ELECTRICAL ENGINEERING

LDPC AND POLAR CODES IN 5G STANDARD

PROF. ANDREW THANGARAJ
Department of Electrical Engineering
IIT Madras

TYPE OF COURSE : New | Elective | PG
COURSE DURATION : 4 weeks (28 Jan'19-22 Feb'19)
INTENDED AUDIENCE : EE PG in communications area, Communication industry professionals
EXAM DATE : 31 March 2019
PRE-REQUISITES : Probability theory, Digital communications, MATLAB

INDUSTRIES APPLICABLE TO : Most communications companies.

COURSE OUTLINE :

This course will introduce the error control codes – Low Density Parity Check codes and Polar codes - that have been proposed for 5G cellular communication systems. The emphasis will be on implementing decoders for these codes.

ABOUT INSTRUCTOR :

Andrew Thangaraj received his B.Tech in Electrical Engineering from the Indian Institute of Technology (IIT), Madras, India in 1998 and a PhD in Electrical Engineering from the Georgia Institute of Technology, Atlanta, USA in 2003. He was a post-doctoral researcher at the GTL-CNRS Telecom lab at Georgia Tech Lorraine, Metz, France from August 2003 to May 2004. From June 2004, he has been with the Department of Electrical Engineering, IIT Madras, where he is currently a Professor. From Jan 2012 to Jan 2018, he served as Editor for the IEEE Transactions on Communications. Since July 2018, he has been serving as an Associate Editor for Coding Techniques for the IEEE Transactions on Information Theory.

COURSE PLAN :

Week 01 : Linear block codes: parameters, parity check matrix, generator matrix, puncturing, shortening, Soft decoding: BPSK-AWGN model, Log-Likelihood Ratio, bitwise MAP soft-decision decoding, successive cancellation soft-decision decoding, list decoding, Examples: Repetition code, Single parity check code, Hamming code

Week 02 : Low Density Parity Check codes: definition, Tanner graph, protograph LDPC code construction (base matrix, expansion), construction in 5G standard, encoding of LDPC codes, Message passing decoding on Tanner graph: column and row operations, minsum approximation, Threshold analysis

Week 03 : Polar code: generator matrix, frozen bits and information bits, butterfly representation, binary tree representation, Successive cancellation decoder for polar codes, Information-theoretic analysis

Week 04 : Simplified successive cancellation decoding of polar codes: REP, RATE1, RATE0, SPC nodes, Successive cancellation list decoding, Simplified successive cancellation list decoding, Fast simplified successive cancellation list decoding