



# University of Tsukuba

A Hub of Academic and Industrial Collaboration



Michiyoshi Ae



Skiing Practice as Outdoor Education



Judo Olympians Training

The University of Tsukuba campus is located at the heart of Tsukuba Science City, about 45 minutes north of Tokyo on the Tsukuba Express train. The modern structure of the university was established in 1973 after the reorganization of its predecessor, the Tokyo University of Education, whose roots go back to 1872. The huge campus—similar in size to New York's Central Park—is home to approximately 16,500 students and 4,100 faculty and administrative staff. The university offers a comprehensive curriculum including arts and social sciences, physical education and sports sciences, physical sciences and engineering, and medicine. Distinguished scholars affiliated with the university include Nobel Laureates Leo Esaki (Physics, 1973), Hideki Shirakawa (Chemistry, 2000), and Sin-Itiro Tomonaga (Physics, 1965).

Looking more broadly, Tsukuba is one of the world's largest science and knowledge-based regions in the world. It has 32 research and academic institutions, approximately 20,000 researchers, and more than 7,000 foreign workers.

In recognition of the technological importance of the Tsukuba region, the Japanese Central Government and local authorities designated Tsukuba City and its peripheral regions as an "International Strategic Zone" in 2011. Managed by the Tsukuba Global Innovation Promotion Agency, the new zone was set up to act as a hub for academia-industry collaboration to foster innovative solutions to major problems facing Japan, such as the declining birth rate, an aging population, and the need for long-term energy resources.

**Yasuo Miake** is vice president and executive director of re-

search affairs at the University of Tsukuba, and one of the central members of the team managing the Ministry of Education, Culture, Sports, Science and Technology (MEXT) Program for Promoting the Enhancement of Research Universities. "Our strategy for running the MEXT program has three main features: introducing an international tenure-track program, headhunting top-class researchers from overseas, and increasing the number of university research administrators from the 11 we have at present to 30 within the next five years," explains Miake. "Importantly, we want to assure our researchers that they will have more time to conduct high-quality research by reducing their time spent on administration and paperwork." Miake also stresses the central roles of the Center for Computational Sciences, the Life Science Center of Tsukuba Advanced Research Alliance, and the Center for Cybernetics Research in achieving the goals of the MEXT program (see sidebars below).

**Michiyoshi Ae**, executive director and vice president in charge of education affairs, who is an expert in sport biomechanics, adds that in addition to traditional research in the basic and applied sciences, the university is a powerhouse for sports and physical education, having produced scores of Olympic medalists and professional sportsmen. "We are now working with MEXT to train sports coaches, physical educators, and sport scientists in Africa and Asia." Research at the University of Tsukuba is truly global and multidisciplinary," concludes Ae.

**Tsukuba International Strategic Zone:**  
[www.tsukuba-sogotokku.jp/en/](http://www.tsukuba-sogotokku.jp/en/)

## Center for Computational Sciences

"Research at the Center for Computational Sciences [CCS] consists of both hardware development and supercomputer construction, and applies these resources to conduct research in areas such as particle physics, astrophysics, weather forecasting, and condensed matter physics," says **Masayuki Umemura**, director of CCS.

CCS has an impressive record of achievements, including completion of the Computational Physics by Parallel Array Computer

System (CP-PACS) in September 1996. At the time CP-PACS was the fastest supercomputer in the world. A more recent development is the 95.4 teraflops T2K Tsukuba System, a large-scale, general-purpose computer cluster that was developed through a collaboration with the University of Tokyo and Kyoto University as part of the T2K Open Supercomputer Alliance. Construction of the 1.166 petaflops (1,166 teraflops) Highly Accelerated Parallel system for Computational Sciences (HA-PACS) in col-



Masayuki Umemura

laboration with the U.S.-based company Cray is another recent achievement because it uniquely



incorporates graphics processing units used for games in personal computers.

New initiatives based on the computing power at CCS include the High Performance Computer Infrastructure (HPCI) Strategic Program, a multi-institute collaborative project. The HPCI includes use of the 8.162 petaflops K-Computer and aims to reveal “the origins and structure of materials and the cosmos.” Notably, CCS was awarded the Gordon Bell Prize twice for work using the K-computer,

for their joint research on electronic states in semiconductor nanowires in 2011, and for their simulations of the gravitational forces acting simultaneously on one trillion astrophysical (dark matter) particles (2012).

Umemura explains that collaborative research with planetary scientists has yielded new insights into the existence of so-called left-handed amino-acids and, by extension, into the origins of life after the big bang. Other research using the simulations has helped scientists

better understand interstellar turbulence and the formation of stars and planets.

“We currently have a staff of 33 full-time researchers and 14 collaborators,” says Umemura. “The funding from the MEXT program will be used to hire four young researchers as part of the university’s international tenure-track program.”

