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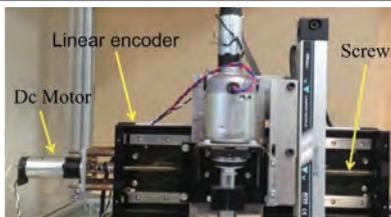
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The Toyohashi University of Technology (Toyohashi Tech) is one of Japan's most innovative and dynamic science and technology based academic institutes. The Toyohashi Tech e-Newsletter (TTeN) is published to update readers on news, research and other activity at the university.
 Chairman: Takaaki Takashima, International Cooperation Center for Engineering Education Development (ICCEED)
 Chief Editor: Adarsh Sandhu, Electronics-Inspired Interdisciplinary Research Institute (EIIRIS)
 Koichi Katsurada, Center for International Relations (CIR)
 Yuko Ito, Research Administration Center (RAC)
 Shizuka Fukumura, International Affairs Division
 Tomoko Kawai, International Affairs Division

Toyohashi University of Technology

1-1 Hibarigaoka, Tempaku
 Toyohashi, Aichi Prefecture, 441-8580, JAPAN
 Enquiries: Committee for Public Relation
 E-mail: press@office.tut.ac.jp
 TEL: +81-532-44-6577 or +81-532-44-6546
 FAX: +81-532-44-6557
 Website: <http://www.tut.ac.jp/english/>

Strong will to succeed

Professor Makoto Ishida is the Director of the Toyohashi University of Technology Research Administration Center (RAC), set up to implement the projects in the MEXT 'Program for Promoting the Enhancement of Research Universities' launched in September 2013: 'Value Creation Engineering' for creating new industries.

It is noteworthy that the selection procedure for the MEXT Program for Promoting the Enhancement of Research Universities was top-down, based on objective metrics, including citations, income from technology transfer and research funding from competitive grants. "Toyohashi Tech was selected as one of 22 outstanding research universities and research institutes *MEXT Research Enhancement Program*," says Professor Ishida. "This acknowledges our research to-date, and the contributions of the Electronics-Inspired Interdisciplinary Research Institute (EIIRIS), the engine at Toyohashi Tech driving the 'research university'."

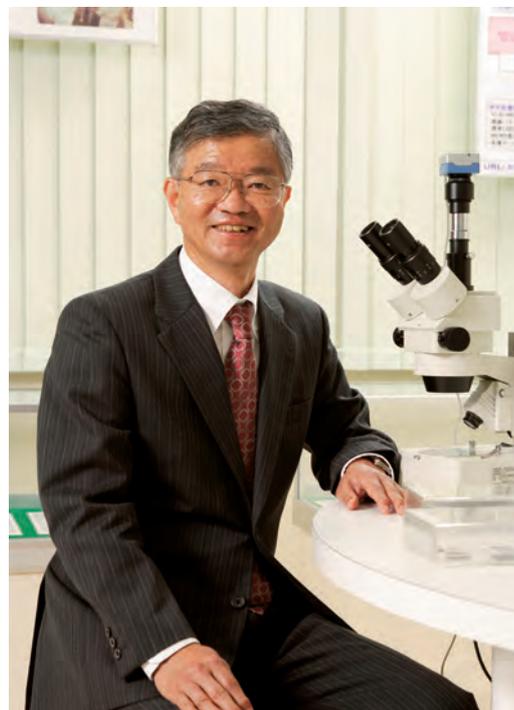
The 'Value Creation Engineering' project is managed by the Research Administration Center (RAC)—set up on 1 December 2013—which includes the University Research Administration (URA) Office.

The creation of 'new industries' is one of the major objectives of the Toyohashi 'Value Creation Engineering' project. "Our University has an excellent record

in technology transfer," explains Ishida. "We want to build on this by linking up with global partners to generate ideas for new innovative industries." Toyohashi Tech will use its expertise in interdisciplinary research and EIIRIS to achieve these goals. The project will entail collaboration with research institutes and companies globally; hiring research staff and students from overseas; and reforms in the personal system.

