

UNIVERSITY OF CALIFORNIA, SAN DIEGO  
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

CORDIALLY INVITE YOU TO THE

JACK KEIL WOLF  
LECTURE SERIES IN  
INFORMATION THEORY AND APPLICATIONS



FEATURING

**RON M. ROTH**

PROFESSOR OF COMPUTER SCIENCE,  
TECHNION-ISRAEL INSTITUTE OF TECHNOLOGY

FRIDAY, FEBRUARY 21, 2014  
LECTURE 1:30PM | RECEPTION 2:30PM  
AUDITORIUM, CENTER FOR MAGNETIC RECORDING RESEARCH (CMRR)  
WARREN MALL, UC SAN DIEGO, LA JOLLA, CA

The University of California, San Diego and its Department of Electrical and Computer Engineering cordially invite you to the

JACK KEIL WOLF LECTURE IN INFORMATION THEORY AND APPLICATIONS

**“The Curse and Blessing of Dimensionality in Constrained Coding”**

Speaker: **Ron M. Roth**, Professor, Computer Science, Technion-Israel Institute of Technology

Date: Friday, February 21, 2014

Time: Lecture 1:30pm; Reception 2:30pm

Location: Auditorium, Center for Magnetic Recording Research (CMRR), UCSD

**Abstract:** Constrained coding goes back to Shannon's 1948 paper. The one-dimensional case, including the widely-used  $(d,k)$ -runlength-limited constraints, is well understood. In particular, it is very easy to compute the capacity of 1-D constraints, and there are general methods for constructing codes for any given constraint. Recent applications, such as data storage, emerging resistive memory technologies, and barcoding, introduce two-dimensional constraints. The study of such constraints, however, is inherently difficult: even the simple problem of determining whether the capacity of a given 2-D constraint is nonnegative, is undecidable. Nevertheless, significant progress has been made in the last 15 years in designing coding schemes for constraints of practical interest. In this talk, we present several recent results in this area. In particular, motivated by the proposed architecture of memristor crossbar memories, we present efficient methods for coding into arrays that satisfy certain weight constraints. [Part of the talk is joint work with Erik Ordentlich and with Gadiel Seroussi.]

**Bio:** Ron M. Roth received the B.Sc. degree in computer engineering, the M.Sc. in electrical engineering, and the D.Sc. in computer science from Technion--Israel Institute of Technology, Haifa, Israel, in 1980, 1984, and 1988, respectively. Since 1988 he has been with the Computer Science Department at Technion, where he now holds the General Yaakov Dori Chair in Engineering. He held visiting positions at IBM Research Division (San Jose, California) and, since 1993, at Hewlett--Packard Laboratories (Palo Alto, California). He is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). Ron Roth was Associate Editor for Coding Theory of the IEEE Transactions on Information Theory and is now serving as Associate Editor of SIAM Journal on Discrete Mathematics. He is the author of the book "Introduction to Coding Theory," published by Cambridge University Press in 2006. His research interests include coding theory, information theory, and their application to the theory of complexity.

**Lecture Series:** This series is named in honor of the late Jack Keil Wolf, who joined the faculty at UC San Diego in 1984 and served as a professor in the Department of Electrical and Computer Engineering (ECE) in the Jacobs School of Engineering. He held an endowed chair at the Center for Magnetic Recording Research (CMRR), where he led the Signal Processing Group, dubbed the "Wolf Pack." "It's hard to overstate Jack's role in getting the information theory community interested in data storage," said Paul Siegel, an ECE professor and former director of CMRR.

"When you save data on a hard disk, the magnetic medium is imperfect. Jack's innovations have allowed us to write and read data from these magnetic devices with near-perfect fidelity. This is at the heart of the information revolution," said Lawrence Larson, Founding Dean of the School of Engineering at Brown University. "Jack was one of the deepest thinkers in terms of how you take information – ones and zeros – and make it so it can be stored or transmitted without losing its fidelity."

In the 1980s, Wolf was instrumental in bringing a technique known as maximum likelihood detection to the field of data storage. Essentially every hard disk drive, tape drive, and DVD player made in the last 20 years uses some form of this technology. "Adopting the maximum likelihood detection technology allowed hard drives to more accurately and rapidly read ones and zeros," said Andrew Viterbi, a co-founder of Qualcomm Incorporated and president of the Viterbi Group. He added that Wolf and his CMRR colleagues "produced many exceptional engineers who subsequently went into industry and hold key positions."

Wolf also served as a consultant and later as a part-time employee at Qualcomm for more than 25 years, and had a number of influential patents in commercial wireless communication systems. For example, Wolf developed widely used coded-modulation methods for high-speed data transmission, as well as interference cancellation techniques that improve the performance of cell-phone networks. "Jack was an original thinker and great fun to collaborate with," recalled Siegel. "He loved teaching and was a dedicated mentor to his many graduate students. He and his wife, Toby, were famous for the warm hospitality with which they welcomed colleagues and students to frequent gatherings at their home."