Avis de Conférence

MEMRISTOR : 37 years later from Nonlinear Physics to Nanoelectronics

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Amphithéâtre 22, bâtiment F, Faculté des Sciences
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Résumé :

On the May 1 2008 issue of Nature, scientists from the Hewlett-Packard Company unveils a nano-scale device called the memristor, a hypothetical circuit element postulated in 1971. This Nature paper has generated unprecedented worldwide interests because, among many applications, memristors can be used as super-dense non-volatile memories for building instant turn-on computers. Even more exciting is the recent suggestions from many brain-research scientists that the memristor's continuous (analog) memory can be used to build ultra-small brain-like learning machines with nano-scale memristive synapses having a density of more than 50,000 synapses per neuron on a single chip. This lecture will provide an introduction to memristors and its potential applications, along with some historical and philosophical perspectives.

The circuit-theoretic foundation of the memristor, and its generalizations to a lossless memory capacitor, and a lossless memory inductor, will be presented along with the devices' constitutive relations. Their identifying fingerprints consist of a pinched hysteresis loop when plotted in the voltage-vs.-current plane, flux-vs.-integrated-charge plane, and charge-vs.-integrated-flux plane, respectively. All three devices are nonlinear and their underlying physical mechanisms are expected to dominate and manifest their memory character as the device size scales below 20 nanometers, when electrons and ions are coupled strongly under intense electric and/or magnetic fields. While all three devices are ideal candidates for non-volatile nano memories, the long-term significance lies in their enabling potentials for designing intelligent nano machines, with learning and adaptive capabilities. Even more fundamental is their memristive nonlinear dynamics, which underpins the biological basis of life itself, where ion channels, with their complex biochemical synaptic dynamics, are essentially memristors.

Brief Technical Biography

Prof. Leon O. Chua is known as a pioneer in 3 research areas, namely, nonlinear circuits, neural networks, and chaos. His work in these areas has been recognized through many awards, including 11 honorary Doctorates from major Universities in Europe and Japan, and 7 USA patents. He was elected as Fellow of IEEE in 1974, a foreign member of the European Academy of Sciences (Academia Europea) in 1997, and a foreign member of the Hungarian Academy of Sciences in 2007. He was honored with many major IEEE prizes, including the IEEE Browder J. Thompson Memorial Prize Award in 1972, the IEEE W. R. G. Baker Prize Award in 1978, the Frederick Emmons Award in 1974, twice winner of the IEEE M.E.Van Valkenburg Award (1995 and 1998). He is also a Recipient of the top 15 most cited authors Award in 2002 from all fields of engineering published during the 10-year period 1999 to 2001, from the Current Contents (ISI) database, the IEEE Neural Networks Pioneer Award in 2000, the IEEE Gustav Kirchhoff Award in 2005, and the IEEE Vitold Belevitch Award in 2007.

Prof. Chua is widely recognized as the father of nonlinear circuit theory and cellular neural networks (CNN). Prof. Chua also invented a five-element electronic circuit for generating chaotic signals, known as the Chua Circuit. It has become a standard paradigm for teaching chaos in textbooks on nonlinear dynamics.

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