The title of our project is 'Value Creation Engineering'. The project will focus on devising methods for creating positive value of nominally negative assets. For example, using waste to create valuable assets such as biofuels, and extending the functions of our CCD imaging devices to universal self-diagnosis healthcare biosensors.

"One of the most important factors to achieve the goals of this project will be "strong will" of our staff to move forward to face the challenges that lie ahead," says Professor Ishida. "I recently listened to a truly inspiring seminar by Hiroichi Yoshida, president of ELIY Power Co.,



Professor Makoto Ishida

Ltd. His company is a leader in the manufacture of large-size lithium ion batteries and electricity storage systems. I was amazed to hear that he started his company with four partners when he was 69 years old. And, incredibly, none of them had any experience in the field of power storage. He said that the success of the company was their "strong will to succeed". Likewise, the success of this project will also depend on a strong will to move forward."

The International Conference of Global Network for Innovative Technology 2014 (IGNITE2014) in Penang, Malaysia

The International Conference of Global Network for Innovative Technology 2014 (IGNITE2014) was held 14-16th December 2014. The conference jointly organized - by the Universiti Sains Malaysia (USM) and Toyohashi Tech to present the results of recent advances a wide range of fields covering applied technology. This was the second time that this conference was held, with the first one being 2013 during the the opening of Toyohashi Tech's Malaysian education base.

In addition to researchers and students from USM, there were many participants

from multinational corporations doing business in Penang. As a result, a total of more than 100 people attended, including researchers and students from Japan.

An opening ceremony was held at the Hotel Jen Penang on 14 December 2014 day before the conference. On 15-16 December the participants moved to Toyohashi Tech's Malaysian education base, where two keynote lectures were given, 70 oral and poster presentations made, and tutorial sessions for young researchers conducted, and very active discussions ensued. Toyohashi Tech's Taichi Goto,

assistant professor at the Department of Electrical and Electronic Information Engineering, received the most outstanding presentation award on the last day.



Participants of IGNITE2014

Toyohashi Tech overseas alumni meet at Penang Campus

A meeting was held on 13 December 2014 at the Toyohashi Tech Penang Campus (Penang, Malaysia) to establish the overseas branch of Toyohashi Tech alumni. Notably, 33 overseas Toyohashi Tech alumni—from Malaysia, Indonesia, Vietnam, Thailand, Laos, and Pakistan—



Toyohashi Tech alumni overseas branch establishment meeting

participated in the meeting. Alumni from Japan and Toyohashi Tech staff also participated. The participants discussed procedures for electing representatives of alumni of each country, recommendations of candidates from Japan for liaison with the overseas branch, and management of the overseas alumni directory.

After the meeting, Tri-Institutional (Nagaoka University of Technology (NUT), National Institute of Technology (KOSEN) and Toyohashi Tech) collaborative overseas alumni meeting was held in Northam All Suite Penang (Penang, Malaysia). The meeting was supported by the Tri-Institutional Collaborative/Cooperative Educational Reform Project, a National University Reform Enhancement Promotion Project launched by MEXT.



Tri-institutional collaborative overseas alumni meeting

In addition to overseas alumni from Toyohashi Tech, the overseas alumni from NUT and KOSEN, representatives from Tri-Institutions and Toyohashi Tech staff and students also participated in the meeting and exchanged opinions about holding future exchange events and organizing the Tri-Institutional alumni network. More than 100 participants deepened their friendship in the social gathering held after the meeting.

The Irago Conference 2014 A 360 degree outlook at critical scientific and technological challenges for a sustainable society

The Irago Conference 2014 was held 6-7 November 2014 at the National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Ibaraki, Japan. The Conference was organized jointly by the Electronics-Inspired Interdisciplinary Research Institute (EIIRIS) at Toyohashi University of Technology and AIST. The major goal of the conference is to enhance mutual understanding between scientists, engineers and policymakers. Highlighting the increasing awareness for an interdisciplinary approach to research, Irago 2014 attracted approximately 200 participants in the one and a half day meeting.

Papers submitted for publication in the proceedings of The Irago Conference 2014

will be refereed and those accepted will be published in the AIP Conference Proceedings of the American Institute of Physics (AIP).

