actively endeavoring to respond to the various challenges for university reform being put forward by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), being selected to participate in a number of innovative MEXT driven projects. In 2012 it was selected for the National University Reform Enhancement Project, and in 2013 for the Leading Graduate School Program as well as the Program for Promoting the Enhancement of Research Universities. By putting these programs into practice, Toyohashi Tech aims to raise its global profile to the point that it becomes recognized worldwide as a leading international university. Thanks in part to its efforts in this regard, Toyohashi Tech applied for, and was selected to take part in, the Top Global University Project under the category of Global Traction Type (Type B).

In order to achieve the goals of this project, Toyohashi Tech will create a truly multicultural campus which will help foster high quality engineers with thoroughly international sensibilities. These 'Global Technology Architects' will be able to apply their advanced technological skills and scientific training to global issues, and their leadership skills and vision to getting the job done in the real world of industry. The following initiatives will be taken to realize this.

"Creative Campus for Nurturing Global Technology Architects"

- Global Technology Architects course
- Multicultural Boarding House
- Global capability upgrade of all students, faculty members and university staff

Further information

Toyohashi Tech website: http://www.tut.ac.jp/english/news/201410/4230.html

President Takashi Onishi is reelected as the head of the Science Council of Japan

Dr. Takashi Onishi, president of Toyohashi Tech

Dr. Takashi Onishi, president of Toyohashi Tech, was reelected as the President of the Science Council of Japan (SCJ) on 1st October 2014.

President Onishi has been the president of SCJ since October 2013, before being appointed the president of Toyohashi Tech in April 2014. He concurrently holds the two positions.

Furthermore, Professor Hiromi Nakano, at the Cooperative Research Facility Center of Toyohashi Tech, was appointed a member of SCJ on 1st October 2014.

The Science Council of Japan represents Japan's scientists across all fields including humanities, social sciences, life sciences, natural sciences, and engineering.

Further information

Science Council of Japan http://www.scj.go.jp/en/

Conference report: First International Conference on Advanced Informatics: Concepts, Theory and Applications (ICAICTA 2014)

Seiichi Nakagawa, Professor, Organization for Leading-graduate-school Program

The First International Conference on Advanced Informatics: Concepts, Theory and Applications,(ICAICTA 2014), which was jointly organized by Informatics Research Group, School of Electrical Engineering and Informatics, Institute of Technology Bandung (ITB) and Department of Computer Science and Engineering, Toyohashi University of Technology (Toyohashi Tech), was held at ITB' campus in Indonesia during 20th and 21nd, August, 2014. The ICAICTA conference aimed to bring together Indonesian, Japanese and international academicians, scientists and industrialists for knowledge sharing, exchange of ideas, collaborations and presentation of their research outcomes in informatics field.

There were 165 submissions with authors from 11 countries around world. All submissions were peer-reviewed by three reviewers for each and finally 65 papers were presented at three oral parallel sessions. The number of attendance was 80 (see the picture). Twenty one faculty members of Toyohashi Tech cooperated in reviewing the papers, Professor Isahara (Toyohashi Tech) was invited as a Keynote Speaker and 12 papers from Toyohashi Tech were presented by 11 graduate students and a faculty member. Professors Nakauchi and Nakagawa (Toyohashi Tech) served as one of General Chairs (the other was

Professor Kistijantoro, ITB) and Chairs of Steering Committee (the other was Professor Supriana, ITB), respectively.

Through the discussion with 6 faculty members attended from Toyohashi Tech and ITB faculty members, it was agreed to hold the conference every year. It is expected that this conference will grow up as one of major informatics conferences at Asia.

Summer Events 2014 at Toyohashi Tech Penang: International Training Program and Global Summer School Program

Toyohashi Tech sent 14 students to the TUT-USM Technology Collaboration Centre in Penang (Toyohashi Tech Penang) for two summer events with students from Universiti Sains Malaysia (USM).

