From the Editor

Guanrong (Ron) Chen
Editor-in-Chief, IEEE Circuits and Systems Magazine

It may seem quite easy. But it is not.

Education, which needs no precise definition in this editorial, generally refers to the activities that impart knowledge and skills through teaching and learning, conceiving also something less tangible but more profound—ideas and wisdom, even comprehension and judgment, along with the knowledge acquisition and transmission.

Being educated over a lifetime, and working in the profession of education for so long, one certainly knows how to appreciate the importance of, as well as the difficulties in, education. When education deals with more specific subjects, such as Circuits and Systems (CAS) in electrical and electronic engineering, it becomes more specialized but also more intricate and intractable, particularly if one wishes to maintain an efficient and effective endeavor with fruitful teaching-learning outcomes. Today, this expectation is calling for more and serious efforts towards better CAS education, efforts that will be vital to the well-being and continued success of our CAS Society.

To address the special nature and efficiency regarding the broad spectrum of subjects in CAS education, a Workshop "Future Directions in Circuits and Systems Education", chaired by Joos Vandewalle, was held on May 23, 2008 (right after the 2008 IEEE International Symposium on Circuits and Systems at Seattle, Washington). During the Workshop, a group of domain experts from both academia and industry shared their experiences on teaching CAS courses in their recent and past professional practices. The speakers gave their presentations on sensible topics related to circuit theory, communication networks, signal processing, communications, and systems engineering, among others, reflecting various viewpoints of students and teachers, as well as engineers in the industry. With appreciation, these speakers are listed here for recognition: Eduard Alarcon, Babak Ayazifar, Soumitro Banerjee, Martin de Federico, Anas Hamoui, Raija Lehto, Arjuna Madayanake, Pui-In (Elvis) Mak, Josef Nossek, Robert Rieger, Tom Robbins, Tapio Saramaki, Tuna Tarim, Ljiljana Trajkovic, Charles Trullemans, and Yannis Tsividis.

During the course of the Workshop, attendees agreed with some common observations and experiences that the role of CAS education has drastically changed over time, especially with the emergence and evolution of the Internet and the World-Wide Web, the rapidly developing computer and information technologies, and the trend of globalization. The new challenges of environmental utilization and protection, energy shortage and reproduction, and economical and educational globalization offer many new opportunities to enhance the traditional CAS education. However, many related problems and open issues are also quite prominent: Is the linkage between teaching and research in the CAS education still as important as before? How may one balance the CAS education among the important aspects of textbook theory, on-paper design, computer simulation, laboratory experiment, and industrial practice? Is the implementation and experimentation in hardware still valuable, or is software alone sufficient for classroom teaching? What are the roles of simulation tools such as SPICE, MATLAB and LabVIEW in teaching CAS courses? Can one still rely on good textbooks and reference material (e.g., *The Circuits and Filters Handbook* edited by W.-K. Chen, CRC Press, 3rd ed., 2008), or rely on other means such as Wikipedia, in order to bring integrated knowledge to the students? Obviously, there are more questions than answers.

During the course of the Workshop, several misconceptions about CAS education, already presented and circulating in the CAS community, were identified and discussed. Examples include, to name just a few: 1) CAS subjects are mature enough to have become a basis for all EE majors, so there is no need to introduce the fundamental theory and mathematics of circuits and systems (e.g., linear algebra, differential equations, and Laplace, Fourier and z-transforms); 2) Due to the availability of powerful software such as MATLAB and LabVIEW, there is no need to study CAS concepts (e.g., KVL, KCL, MNA, transfer function, impedance, and Bode diagram), because the students can learn them through simulations simply by using for example

Digital Object Identifier 10.1109/MCAS.2008.931740

(continued on page 8)

 (continued from page 4)

SPICE; 3) The industry is no longer interested in hiring college graduates who acquired CAS concepts and methods, but rather, those with only limited knowledge and basic skills in using commercial electronic products. Other misleading beliefs could also be listed, which should evoke the awareness and concern of our professionals in the traditional fields of CAS about the seriousness of these misconceptions and their causes and consequences.

After the presentations and the ensuing discussions on existing problems related to the lack of interest from students in CAS courses, the Workshop participants reached a consensus that the students have to be motivated by the educators from "inside" with outcome-based learning and hands-on experiences offered in tandem with the taught theory in a way that students would feel learning CAS subjects is useful and fun. In order to address this and some other related issues, many actions were recommended, including the need to establish a CAS Education and Outreach Technical Committee within the CAS Society, develop a list of actions and tools for motivating students, to involve IEEE with the accreditation of academic programs, and to publish a Special Issue in the *CAS Magazine* reporting valuable experiences and introducing good teaching models. This latter point has led to a major part of the contents in the present issue of the Magazine.

Obstacles notwithstanding, right here, right now, once and for all without nuance and hesitation, we the CAS Society members must work together closely to further promote our CAS education in the coming future.