One of the most anticipated speakers was Dr Chiaki Mukai, Japan Aerospace Exploration Agency (JAXA), Japan, who shared her experiences of space flight and insights into "Space medicine is the ultimate preventive medicine".

Highlights of the conference related to advances in life sciences included talks by: Professor Roger Reddel, University of Sydney, on "Telomeres: Opportunities for Targeted Cancer Therapies"; Makoto Asashima, National Institute of Advanced Industrial Science & Technology (AIST), A

simplified view of the complexity of cell stemness, development and differentiation"; Anne L. Plant, National Institute of Standards and Technology, "Measurement of Biological Activity of Cells: Challenges for research and manufacturing"; Joanna Groden, Ohio State University, "Inherited Susceptibility to Cancer: Lessons in Cancer Biology"; Shivendra Singh, University of Pittsburgh Cancer Institute, "Naturally GREEN Cancer Chemorevention"; Renu Wadhwa, AIST, "Indian Ayurvedic Herb-Ashwagandha for Cancer Treatment"; Yoshihiro Ohmiya, AIST, "Mystery of Bioluminescence"; Chae-Ok Yun, Hanyang University, Korea, "Adenovirus/Nanomaterial Complex for Cancer Gene Therapy".

More general topics, such as interdisciplinary research and national projects, were covered by speakers including Ryoji Chubachi, Director of AIST, "Electronics-Inspired Strategies for Basic and Applied Research"; Makoto Ishida, Toyohashi University of Technology, "Interdisciplinary Research at EIIRIS"; T. Madhan Mohan, Department of Biotechnology, India, "Merger of Biotechnology and Bioinformatics" — "Strategic development by the Department of Biotechnology, Government of India"; Listyani Wijayanti, Agency for the Assessment and Application of Technology, Indonesia, "Current Status of Biotechnology in Indonesia"; Shin-ichi Yamamoto, Okayama University, Japan, "Development of Interdisciplinary Sciences at Okayama University — Progress, Trend and Future Prospect".

Experts in fields of research not related to medicine and the life sciences included: Yasuhiro Iwasawa, University of Electro-Communications, Japan, "Intriguing insights into how catalysts behave in automobile fuel cells by advanced XAFS techniques"; Hideki Komatsu, Bridgestone Corporation, Japan, "Tire Technology for the Future"; Jian-Ren Shen, Okayama University, Japan, "An approach to clean, renewable energy source — Water oxida-



tion by a natural catalyst photosystem II". The Graduate Student Session was held during the lunch break on 7 November 2014, with members of the audience given the task of selecting the best student speaker.

The Irago Conference 2015 is scheduled for 22-23 October 2015 at the Irago Sea-Park & Spa Hotel, Tahara City, Japan.

Information about previous Irago Conferences Irago

Conference website: <http://www.irago-conference.jp/index.html>

Toyohashi Tech International Student Program 2014

A meeting of the Toyohashi Tech International Student Program 2014 was held over five days from Monday 27 October to Friday 31 October, 2014. The meeting included 23 students from six overseas partner universities and 28 students from Toyohashi Tech.

On the first day, the visitors from overseas were given a tour of the campus, language class in basic Japanese, interacted with Toyohashi Tech students and faculty, and a welcome party.

Activities from the second day onwards involved students splitting up into six groups with Toyohashi Tech students (including international students) to discuss topics such as disaster prevention, future cities, and campus life. The visitors deepened their understanding of the research activities and lives of Toyohashi Tech students by visiting laboratories and observing research facilities and equipment as well as attending seminars.

With regards to activities outside the school, the students learned about the process of cleaning polluted water utilizing the power of microorganisms at the Toyogawa Sewage Treatment Center, and participated in a tea ceremony and flower arrangement as Japanese culture experiences. In addition, the students went on a field trip to the Toyota Commemorative Museum of Industry and Technology and learned about the development of Japanese industries and technology.

On the final day, each of the groups gave short presentations summarizing their experiences of the program. Although time was short, the students experienced many things, and the training course was rewarding for both the visitors and Toyohashi Tech students.

