# IEEE Life Fellow 林舒教授浙江大学客座教授受聘仪式暨系列学术讲座

美国加州大学戴维斯分校林舒教授将受聘浙江大学客座教授，并于 2011 年 10 月 31 日---11 月 2 日在浙江大学做精彩的系列学术讲座。

讲座题目：Low-Density Parity-Check Codes（低密度奇偶校验码）

讲座 1：LDPC Codes: Developments, Constructions, Applications, and Research Directions

2011 年 10 月 31 日 14:00，浙江大学玉泉校区 教三-441

讲座 2：A Transform Approach for Construction and Analysis of Quasi-Cyclic LDPC Codes

2011 年 11 月 1 日 14:00，浙江大学玉泉校区 信电系楼 215 学术厅

讲座 3：Trapping Sets of Structured LDPC Codes

2011 年 11 月 2 日 14:00，浙江大学玉泉校区 信电系楼 215 学术厅

欢迎各位老师和同学参加。

## 林舒教授简介

林舒教授 1959 年毕业于国立台湾大学，获得电子工程学学士学位，后于 1964 年和 1965 年从美国莱斯大学（Rice University）分别获得电子工程学硕士和博士学位。1965 年起，他就职于美国夏威夷大学（University of Hawaii），任电子工程学助理教授，后于 1969 年成为副教授，于 1973 年成为教授。1986 年，他作为 Irma Runyon Chair Professor 加入德州农机大学（Texas A&M University）。1987 年，他回到夏威夷大学。从 1978 年到 1979 年，作为 IBM Thomas J. Watson 研究中心的访问科学家从事数据通信系统的差错控制协议的研究工作。1996-1997 年，他作为客座讲座教授加盟德国慕尼黑工业大学（Technical University of Munich）。2000-2011 年，他任英国兰开斯特大学（Lancaster University）名誉教授。1999 年从夏威夷大学退休，现担任加州大学戴维斯分校的兼职教授。

林教授在国际知名的期刊和会议上发表了 400 余篇论文。他撰写了 An Introduction to Error Correcting Codes，并与 D. J. Costello 合著了 Error Control Coding: Fundamentals and Applications，与 T. Kasami, T. Fujiwara, and M. Fossorier

合著了 Trellises and Trellis-Based Decoding Algorithms, 和 Channel Codes: Classical and Modern。他现在的研究领域包括：代数编码理论（algebraic coding theory），编码调制（coded modulation）,差错控制系统（error control systems），卫星通信（satellite communications）以及存储系统编码（coding for storage systems)。他作为首席科学家承担了美国国家自然科学基金、NASA 和私营通信企业的 43 个研究项目。

林教授曾于 1976 年到 1978 年担任 IEEE TRANSACTIONS ON INFORMATION THEORY 代数编码理论的副主编，这是第一次由华裔美国人担任此职务。他曾担任 1988 年日本神户 IEEE International Symposium of Information Theory （ISIT）联合主席，1988 年北京 IEEE Information Theory Workshop 联合主席和 2007 年成都 IEEE Information Theory Workshop 联合主席。他曾于 1991 年任 IEEE 信息论学会主席，这是第一次也是迄今唯一一次由华裔学者担任此职。

林教授 1980 年被选举为 IEEE Fellow，并于 2000 年被选为 IEEE Life Fellow。1996 年，他荣获美国高级科学家 Alexander von Humboldt Research Prize。2000 年，他荣获 IEEE 第三千禧年奖章。2007 年，他荣获通信学会通信理论领域的 Stephen O. Rice Prize。

林教授被誉为世界最顶级的编码理论家和实用家。他与 Costello 合著的 Error Control Coding: Fundamentals and Applications 被全世界的实用通信工程师誉为“编码圣经”。他设计或发明的许多编码和差错编码方案曾经或者正在作为通信系统的标准而使用。

## 讲座摘要

讲座 1：LDPC: Developments, Constructions, Applications, and Research Directions

Abstract：The rapid dominance of low-density parity-check (LDPC) codes in applications requiring error control coding is due to their capacity approaching performance which can be achieved with practically implementable iterative decoding algorithms. LDPC codes were first discovered by Gallager in 1962 and then rediscovered in late 1990’s. Ever since their rediscovery, a great deal of research effort has been expended in design, construction, structural analysis, efficient encoding and decoding, performance analysis, generalizations and applications of LDPC codes.

Numerous papers have been published on these subjects. Many LDPC codes have been chosen as the standard codes for various next generations of communication systems and they are appearing in recent data storage products.

In this and the following lectures, recent developments of LDPC codes, their constructions, applications and possible research directions are presented.

讲座 2：A Transform Approach for Construction and Analysis of Quasi-Cyclic LDPC Codes

Abstract：A matrix-theoretic approach for studying quasi-cyclic codes based on matrix transformations via Fourier transforms and row and column permutations is developed. These transformations put a parity-check matrix in the form of an array of circulant matrices into a diagonal array of matrices of the same size over an extension field. The approach is amicable to the analysis and construction of quasi cyclic low-density parity-check codes since it takes into account the specific parity-check matrix used for decoding with iterative message-passing algorithms. Based on this approach, the dimension of the codes and parity-check matrices for the dual codes can be determined. Several algebraic and geometric constructions of quasi-cyclic codes are presented as applications along with simulation results showing their performance over AWGN channels decoded with iterative message-passing algorithms.

讲座 3：Trapping Sets of Structured LDPC Codes

Abstract：LDPC codes perform amazingly well with iterative decoding based on belief propagation using algorithms such as the sum-product algorithm or the min-sum algorithm. However, with iterative decoding, most LDPC codes have a common severe weakness, known as the error-floor. The error-floor of an LDPC code is characterized by the phenomenon that, as the SNR continues to increase, the error probability suddenly drops at a rate much slower than that in the region of low to moderate SNR. High error-floors may preclude LDPC codes from applications where very low error rates are required. High error-floors most commonly occur for unstructured random or pseudo-random LDPC codes constructed using

computer-based methods or algorithms. Structured LDPC codes constructed algebraically, such as finite geometry and finite field LDPC codes, in general, have much lower error-floors.

Ever since the phenomenon of the error-floors of LDPC codes with iterative decoding became known, a great deal of research effort has been expended in finding its causes and methods to resolve or mitigate the error-floor problem. For the AWGN channel, the error-floor of an LDPC code is mostly caused by an undesirable structure, known as a trapping set, in the Tanner graph of the code based on which the decoding is carried out. In this presentation, we are concerned with the trapping set structure of the Tanner graphs of RC-constrained LDPC codes. For several classes of RC-constrained regular LDPC codes constructed algebraically, we show that their Tanner graphs contain no trapping sets of sizes smaller than their minimum weights. Consequently, their error-floor performances are dominated by their minimum weights.