

ECE Distinguished Seminar Series

Capacity-Approaching Low-Density Parity-Check Codes: Developments and Applications

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Showcase Room, Research Hall

Abstract

The ever-growing needs for cheaper, faster, and more reliable communication and storage systems have forced many researchers to seek means to attain the ultimate limits, known as the channel capacities, on reliable information transmission and storage. Low-density parity-check (LDPC) codes are currently the most promising coding technique to achieve (or close to) the channel capacities (or Shannon limits) for a wide range of channels.

Discovered by Gallager in 1962, these codes were rediscovered in the late 1990's. Ever since their rediscovery, a great deal of research effort has been expended in design, construction, encoding, decoding algorithms and complexity, structure, performance analysis, generalizations and applications of these remarkable codes. Many LDPC codes have been adopted as the standard codes for various current and next generations of communication systems. Applications to high-density data storage systems, such as flash memories, are now being seriously considered. In fact, they are appearing in some recent data storage products.

This rapid dominance of LDPC codes in applications is due to their capacity-approaching performance which can be achieved with practically implementable iterative decoding algorithms. This presentation gives an overview of LDPC codes and their recent developments in code constructions and reduced-complexity decoding schemes.

Biography

Shu Lin (S'62-M'65-SM'78-F'80-LF'00) received the B.S.E.E. degree from the National Taiwan University, Taipei, Taiwan, in 1959, and the M.S. and Ph.D. degrees in electrical engineering from Rice University, Houston, TX, in 1964 and 1965, respectively. In 1965, he joined the Faculty of the University of Hawaii, Honolulu, as an Assistant Professor of Electrical Engineering. He became an Associate Professor in 1969 and a Professor in 1973. In 1986, he joined Texas A&M University, College Station, as the Irma Runyon Chair Professor of Electrical Engineering. In 1987, he returned to the University of Hawaii. From 1978 to 1979, he was a Visiting Scientist at the IBM Thomas J. Watson Research Center, Yorktown Heights, NY, where he worked on error control protocols for data communication systems. He spent the academic year of 1996-1997 as a Visiting Chair Professor at the Technical University of Munich, Munich, Germany.

He retired from University of Hawaii in 1999 and he is currently an Adjunct Professor at University of California, Davis, California. He has published at least 800 technical papers in prestigious refereed technical

journals and international conference proceedings. He is the author of the book, *An Introduction to Error-Correcting Codes* (Englewood Cliff, NJ: Prentice-Hall, 1970). He also co-authored (with D. J. Costello) the book, *Error Control Coding: Fundamentals and Applications* (Upper Saddle River, NJ: Prentice-Hall, 1st edition, 1982, 2nd edition, 2004), the book (with T. Kasami, T. Fujiwara, and M. Fossorier), *Trellises and Trellis-Based Decoding Algorithms*, (Boston, MA: Kluwer Academic, 1998), and the book, *Channel Codes: Classical and Modern* (Cambridge University Press 2009).

Dr. Lin was elected to IEEE (Institute of Electrical and Electronic Engineering) Fellow in 1980 and Life Fellow in 2000. In 1996, he was a recipient of the Alexander von Humboldt Research Prize for U.S. Senior Scientists and a recipient of the IEEE Third-Millennium Medal, 2000. In 2007, he was a recipient of The Communications Society Stephen O. Rice Prize in the Field of Communications Theory. In 2014, he was awarded the NASA Exceptional Public Achievement Medal.