The program was conducted with some aid from the Sakura Exchange Program in Science of JST. Toyohashi Tech plans to continue to conduct the programs, that

will spark the interest of even more overseas students to come to Toyohashi Tech as international students.



Welcome party



Group discussion

Visitors to the Toyohashi University of Technology in 2014

- 17 Mar. 2014, Dato Seri Jamaludin Hasan, Member of the Board of Governors, Universiti Sains Malaysia, Malaysia, and 2 others
- 17 Apr. 2014, Dr. Prapat Wangskarn, Dean of Faculty of Engineering, Thammasat University, Thailand, and 3 others
- 25 Apr. 2014, Assoc. Prof. Dr.Krisada Visavateeranon, President, Thai-Nichi Institute of Technology, Thailand, and 2 others
- 23 Jun. 2014, Prof. Muhammad Basir

- Cyio, Rector, Tadulako University, Indonesia, and 10 others
- 17 Sep. 2014, Mr. Farukh Amil, a Pakistani Ambassador to Japan, Pakistan, and another
- 23 Oct. 2014, Dr. Achmad Wicaksono, Director of Quality Assurance Center, University of Brawijaya, Indonesia, and 5 others
- 4 Nov. 2014, Prof. Armin Züger, Head International Relations, School of Engineering, Zurich University of Applied

- Sciences, Switzerland, and another
- 28 Nov. 2014, Prof. John Hendri, Vice Rector for Planning and Cooperation, University of Lampung, Indonesia, and 3 others
- 9 Dec. 2014, Prof. Dwia Aries Tina Puluahu, Rector, Hasanuddin University, Indonesia, and 7 others
- 19 Dec. 2014, Ir. Ahmad Seng, MT, Dean of Engineering Faculty, Khairun University, Indonesia, and another

Industrial electronics: reducing the energy consumption of feed-drive systems

Servo systems are used in a wide variety of industrial applications for providing accurate, high-speed motion of mechanical components. Notably, the extensive use of servo systems necessitates careful management and reduction of their electrical power consumption. Therefore, as Abd El Khalick Mohammad and colleagues at the Toyohashi University of Technology explain in their report, “the reduction of the consumed energy by feed-drive systems has become an important issue in modern machining technology”.

The Toyohashi Tech team led by Naoki Uchiyama describe a new technique for enhancing the performance of ball-screw-driven mechanisms actuated by servo drives. The sliding-mode control is a known and effective method to drive systems subject to external disturbances, but reaching the target via a linear sliding surface strategy leads to overshooting—a significant waste of energy. The researchers demonstrated how a suitably designed non-linear sliding surface enables the variation of the system’s damping ratio to achieve fast response with small overshoot, thereby providing a smaller tracking error than conventional methods.

This innovative control routine was tested



Naoki Uchiyama

experimentally in a ball-screw feed-drive system driven by a dc servo motor. Comparison with standard linear methods demonstrated a 35% reduction in tracking error magnitude. Such enhanced accuracy paves the way for systematic energy savings, where by operating the system with a smaller control input voltage comparable performances were obtained with almost a 13% reduction in energy consumption.

Reference:

- A.E.K. Mohammad, N Uchiyama and S Sano.
- Reduction of Electrical Energy Consumed by Feed-Drive Systems Using Sliding-Mode Control With a Nonlinear Sliding Surface.
- *IEEE Transactions on Industrial Elec-*

tronics 61(6), 2875 (2014)

• doi:10.1109/TIE.2013.2275975

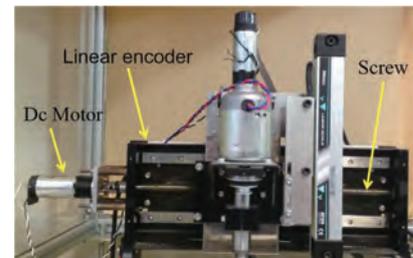


Fig.1: A novel non-linear sliding surface controller for ball-screw feed-drive systems was developed by researchers from the Toyohashi University of Technology. Servo-drive systems are widely used in industry, in particular for power efficiency applications.