An international training program for the 14 selected undergraduate students was held from 31st August to 6th September. The students discussed various topics with 17 USM students and also visited the USM campus, companies with a global presence, a world heritage in Penang.

Global Summer School for students in Leading Graduate School Program started from 7th September. Jointly with USM students, they participated in debates and practical training during the two week summer school.

These two events provided the students a good opportunity to learn about different cultures, languages and lifestyle, and also to think about how to collaborate with international partners as global engineers.

USM website: http://summerschoolblog.com/

International Training Program

Global Summer School for students in Leading Graduate School Program

Disaster logistics and inventory: Controlling disaster relief operations

Disaster relief is a mandatory operation after natural disasters that involves several stakeholders including national governments, NGOs, and donors. Two of the major concerns in disaster relief operations is logistics and inventory.

However, chaotic conditions after natural disasters lead to imbalances in the levels of inventory between warehouses of disaster shelters.

Nur Budi Mulyono and Yoshiteru Ishida at Toyohashi University of Technology have developed a method called 'relief lateral transshipment' to balance inventory levels of respective warehouses.

The design of the transshipment model is based on a spatial version of the so-called Prisoner's Dilemma in game theory. Three options for transshipment were evaluated: without transshipment, with fully transshipment, and with partial transshipment. And, each of these options can be update their strategy according to three preferences:

Nur Budi Mulyono

maximum payoff, static support, and dynamic support.

The best option was found to be the partial transshipment with dynamic support updating. This strategy increased the performance of relief inventory by 50% and reduced the logistic frequency by 20% for volcanic eruption disaster relief.

This research showed that balancing inventory levels under chaotic conditions after natural disasters can be achieved by partial support from other warehouse shelters.

Reference:

- Authors: Nur Budi Mulyono and Yoshiteru Ishida.
- Title of original paper: Spatial strategy of disaster relief inventory.
- Journal, volume, pages and year: *International Journal of Innovative Computing Information and Control* Vol 11 No 2 (April 2015).
- Affiliations: School of Business and Management, Bandung Institute of technology Indonesia. Department of Computer Science and Engineering, Toyohashi University of Technology.

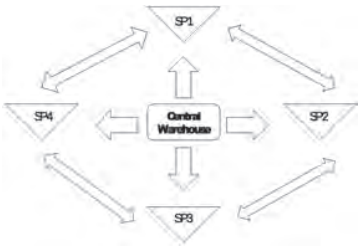

Fig.1: Lateral Transshipment.

Fragment-based molecular evolution for drug design and discovery

Evolutionary algorithms are actively used for computerized molecular design. But the method often results in many unfavorable structures that contain invalid hetero—hetero atomic bonds such as O—O and N—F.

For this reason, it is required to explore candidate molecules that are expected to have desirable drug actions as well as being chemically feasible.

Yoshimasa Takahashi at Toyohashi Tech and colleagues at Kaken Pharmaceutical Co. Ltd. have reported a similarity-driven simple evolutionary approach to producing candidate molecules that are structurally similar to a reference molecule and yet somewhat different in peripheral chains and/or scaffolds.

Yoshimasa Takahashi

The method employs a known active molecule of interest as the reference molecule which is used to navigate a huge chemical space. The initial set of individual structures is prepared with seed fragments and additional fragments using the connection rules defined in advance. The fragment library is preferably prepared from a collection of known molecules related to the target of the reference molecule. New individuals are produced by the crossover and the fragment mutation with the fragment library. In the work, a total of 97,084 bioactive molecules with 313,980 assays recorded in GPCR

SARfari of ChEMBL were used to prepare the fragment library.

Computer experiments for exploring GPCR ligands with their own fragment library verified the feasibility of this approach to drug discovery.

The method could be used to explore chemically feasible candidate molecules and scaffolds in the huge chemical space for the discovery of a new drug of interest.

