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.

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/
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).

Umema 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 Cybernics Research: www.first.ccr.tsukuba.ac.jp/english/

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 CED197 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 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/