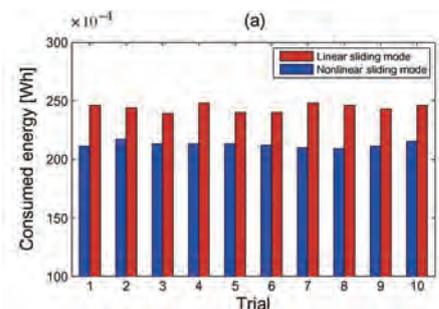


Fig.2: Non-linear sliding surface (blue) yields an energy reduction of approximately 13% compared to standard linear methods.

Chiral chemistry: catalysts benefit from polymer support

In industrial chemistry numerous processes hinge on a chemical’s “chirality”- a feature of the molecular structure that has implications on its chemical and optical properties. A great deal of work has gone into finding ways of selectively producing chiral chemicals. While chiral catalysts can improve pro-

duction efficiency under milder conditions, so far approaches for retrieving the catalysts from the product have mostly reduced the catalytic activity. Now Shinichi Itsuno, Yosuke Hashimoto and Naoki Haraguchi report how to immobilise industrially important chiral complexes on polymer supports

for re-use in effective chiral catalysis. Chirality describes a type of asymmetry whereby the molecular structure cannot be superposed on its mirror image (like your left and right hands). An example is the sweetener aspartame whose mirror image or alternative ‘enantiomer’ is tasteless. Chiral amines (organic

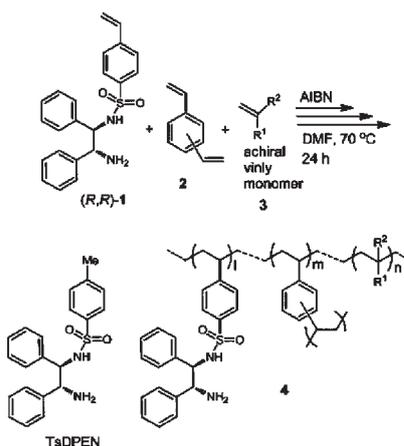
chemicals with an $-NH_2$ group) and their derivatives are particularly important intermediates and building blocks for the synthesis of biologically active molecules.

Itsuno and colleagues at Toyohashi University of Technology devised an approach for synthesising chiral complexes of iridium immobilized on a crosslinked polymer to catalyse hydrogenation of cyclic chemicals into chiral amines. Contrary to previous reports where polymer supports have inhibited catalytic activity they found the reaction rates were similar to the non-polymerised complex and the enantiomer selectivity was greater.

Experiments also demonstrated potential for chiral catalytic activity in aqueous environments. As the researchers point out in their report, "To our knowledge, this is the first example of a polymeric iridium catalyst for chiral amine synthesis."



Shinichi Itsuno



Reference:

- S. Itsuno, Y. Hashimoto, and N. Haraguchi.
- Synthesis of chiral iridium complexes immobilized on amphiphilic polymers and their application to asymmetric catalysis.
- Journal of Polymer Science A 52, 3037–3044 (2014)
- doi: 10.1002/pola.27351

Fig.1: Itsuno, Hashimoto and Haraguchi have synthesised an iridium complex crosslinked on a polymer support that can be effectively used to catalyse hydrogenation of cyclic nitrogen-containing molecules into chiral amines. N-toluenesulfonyl-1,2-diphenylethylenediamine (TsDPEN)-Ir-Cp* shown on the left still had high catalytic activity when crosslinked with polymers. Polymer crosslinking was achieved by introducing the achiral vinyl monomer ligand (3) in the presence of the crosslinking agent divinyl benzene (2) to produce polymeric chiral ligand (4).

Novel stability concept in miniaturized jet flames

Micro-engines and miniature combustion devices require carefully-designed micro-burners to produce stable miniature jet flames. The size of the burner leads to a strong interaction between the tip of the burner itself, the flame, and the gases in the air inside the burner. Flame stability problems are common because the burner itself can act as a heat sink, meaning the flame gradually dissipates energy before eventually going out.

In an attempt to verify the best conditions for generating steady flames, Yuji Nakamura (Toyohashi University of Technology) and Akter Hossain (Hokkaido University) examined numerically the stability of miniature hydrogen jet diffusion flames inside micro-burners made from different materials¹.