Reference:

- Authors: Kentaro Kawai[1], Naoya Nagata[1] and Yoshimasa Takahashi[2].
- Title of original paper: De novo design of drug-like molecules by a fragment-based molecular evolutionary approach
- Journal, volume, pages and year: *J. Chem. Inf. Model.*, 54, 49-56 (2014).
- Digital Object Identifier (DOI): 10.1021/ci400418c
- Affiliations: [1]Central Research Laboratories, Kaken Pharmaceutical Co. Ltd.; [2]Department of Computer Science and Engineering, Toyohashi University of Technology.
- Department website: http://www.cs.tut.ac.jp/

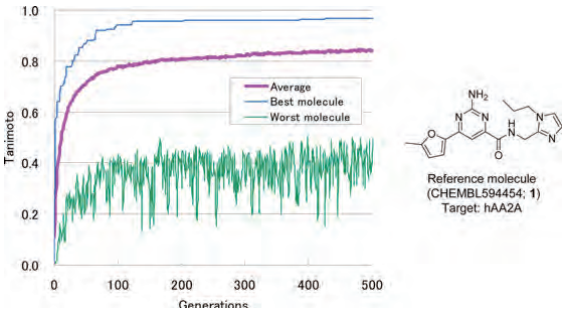

Fig.1: Fitness curve in the computational trials of the molecular evolution for the target of hAA2A with the reference molecule 1. The red line shows the total average of the ten trials. The blue line shows that for the best molecule and the green for the worst molecule.

Finding achilles' heel of GaN-based LED in harsh radiation environments

Gallium nitride (GaN) based devices are attractive for harsh environment electronics because of their high chemical and the mechanical stability of GaN itself that has a higher atomic displacement energy than other semiconductor materials.

However, degradation mechanisms of GaN device under radiation environments is not clear mainly because devices consist of many different types of semiconductors, such as p-type and n-type layers in light emitting diode (LED), and each layer has different hardness to radiation.

Now, researchers at the Electronics-Inspired Interdisciplinary Research Institute (EIIRIS) and Department of Electrical and Electronic Information Engineering at Toyohashi University of Technology, and the Japan Atomic Energy Agency (JAEA) describe the physical mechanism of an observed increase in the resistance of p-type GaN irradiated with 380 keV protons compared with n-type GaN.

The GaN-based LED structure shown in Fig.1 was irradiated with protons and the resulting electrical properties measured. Notably, the electrodes to measure the resistance of the p-type and n-type layers were produced independently using the clean room facilities at EIIRIS and the ion implanter in JAEA.

Hiroshi Okada

The two terminal resistance of the n-type GaN did not vary from its initial value after $1x10^{14}$ cm^{-2} proton irradiation, and remained of the same order after $1x10^{15}$ cm^{-2} protons. However, a clear increase of the resistance was found in the p-type GaN after $1x10^{14}$ cm^{-2} irradiation. The resistance increased further by six orders of magnitude after $1x10^{15}$ cm^{-2}.

The observed increase of the resistance in p-type GaN is explained as being due to the lower initial carrier density than in n-type GaN due to a lack of efficient p-type doping technology for GaN, which is a key for the realization of novel devices operable in harsh environments.

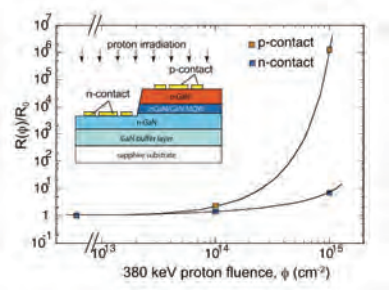

Fig.1:Two-terminal resistance of p- and n-type GaN as a function of proton fluence. Inset shows schematic of the sample and the lines are guide for ease of understanding.