**Center for Computational Sciences:**  
[www.ccs.tsukuba.ac.jp/eng/](http://www.ccs.tsukuba.ac.jp/eng/)

## Life Science Center, Tsukuba Advanced Research Alliance

The Life Science Center of Tsukuba Advanced Research Alliance (LS-TARA Center) was originally launched as the Tsukuba Advanced Research Alliance (TARA) in May 1994 by the former president of the University of Tsukuba, Leo Esaki. TARA was a research platform used to conduct interdisciplinary research in cutting-edge research areas such as life science and nanomaterials, through collaborations between academia, industry, and government.

In March 2010, TARA was reorganized to create the LS-TARA Center, reflecting the university’s determination to strengthen its contribution to research in the life sciences, including fast and inexpensive genome sequencing, animal cloning, and stem cell research.

**Akiyoshi Fukamizu** is vice director of the LS-TARA Center and is internationally renowned for his research on a mouse model

used to study high blood pressure during pregnancy. “Our findings on pregnancy-induced hypertension [PIH] in mice were a classic case of serendipity,” explains Fukamizu. “We had spent many years studying genes that encoded proteins involved in the regulation of blood pressure and the role of the renin-angiotensin system.” Breeding genetically altered mice carrying certain combinations of the renin-angiotensin system proteins led to the discovery of pregnant mice exhibiting PIH-related symptoms. The publication of these results in *Science* in 1996 led to worldwide discussion of their implications and the utility of having a mouse model to study PIH, which occurs in 10% of women. “These animals do not exist in nature because they die,” explains Fukamizu. “This is an important model for finding a treatment for PIH.”



**Akiyoshi Fukamizu**

Future research at LS-TARA will receive extensive support from MEXT, in particular for hiring at least 10 principle investigators with expertise in areas such as genetics, chemical communication, and metabolism. “We are actively recruiting new research staff,” says Fukamizu. “I am busy travelling overseas to interview candidates to fill these new, exciting posts.”

**Life Science Center of Tsukuba Advanced Research Alliance:**  
[www.tara.tsukuba.ac.jp/about/aboutENGLISH.html](http://www.tara.tsukuba.ac.jp/about/aboutENGLISH.html)

## Center for Cybernics Research

Robot Suit HAL (Hybrid Assistive Limb) is the creation of **Yoshiyuki Sankai**, director of the Center for Cybernics Research, born out of his passionate desire to help people around the world. “HAL is the world’s first cyborg-type robot that treats, supports, and expands the physical capabilities of humans. We are also developing this device to be used for medical treatment,” says Sankai. “This powered exoskeleton is already in use at over 170 medical and welfare institutions in Japan. Clinical trials with HAL are being carried out in Japan as well as at BG-University Hospital “Bergmannsheil” in Germany and the Karolinska Institute in Sweden, and HAL has been granted CE0197 certification in Europe. Furthermore, a neuro-rehabilitation center in Germany is providing treatments using HAL that are now covered by national workers insurance. This is the realization of one of my childhood dreams: to build robots to help humans.”

HAL is manufactured by Cyberdyne Inc., a venture company set up by Sankai and now ISO 13485 certified. The exoskeleton is controlled by a combination of special algorithms,

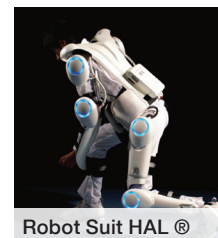
a Cybernic Voluntary Control (CVC) system, and a Cybernic Autonomous Control (CAC) system. The CVC system uses the wearer’s own intentions (i.e., bioelectrical signals from brain to muscle) detected by the sensors, while the CAC system operates based on a preprogrammed system determined by analysis of basic motion patterns and movement mechanisms in humans, in case the bioelectrical signals are weak. A dual systems operation mode enables support of natural physical movements in accordance with the wearer’s intentions.

Sankai explains that the success of HAL is a testament to the “flat nature of the organization” at the University of Tsukuba and its mission to “open new frontiers.” Says Sankai: “One of the unique characteristics of the university is that professors all receive the same annual university funding, irrespective of whether they are full or assistant professors. We are treated equally and given every opportunity to start new, innovative projects, as I did when I started work on robotics in my younger days here.”

Important recent developments include the electronically powered exoskeleton being the



**Yoshiyuki Sankai**



**Robot Suit HAL ®**

world’s first ever device of its kind to receive a global safety certificate (ISO/DIS13482). In addition, in August 2013 the potential of HAL was recognized when it was awarded the European Conformity (Conformité Européenne, CE) mark for medical devices.

Sankai is confident that HAL will help resolve many problems related to Japan’s rapidly aging society and health care in general. “This is just the beginning. We are initiating clinical tests and new experiments in areas such as testing new drugs for treating polio. We have full support from the university and the Japanese government as part of this program and other projects.”

**University of Tsukuba Center for Cybernics Research:**  
[www.first.ccr.tsukuba.ac.jp/english/](http://www.first.ccr.tsukuba.ac.jp/english/)