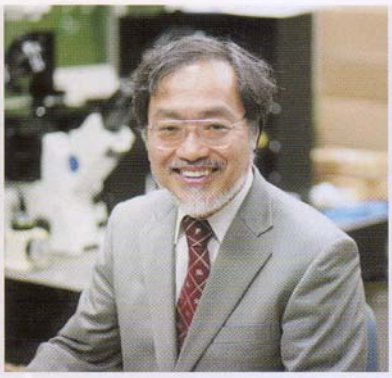

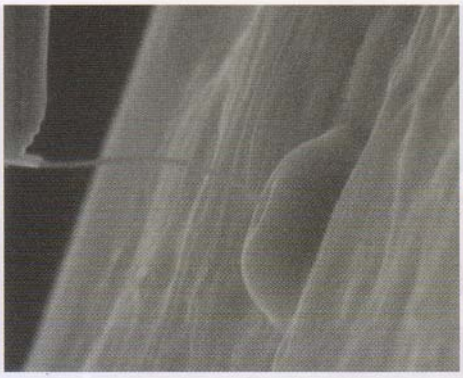

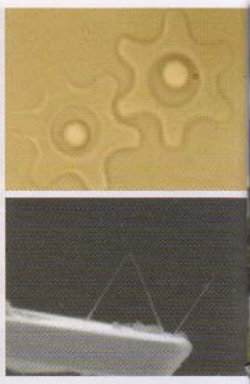

The cultural impact of 'small'

Nagoya University is a world leader in micro-electromechanical systems (MEMSs), and the university is reinforcing that leadership through a five-year education-and-research program with Global Center of Excellence (G-COE) funding from the Japanese government.

"We call our program the Center of Excellence for Education and Research in Micro–Nano Mechatronics," explains Toshio Fukuda, the program director. A professor of micro–nano systems engineering in Nagoya University's School of Engineering, Fukuda has garnered international acclaim for his contributions to mechatronics and robotics.

"Our centre," Fukuda continues, "carries on the work of an earlier centre of excellence at Nagoya University in the same discipline. We continue working to develop exciting new applications for micro- and nano-scale fabrication and to improve reliability and performance in established applications. That means fostering researchers who are eager and able to explore uncharted realms of technological possibilities. It also means allocating resources strategically to sectors where we assert special strengths, reaching across borders to leverage our resources through international collaboration and by fostering productive ties with corporate partners."

Fukuda is a passionate spokesman for the social and cultural ramifications of miniaturization. "Our lives change dramatically," he notes, "when size reductions reach a critical mass. 'Portable' phones the size of lunch boxes didn't attract many users. But when cell phones became small enough to fit in a pocket, everyone started using them."

Small is a many-splendored thing, as Fukuda details enthusiastically. "Performance improves in smaller packages. Oscillation becomes faster, and control becomes more precise. Think about the actuator in an automotive airbag system. At the heart of the actuator is a micro-scale electromechanical element for detecting the sharp deceleration characteristic of a collision. The micrometre-order tolerances in detection enable the actuator to provide the split-second response needed to save lives."

Life-saving smallness can even be big enough to hug. Witness the life-sized endovascular mannequin dubbed 'Eve'. A student of Fukuda, Seiichi Ikeda, developed Eve to evaluate the performance of robotic control devices for microcatheter surgery. The technology proved useful to physicians in preparing for endovascular surgery, and Ikeda has launched a venture business, FAIN Biomedical, to commercialize the invention.

Eve — the name deriving from 'endovascular evaluator' — is a patient-specific simulation of blood-vessel structure. Ikeda uses rapid prototyping based on computed tomography and magnetic resonance imaging to reproduce pertinent vasculature in a patient's head, upper torso or whole body. The resultant model features precision on the order of micrometres, allowing physicians to rehearse for endovascular surgery in blood vessels of less than a millimetre in diameter. Along with supporting refinements in surgical technique, Eve reduces the need for laboratory animals in endovascular training and research.

Nagoya University's researchers in micro- and nano-scale mechatronics are poised to produce more real-world breakthroughs in the same vein as Eve. The university has assembled experts in advanced materials, mechanical science, system measurement, control engineering and biomedical engineering. And those experts are joining hands with a global network of partners in academia and industry.

Cross-border partners

Fukuda and his colleagues are especially serious about demonstrating the international perspective denoted by the title of Global Center of Excellence. They dispatch researchers abroad to participate in international conferences and joint research projects, and they have stepped up their activity in recruiting doctoral students and postdoctoral fellows internationally. At the heart of their international activity is a close working relationship with the University of California, Los Angeles (UCLA).

Cooperation between Nagoya University and UCLA in micro–nano mechatronics predates the establishment of the G-COE. The two universities have held three international symposiums in the field since 2007. Chih-Ming Ho, a professor in the UCLA School of Engineering and a pioneer in MEMSs, is a member of Nagoya University's Micro–Nano Mechatronics G-COE. Ho heads the Center for Cell Control, a nanomedicine development centre based at UCLA and operated under the US National Institutes of Health. Ho's centre acts as an interface for a great deal of the vigorous interchange between the two universities.

Fukuda and his colleagues are also serious about fostering close working relationships with corporate partners. A member of the G-COE who is especially active in joint research with corporate partners is Kazuo Sato. He heads the Integrated Mechatronics Devices Group in Nagoya University's Department of Micro–Nano Systems Engineering. Sato is prominent in anisotropic etching, a

Eve, the endovascular evaluator. A mannequin for training, evaluation and simulation of endovascular surgery.

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