Reference:

- Authors: Hiroshi Okada, Yuki Okada, Hiroto Sekiguchi, Akihiro Wakahara, Shin-ichiro Sato, and Takeshi Ohshima.
- Title of original paper: Study of Proton Irradaition Effects on p- and n-Type GaN Based-on Two-Terminal Resistance Dependence on 380 keV Proton Fluence.
- Journal, volume, pages and year: *IEICE Transactions on Electronics* E97-C, 409 (2014).
- Digital Object Identifier (DOI): 10.1587/transele.E97.C.409
- Affiliations: Electronics-Inspired Interdisciplinary Research Institute (EIIRIS), and Department of Electrical and Electronic Information Engineering, Toyohashi University of Technology, and Japan Atomic Energy Agency (JAEA)
- Department website: http://www.eiiris.tut.ac.jp

High efficiency electrodeposited ZnO-Nanowire/Cu_2O photovoltaic devices

The wide bandgap energy and high optical absorption coefficient of oxide photovoltaic devices are attractive properties for next generation thin film device applications, especially as top cells in high performance multi-stacked solar cells.

However, the conversion efficiency oxide photovoltaic devices is low compared with theoretical estimates with the result that current commercial solar cells are produced using Si and Cu(InGa)Se_2.

Here, in an international collaboration between Toyohashi University of Technology (Toyohashi Tech) and Centre National de la Recherche Scitenfique (CNRS), Ecole Nationale Superiure de Chimie de Paris (ENSCP), ZnO nanowire (NWs) were used to expand the active layer in the Cu2O light-absorbing layer and in the highly resistive i-ZnO layer to reduce the recombination loss at the heterointerface of ZnO/Cu_2O photovoltaic devices.

The ZnO-NWs was electrodeposited onto a transparent conductive glass substrate at CNRS, and then i-ZnO and Cu_2O layers were electrochemically stacked onto the ZnO-NWs at Toyohashi Tech for complete the fabrication of a photovoltaic device.

The introduction of the ZnO-NWs and the i-ZnO layer yielded an increase in the short circuit currenrt density and an improvement of the conversion efficiency of solar cells to 1.26 % which is higher than the 0.47 % reported today.

Masanobu Izaki

The results demonstrate show the importance of the heterointerface on the performance of oxide photovoltaic devices as solar cells.

Acknowledgements

This research was conducted with financial support from the Japan-France Integrated Action Program (SAKURA) of the Japan Society of Promotion of Science (JSPS).

Reference:

- Authors: Masanobu Izaki, Takayuki Ohta, Misaki Kondo, Toshiaki Takahashi, Fariza binti Mohamad, Mohd Zamzuri, Junji Sasanoi, Tsutomu Shinagawa, Thierry Pauporte
- Title of original paper: Electrodeposited ZnO-Nanowire/Cu^2O Photovoltaic Device with Highly Resistive ZnO Intermediate Layer.
- Journal, volume, pages and year: *American Chemical Society Applied Materials & Interface*, 6, 13461-13469(2014).
- Digital Object Identifier (DOI): 10.1021/am502246j
- Affiliations: Department of Mechanical Engineering, Toyohashi University of Technology, and Ecole Nationale Superiure de Chimie de Paris.
- Department website: http://tf.me.tut.ac.jp

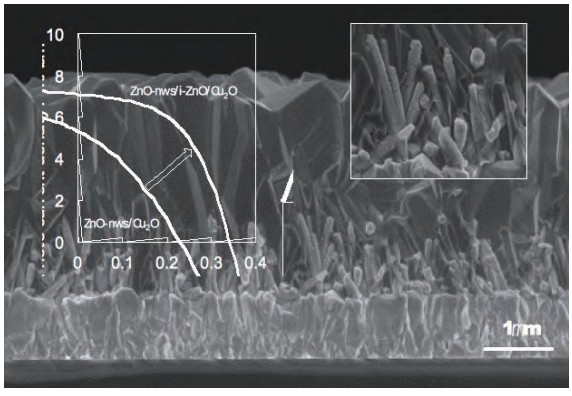

Fig.1: Integrated circuit with ZnO nanowires.