The researchers investigated the gaseous



Yuji Nakamura

components of the air surrounding the flame, as well as heat transfer within the solid parts of the burner itself. Numerical modelling helped Nakamura and Hossain determine the thermal and chemical characteristics of the jet flames resulting from different fuel ejection velocities, and thus assess flame stability.

A burner made from titanium, a relatively

poor conductor of heat, provided the hottest, yet stable flame. The team believe the use of low thermally conductive burner material created a unique flame structure brought on by heat recirculation, which

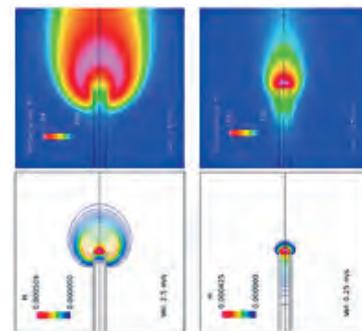


Fig.1: 2-D temperature and mass fraction of H-atom distributions for different fuel ejecting velocities ((a) $u_{in} = 2.5$ m/s and (b) $u_{in} = 0.25$ m/s) over titanium burner.

also enhanced reactivity within the burner. Pre-heating the fuel flow and adding oxygen to it stabilized the flame still further. It is important to reveal the fact that unique flame structure is established and even modified by adopting various burner mate-

rials taking advantage of thermal interaction to lead excess-enthalpy combustion.

Reference:

- A. Hossain and Y. Nakamura.
- Thermal and chemical structures

formed in the micro burner of miniaturized hydrogen-air jet flames.

- *Proceedings of the Combustion Institute* (2015)
- <http://dx.doi.org/10.1016/j.proci.2014.08.008>

Materials science: enhancing the ductility of bulk metallic glasses

Metals exist in nature as crystals with their atoms arranged in regular lattices. On the other hand, the atoms of so-called amorphous materials do not display any well-defined crystalline order, and often resemble the atomic structure of liquids. The most well-known of these amorphous materials is glass, but notably, rapidly cooling metals can also lead to an amorphous structure. Metals composed of more than one element are referred to as alloys, and their composition enables the possibility of creating thick samples of amorphous metals known as bulk metallic glasses. The lack of an ordered lattice structure endows such materials with extraordinary mechanical properties, such as large reversible deformation thresholds, making them highly appealing as structural materials.

However, the amorphous nature of bulk metallic glasses severely limits their ductility - under tensile plastic strain only single shear bands are formed, leading to significant softening. Now, a team of researchers from the Toyohashi University of Technology and Tohoku University report how mechanically-induced defects can counter this limitation and enhance the ductility of bulk metallic glasses. The study describes the results of differential scanning calorimetry measurements on bulk metallic glass $Zr_{50}Cu_{40}Al_{10}$.

The researchers discovered that the shear-induced atomic rearrangements were activated via a universal mechanism known as β -relaxation, whose energy cost depends

on the material composition. Rather than altering the material, Nozumo Adachi and co-workers introduced structural defects into the sample in the form of free volumes and anti-free volumes, by high-pressure torsion. The processed bulk metallic glass underwent β -relaxation more easily, and enhanced tensile properties of up to 0.34% plastic elongation. These results show that systematic deformation of bulk metallic glasses is a promising technique for enhancing their mechanical properties without the need for composition alterations.



Nozomu Adachi

Reference:

- N. Adachi, Y. Todaka, Y. Yokoyama and M. Umemoto.
- Improving the mechanical properties of Zr-based bulk metallic glass by controlling the activation energy for β -relaxation through plastic deformation.
- *Applied Physics Letters* 105, 131910 (2014)
- [doi:10.1063/1.4897439](https://doi.org/10.1063/1.4897439)

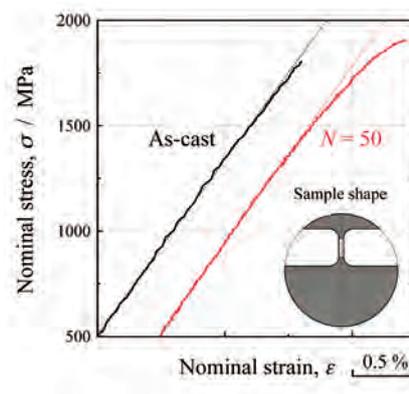


Fig.1: Comparison between the tensile properties of the bulk metallic glass $Zr_{50}Cu_{40}Al_{10}$ with (red line) or without (black line) high-pressure torsion-induced defects. Research from the Toyohashi University of Technology and Tohoku University reported how structural defects have the potential to enhance the ductility of bulk metallic glasses, one of the limitations to their use as structural materials.

