Rice, Nanyang Tech collaborate on sustainable nanoelectronics

September 4 2007

Computing researchers at Houston's Rice University and electronics specialists at Singapore's Nanyang Technological University (NTU) today announced the formation of a $2.6-million Institute for Sustainable Nanoelectronics (ISNE). The joint research initiative, valued at 4 million Singapore dollars, aims to slash the design and production costs for embedded microchips -- special-purpose computer chips that power everything from cell phones and digital cameras to jet airplanes and MRI machines.

"A major goal of the collaboration is to help sustain Moore's Law and exploit the exponential rate at which electronic components have been shrinking for more than four decades," said Rice researcher Krishna Palem, the architect of the multinational initiative.

For instance, in a streaming video application on a cell phone, it's unnecessary to conduct precise calculations. The small screen, combined with the human brain's ability to process less-than-perfect pictures, results in a case where the picture looks just as good with a calculation that's only approximately correct.

"The key is tying the costs for design, energy consumption and production to the value that the computed information has for the user," Palem said.

ISNE is funded by and based at NTU. It will draw upon an International Network of Excellence directed by Palem. The broad-based network will

include computing experts from elite organizations like NTU, Rice and the Georgia Institute of Technology.

"NTU is pleased to be collaborating with Rice to spearhead research in sustainable nanoelectronics," said NTU President Su Guaning. "Leveraging the strengths of NTU and Rice, both top technological universities, will no doubt bring about exciting breakthroughs. We are also glad to have Professor Palem, renowned for his computing methodology, head the ISNE."

The institute will partner with Rice's new Value of Information-based Sustainable Embedded Nanocomputing Center, or VISEN, which Palem recently established with seed funding from Rice.

"Rice and NTU are well-positioned to lead the search for sustainable new technologies in nanoelectronics," said Rice President David Leebron. "NTU is a leader in electronics and a well-known contributor to Singapore's economic vitality. Rice is a leader in engineering and nanotechnology, with a well-deserved reputation for international collaboration and the development and application of new ideas."

The institute hopes to evolve a design methodology that will be applicable not only to today's complementary metal–oxide semiconductors, or CMOS, but also to emerging computing platforms based on photonics and nanotechnology. The platform-independent approach is one of the institute's central themes, said Palem, who recently finished a yearlong appointment at the California Institute of Technology as a Gordon Moore Distinguished Scholar.

One example of the new "value-of-information" approach is probabilistic CMOS, or PCMOS, a new technology and an accompanying computing architecture invented within the past five years by Palem's research team. The key to PCMOS is a scheme that allows

chips to trade off energy consumption at the cost of increased electronic "noise," which leads to slight processing errors.

The beauty of PCMOS is that most of today's chips are over-engineered for day-to-day applications. In prior research, Palem ran cell-phone-style streaming video applications in a side-by-side comparison on PCMOS chips and traditional, power-hungry cell-phone chips. An award-winning demonstration of the technique at a 2006 conference in Seoul, South Korea, wowed audiences, who saw no appreciable difference in picture quality, even though the PCMOS chips used five times less power. Palem and colleagues at NTU are currently testing the first-generation production prototype PCMOS chips.

"As information processing systems become more ubiquitous in consumer-driven applications, their designs must be tailored to reflect the needs of the end-users, and it is in this area that the new NTU/Rice Institute for Sustainable Nanoelectronics will make substantial contributions," said Ralph Cavin, chief scientist at the non-profit Semiconductor Research Corporation in Durham, N.C. "The institute's goal of developing design technologies for extremely-scaled CMOS, so that the consumer's needs are met at reduced cost, is well-aligned with emerging directions in integrated circuit applications."

Palem, who is the Ken and Audrey Kennedy Professor in Computer Science and professor of electrical and computer engineering, joined Rice's faculty July 1 from Georgia Tech, where he founded and directed the Center for Research in Embedded Systems and Technology.

"Krishna was recruited to Rice by the legendary computer scientist Ken Kennedy," said Sallie Keller-McNulty, dean of Rice's George R. Brown School of Engineering. "Ken was passionate about optimization, about making all computers -- be they supercomputers or smart devices – more efficient and easier to use. We're proud that Krishna is continuing the

tradition of international excellence that Ken fostered at Rice."

Source: Rice University