High photosensitivity few-layered $MoSe^2$ back-gated field-effect phototransistors

Two-dimensional (2D) layered materials are now attracting a lot of interest due to their unique optoelectronic properties at atomic thicknesses. Among them, graphene has been mostly investigated, but the zero-gap nature of graphene limits its practical applications. Therefore, 2D layered materials with intrinsic band gaps such as MoS_2, $MoSe_2$, and $MoTe_2$ are of interest as promising candidates for ultrathin and high-performance optoelectronic devices.

Here, Pil Ju Ko and colleagues at Toyohashi University of Technology, Japan have fabricated back-gated field-effect phototransistors made of $MoSe_2$ crystals having a thickness of only twenty nanometers. The devices were fabricated by mechanical cleavage of $MoSe_2$ crystals into few-layered flakes, followed by transfer onto a silicon wafer with predeposited titanium electrodes.

Despite their ultra-thin physical size, the devices showed excellent field-effect phototransistor characteristics. The measured photoresponsivity of 97.1 AW^{-1} at zero back gate voltage was higher than previous reports of photodetectors fabricated using GaS, GaSe, MoS_2, and InSe. The photoresponse of the $MoSe_2$ was much faster (less than 15 msec) than ultrasensitive photodetectors based on monolayer MoS_2. Furthermore, the theoretical external quantum efficiency was 280-fold higher than of commercial Si and InGaAs photodiodes.

The research shows that $MoSe_2$ is a promising material for photodetector applications. The group is optimization the device performance by studying thickness-dependent of the photosensitivity.

Pil Ju Ko

Reference:

- Authors: Abdelkader Abderrahmane, Pil Ju Ko, Tran Viet Thu, Shunji Ishizawa, Tsukasa Takamura and Adarsh Sandhu.
- Title of original paper: High photosensitivity few-layered $MoSe^2$ back-gated field-effect phototransistors.
- Journal, volume, pages and year: *Nanotechnology* 25 365202 (1-5) (2014).
- Digital Object Identifier (DOI): 10.1088/0957-4484/25/36/365202.

- Affiliations: Electronics-Inspired Interdisciplinary Research Institute (EIIRIS) and Department of Electrical and Electronic Information Engineering, Toyohashi University of Technology, 1-1 Hibarigaoka, Tempaku, Toyohashi, Aichi 441-8580, Japan
- Department website: http://www.sandhu.jp/

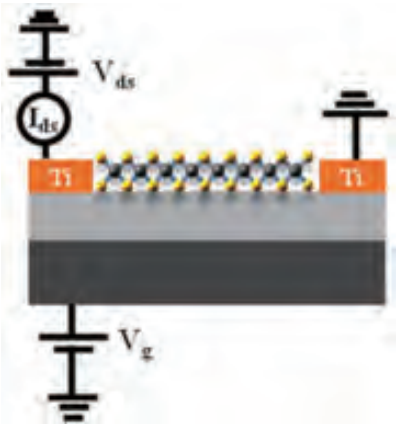

Fig.1: Schematic structure of the few-layered MoSe2 FETs.

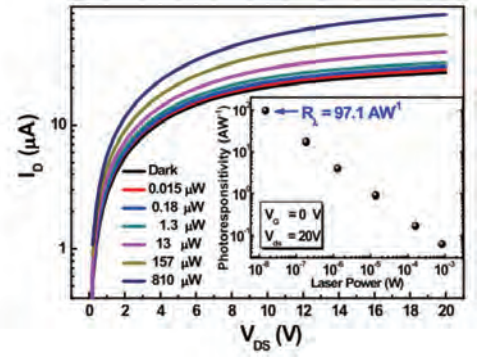

Fig.2:Laser power dependence of the drain current versus the drain-source voltage at zero gate voltage. Inset: photoresponsivity extracted from the Id-Vds characteristic.

