Through Calit2, Ericsson Endows UCSD Chair in Wireless Communication

November 16, 2005

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A long-time faculty member and leading expert in digital communication theory will be the first holder of a new chair at the University of California, San Diego funded by telecommunications giant Ericsson. Professor Laurence Milstein, 63, will occupy the Ericsson Endowed Chair in Wireless Communication Access Techniques. "Professor Milstein has been an important force in the school for nearly 30 years," said Frieder Seible, Dean of UCSD's Jacobs School of Engineering and Co-chair of the Governing Board of Calit2, a partnership of UCSD and UC Irvine. "This chair recognizes the tremendous impact he has had on more than fifty Ph.D. students he has been mentoring over the years, many of whom have played critical roles in the migration of communications systems from analog to the digital realm in both industry and academic research." The new chair -- the twenty-first at the Jacobs School -- is one of two endowed chairs and two faculty fellowships to be provided by Ericsson through its corporate commitment to the UCSD Division of Calit2.

"Larry has significantly contributed to wireless communication, in particular the area of CDMA and interference suppressing receivers," says Stefan Parkvall, senior specialist at Ericsson Research and a former postdoctoral researcher in Milstein's lab in 1996-'97. "The theoretical foundation in this area is very important for Ericsson to provide high-performance cellular networks, and interference handling will become increasingly important in future systems as the user data rate increases."

Milstein joined the UCSD faculty in 1976. He is a professor and former chairman of the Jacobs School's Electrical and Computer Engineering (ECE) department. Previously he was a professor of electrical engineering at Rensselaer Polytechnic Institute in New York. Before that, Milstein spent six years in the Space and Communications Group of Hughes Aircraft Company, which he joined in 1968 after earning his doctorate from the Polytechnic Institute of Brooklyn.

"When the IEEE honored Larry Milstein in 2000 with its Edwin Howard Armstrong Achievement Award, the organization cited his seminal technical contributions in spread spectrum and CDMA wireless communications for commercial and military systems," said Ramesh Rao, director of Calit2's UCSD Division and a professor of electrical and computer engineering in the Jacobs School. "He has been a prolific source of new ideas in wireless communications, and based on his current research agenda, we look forward to many more great ideas coming out of his lab."

Milstein typically serves as an advisor to between 15 and 20 doctoral students, and a handful of Master's degree candidates. He says the biggest advantage of being selected to hold the Ericsson Endowed Chair is the extra funding that will go to support those graduate students. "I don't expect the Ericsson chair to change my research qualitatively," he said. "But quantitatively, the Ericsson chair is a tremendous opportunity to fund students who I couldn't have sponsored otherwise."

Elected a Fellow of the IEEE in 1985, Milstein has served on the Board of Governors of the organization's Information Theory Society as well as its Communications Society.

Milstein's work in digital communications theory has focused on spread-spectrum wireless technologies. "I believe that the name of the endowed chair recognizes my work in code division multiple access which goes back to its early days as primarily a military technology," said Milstein.

Most of the support received by Milstein over the years has come from the Pentagon - notably the Office of Naval Research and Army Research Office - and from consulting with defense contractors such as Lockheed Martin and Hughes. More recently he has worked on potential commercial uses of spread spectrum technologies, with funding members of UCSD's Center for Wireless Communications (CWC) and from Ericsson.

Although his work is theoretical, Milstein's area of expertise is the 'physical' layer of communication. "Larry is a real team player and has collaborated with many of his fellow professors in the ECE department, including some - such as CWC co-director Pamela Cosman -- who specialize in theory related to other layers of communications," said ECE chair Paul Yu. "He also routinely teams with department faculty who implement the technology, including professor Shaya Fainman and CWC co-director Larry Larson."

Milstein is the principal investigator on a four-year CDMA Systems research project sponsored through Calit2 by Ericsson and the UC Discovery Grant program since 2002. He and fellow researchers are trying to design CDMA systems that are spectrally efficient when used in conjunction with both source coding and channel coding techniques."

"A huge amount of our work is on the interference issue," said Milstein. "And much of that work is performance analysis." Indeed, interference is the thread running through most of Milstein's research, even as he shifts the focus away from CDMA. "I will continue to do a reasonable amount of work on CDMA," he said, "but our work is gradually shifting into other areas that hold immense promise."

Those new areas include ultra wideband (UWB) communications; multiple-input multiple-output (MIMO) systems; and orthogonal frequency division modulation (OFDM), a spread-spectrum technique that distributes the data over a large number of carriers that are spaced apart at precise frequencies. Milstein and several graduate students are also focusing on cognitive radio.

"It's an evolution of software radio," explained Milstein. "Based on the instantaneous quality of the channel and specific band as well as a given location and point in time, the system senses whether the primary users who are paying for that bandwidth are using it, how strong it is, and how high a data rate you can get across it. The system then makes a decision whether the band can be used, and if so, the data rate and modulation format, and sends that decision to the transmitter. That's the cognition part of cognitive radio."

Both cognitive radio and ultra wideband aim to let multiple users share common spectrum without excessive interference, but UWB, which is primarily intended for use indoors (at home or in the office) does it differently. It spreads the signal over a huge bandwidth - between 500 megahertz and 7.5 gigahertz - and does it at such low-power spectral density that it falls below the noise floor.

"The show-stopper is whether these systems impose too much interference on the primary users of the spectrum, because the Federal Communications Commission won't tolerate that," explained Milstein. "I don't think it will be known for sure until ultra wideband is fully deployed."

One of Milstein's current graduate students studying ultra wideband, Matteo Sabattini, recently won the best-paper award at the 16th annual IEEE International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC). He was cited for his work with Milstein and ECE professor Elias Masry on "beamforming for interference mitigation in TH impulse radio UWB systems." (CWC members got a preview of that research at the center's 2004 Research Review last November.) Three other graduate students in Milstein's lab are also working on UWB.

Spatial diversity offers another way to minimize interference. MIMO systems, usually involving two or more antennas, minimize the fading of a signal by sending a replica of that one signal over other channels. "If one channel fades, you can still get the information across," said Milstein. Media Contacts: Doug Ramsey, (858) 822-5825.