Stanford

Robert M Gray

Alcatel-Lucent Professor in Communications and Networking, Emeritus

Electrical Engineering

Bio

BIO

Robert M. Gray is the Alcatel-Lucent Technologies Professor of Communications and Networking in the School of Engineering, Emeritus, and Professor of Electrical Engineering, Emeritus, at Stanford University. He is a Fellow of the IEEE and the Institute for Mathematical Statistics and he was a 1981--82 Fellow of the John Simon Guggenheim Foundation. His professional awards include an Education Award, Meritorious Service Award, Technical Achievement Award, and Society award from the IEEE Signal Processing Society, a Golden Jubilee Award for Technological Innovation and the Claude E. Shannon Award from the IEEE Information Theory Society, and the Jack S. Kilby Signal Processing Medal and Centennial and Third Millennium Medals from the IEEE. He received a Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM). He is a member of the National Academy of Engineering. He retired from Stanford in April 2013 and is currently a Research Professor at Boston University.

ACADEMIC APPOINTMENTS

- Emeritus Faculty, Acad Council, Electrical Engineering

HONORS AND AWARDS

- 2020 Okawa Prize, The Okawa Foundation for Information and Telecommunications (2021)
- Aaron D. Wyner Distinguished Service Award, IEEE Information Theory Society (2020)
- Stanford University President's Award for Excellence through Diversity, Stanford University (2013)
- Education Award, IEEE Signal Processing Society (2009)
- Research Fellow, Michelle R. Clayman Institute for Gender Research, Stanford University (2008-2009)
- Claude E. Shannon Award, IEEE Information Theoryt Society (2008)
- Jack S. Kilby Signal Processing Medal, IEEE (2008)
- Member, National Academy of Engineering (2007)
- Distinguished Lecturer, IEEE Signal Processing Societyt (2006-2007)
- Meritorious Service Award, IEEE Signal Processing Society (2005)
- First Lucent Technologies Chair in Communications and Networking in the School of Engineering, Stanford University (2004)
- Distinguished Alumni in Academia Award, University of Southern California (2003)
- Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM), White House and NSF (2002)
- Third Millennium Medal, IEEE (2000)
- Golden Jubilee Award for Technological Innovation, IEEE Information Theory Society (1998)
- Vinton Hayes Distinguished Visiting Scholar, Harvard University (1995)
- Society Award, IEEE Signal Processing Society (1993)
- Fellow, Institute for Mathematical Statistics (IMS) (1992)

- Fellowship, NATO/Consiglio Nazionale delle Ricerche (1990)
- Fellowship, University of Napoli, NATO/Consiglio Nazionale delle Ricerche (1990)
- Centennial Medal, IEEE (1984)
- Senior Award, IEEE Signal Processing Society (1983)
- Fellowship, John Simon Guggenheim Foundation (1982)
- Fellowship, Japan Society for the Promotion of Science (1981)
- Fellow, IEEE (1980)
- Prize Paper Award, IEEE Information Theory Group (1976)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Editor-in-Chief, Transactions on Information Theory, IEEE (1981 - 1983)

LINKS

- Robert M. Gray: https://ee.stanford.edu/~gray/

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

My current research falls in the intersection of Shannon information theory and signal processing. In particular, I am interested in the theory and design of block codes and sliding-block (or stationary or time-invariant) codes for data compression and their relation to each other. Block codes are far better understood and more widely used, but their lack of stationarity causes difficulties in theory and artifacts in practice. Very little is known about the design of good sliding-block codes, but the problem is known to be equivalent to the design of entropy-constrained simulators of complex random processes. I also do research in the history of information theory and signal processing, especially in the development of speech processing systems and real time signal processing.

Publications

PUBLICATIONS

- **In Memory of AH "Steen" Gray Jr.** *IEEE SIGNAL PROCESSING MAGAZINE*
  Gray, R. M.
  2020; 37 (2): 96–100
- **Rate-Constrained Simulation and Source Coding i.i.d. Sources** *2010 Data Compression Conference (DCC 2010)*
  Mao, M. Z., Gray, R. M., Linder, T.
  IEEE-INST ELECTRICAL ELECTRONICS ENGINEERS INC.2011: 4516–29
- **On Asymptotically Optimal Stationary Source Codes for IID Sources** *Data Compression Conference (DCC)*
  Mao, M. Z., Gray, R. M., Linder, T.
  IEEE COMPUTER SOC.2011: 3–12
- **A Robust Hidden Markov Gauss Mixture Vector Quantizer for a Noisy Source** *15th IEEE International Conference on Image Processing (ICIP 2008)*
  Pyun, K. (., Lim, J., Gray, R. M.
  IEEE-INST ELECTRICAL ELECTRONICS ENGINEERS INC.2009: 1385–94
- **Real-world image annotation and retrieval: An introduction to the special section** *IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE*
  Wang, J. Z., Geman, D., Luo, J., Gray, R. M.
  2008; 30 (11): 1873-1876