Toyohashi Tech Jazz Club

Either you love jazz or it grates on you. There is no question where the sentiments of TUT's 30-member Jazz Club lie, for most of them also belong to the university's Popular Music Club, so playing jazz means doing double duty for the music they enjoy. They meet for three hours a week and form groups to practice and play live sessions in the clubroom in front of club members and visiting international student fans of jazz. To give everyone a chance to play, the musicians change according to the pieces being played. Music is chosen from The Jazz Standard Bible, which contains many popular jazz numbers.

"We also give live performances in bars in the city," says Ruyma Itabashi, leader of the club and a third year student studying chemistry. "Though the audiences are small, it is still a great experience to

perform live like that."

All types of jazz are played, so the range of instrument used is also varied and includes wood and electric bass, saxophone, clarinet, trumpet, guitars and drums. "The club only has a few of its own instruments, and most members end up buying their own," says Itabashi. "Prices range from around 50,000 Yen to as high as 300,000 Yen. My guitar cost 200,000 Yen."

Itabashi began playing the guitar at junior high school and over time taught himself to play instrumental pieces then some jazz numbers. He also intends to keep playing after graduating.

"I like jazz because it is creative and you can improvise," Itabashi explains. "You can add your own interpretation to a piece, whereas with rock music, you play according to the sheet music."

Itabashi says playing together with other members and getting feedback helps each of them to better understand the theory of music, as well as how to improvise. Jazz, he adds, is nothing if not creative?



Toyohashi Festival

Fezai Alaa, Department of Mechanical Engineering

As a student who never visited Japan before I was honored to have had the opportunity to experience this country's natural and cultural beauty. In my mind I always associated Japan with the metropolis of Tokyo, the impressive technology and the modern society. However, being part of a double degree program between the University of Stuttgart in Germany and Toyohashi Tech, I had the opportunity to have a real insight into the Japanese culture and society in this quite small city. After only one week in Toyohashi I was invited to visit this city's summer festival which took place, as I was told, only once a year. So it was a unique opportunity to experience and learn more about Japanese culture. On that day I first went to the office of the international association of Toyohashi accompanied by other international students coming from different countries

of the world. After arriving, we were first offered traditional Japanese clothes to wear. The girls wore beautiful and colorful "Yukata" while we were given elegant "Happi"?straight-sleeved coat made of indigo or brown cotton.

After going for a walk through the streets of central Toyohashi and experiencing some tasty and exotic Japanese food such as "takoyaki", we went back to the office of the international association to practice traditional Japanese dance. As most of us were complete beginners, a dance teacher was there to show us, during one hour, how to perform it the right way. Despite the fact that I was one of the worst dancers, spending these enjoyable moments with people from different

countries and ages was one of the most memorable experiences of my life.

The most important event of the day started at 6 pm. It was when we went out to the main street to show the dancing skills that we had practiced. The number of people and groups taking part in the festival was amazingly huge. The flashing lights of Toyohashi, the magnificent colors of the dancing groups and the charming traditional music and sounds made these 30 minutes or so a delightful and awesome experience that marked my first days in Toyohashi.



Mr. Fezai Alaa in the center of the front row



View of the dancing ceremony

Toyohashi Tech eNewsletter video letter produced by international students from Malaysia

Some statistics about students from Malaysia (as of January 2015)

-A total of 59 students from Malaysia studying at Toyohashi Tech. This is 35.5% of the total number of international students at Toyohashi Tech, the largest number from

any one country or region.

-34 undergraduates, 16 masters and 9 doctoral

-55 of the students were admitted as third years.

Video Letter