Virtual handshake: Electronic gadget for shaking hands over the internet

Takanori Miyoshi

Toyohashi Tech's Takanori Miyoshi has developed an innovative gadget that enables people to 'shake hands' over the internet, irrespective of their location (Fig.1 and Fig.2).

Miyoshi recently displayed his handshake gadget in April 2014 at the 2014 Niconico Chokaigi, Tokyo. "We connected people located in Japan and Taiwan," says Miyoshi." The participants in Tokyo included Japan's Prime Minister."

Notably, approximately 96% of the participants showed 'excitement for the device' and more than 65% could feel 'mutual force and motion'.

The handshake gadget developed by Miyoshi is simple, and constructed using components readily available on the internet. The main parts include the well-known Falcon haptic device, a force sensor, and tele-control algorithm.

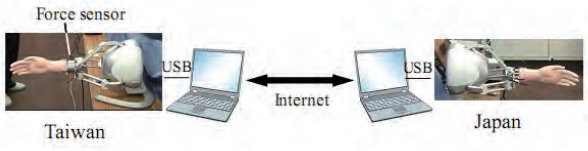

Fig.1 The main parts of the internet based handshaking system.

However, the development of the handshake system demanded the resolution of a problem related to 'howling' in the control electronics that led to instability in the 'virtual handshake'. This problem can be understood as being similar to the loud howling noise that is sometimes generated when two microphones come too close together in an auditorium.

"I solved the problem of howling by constructing a unique low pass filter," explains Miyoshi. This is the triangular component shown as 'Ws(s) in Fig. 2. "The filter keeps the gain at less than unity, and thereby prevents instabilities in the circuit."

Miyoshi intended to develop the handshake system for applications including internet games, remote surgery to give doctors greater feeling during surgical procedures, and hand operated robotic arms used in nuclear power stations managing radiative materials.

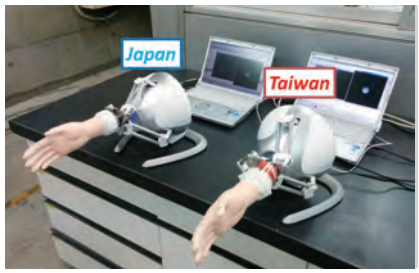

Fig.2 The internet based handshake system connecting Japan and Taiwan.

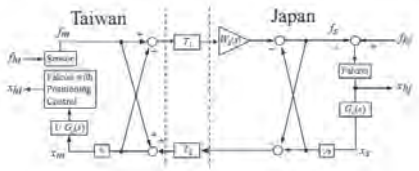

Fig.3 showing the low pass filter developed by Takanori Miyoshi to prevent 'howling' in the handshake system.

Toyohashi Tech Table Tennis Club

According to Daichi Takahashi—a third year student at Toyohashi Tech studying mechanical engineering—table tennis is, "exciting yet not stressful, and energetic enough to provide plenty of excise, but not overly so." In other words, it's just right.

Takahashi is the captain of the Toyohashi Tech Table Tennis Club. His role is to organize the fifteen members in practice sessions and to participate in competitions.

"We meet three hours twice a week," says Takahashi. "Most of our time is spent playing and practicing." These sessions are held in the gym, where the tables provided by the university are stored and brought out each time.

There are competitions every three months or so, with the most important being the Tokai Regional National University Table Tennis Tournament. "So far, we haven't won, but we intend do better," says Takahashi.

His interest in the sport began in junior high school. Given there are no PE classes at university, he was eager to take the sport up again because, "It's important to exercise and take care of your health."

All levels of players are welcome. "We don't have a coach, but our best players will help beginners, as well as give feedback to each other," he explains.

Toyohashi Tech allocated a day at the beginning of the academic year for the student circles to meet and promote their activities to newcomers. Takahashi likes to point out that table tennis is a sport where you have to use your mind as well as your body. "You have to decide instantly where best to hit the ball and be ready to react to the return." In other words, it's a sport that literally demands you having to think on your feet.