- **Lagrangian vector quantization with combined entropy and codebook size constraints** *IEEE TRANSACTIONS ON INFORMATION THEORY*
  Gray, R. M., Linder, T., Gill, J. T.
  2008; 54 (5): 2220-2242
- **A note on rate-distortion functions for nonstationary Gaussian autoregressive processes** *IEEE TRANSACTIONS ON INFORMATION THEORY*
  Gray, R. M., Hashimoto, T.
  2008; 54 (3): 1319-1322
- **Rate-distortion functions for nonstationary Gaussian autoregressive processes** *18th Data Compression Conference*
  Gray, R. M., Hashimoto, T.
  IEEE COMPUTER SOC.2008: 53–62
- **Bits in Asymptotically Optimal Lossy Source Codes are Asymptotically Bernoulli** *19th Data Compression Conference*
  Gray, R. M., Linder, T.
  IEEE COMPUTER SOC.2008: 272–281
- **Entropy-based distortion measure and bit allocation for wavelet image compression** *IEEE TRANSACTIONS ON IMAGE PROCESSING*
  Andre, T., Antonini, M., Barlaud, M., Gray, R. M.
  2007; 16 (12): 3058-3064
- **Image segmentation using hidden Markov Gauss mixture models** *IEEE TRANSACTIONS ON IMAGE PROCESSING*
  Pyun, K. (., Lim, J., Won, C. S., Gray, R. M.
  2007; 16 (7): 1902-1911
- **Clustering and finding the number of clusters by unsupervised learning of mixture models using vector quantization** *32nd IEEE International Conference on Acoustics, Speech and Signal Processing*
  Yoon, S., Gray, R. M.
  IEEE.2007: 1081–1084
- **Quantization with joint entropy/memory constraints** *16th Data Compression Conference*
  Gray, R. M., Gill, J. T.
  IEEE COMPUTER SOC.2006: 223–232
- **Entropy-based distortion measure for image coding** *2006 IEEE INTERNATIONAL CONFERENCE ON IMAGE PROCESSING, ICIP 2006, PROCEEDINGS*
  Andre, T., Antonini, M., Barlaud, M., Gray, R. M.
  2006: 1157-?
- **Gauss mixture model-based classification for sensor networks** *16th Data Compression Conference*
  Ozonat, K., Gray, R. M.
  IEEE COMPUTER SOC.2006: 322–331
- **Quantization in task-driven sensing and distributed processing** *31st IEEE International Conference on Acoustics, Speech and Signal Processing*
  Gray, R. M.
  IEEE.2006: 5907–5910
- **Image compression with a vector speck algorithm** *31st IEEE International Conference on Acoustics, Speech and Signal Processing*
  Chao, C., Gray, R. M.
  IEEE.2006: 1693–1696
- **Quantization in task-driven sensing and distributed processing** *31st IEEE International Conference on Acoustics, Speech and Signal Processing*
  Gray, R. M.
  IEEE.2006: 1049–1052
- **Entropy and memory constrained vector quantization with separability based feature selection** *IEEE International Conference on Multimedia and Expo (ICME 2006)*
  Yoon, S., Gray, R. M.

IEEE.2006: 269–272

- **ONE-PASS ADAPTIVE UNIVERSAL VECTOR QUANTIZATION** *1994 IEEE International Conference on Acoustics, Speech and Signal Processing*
  Effros, M., Chou, P. A., Gray, R. M.
  IEEE.1994: 625–628
- **IMAGE RECONSTRUCTION USING VECTOR QUANTIZED LINEAR INTERPOLATION** *1994 IEEE International Conference on Acoustics, Speech and Signal Processing*
  Hemami, S. S., Gray, R. M.
  IEEE.1994: 629–632
- **QUANTIZATION NOISE SPECTRA** *IEEE TRANSACTIONS ON INFORMATION THEORY*
  Gray, R. M.
  1990; 36 (6): 1220-1244
- **SIGMA-DELTA MODULATION WITH IID GAUSSIAN INPUTS** *IEEE TRANSACTIONS ON INFORMATION THEORY*
  Wong, P. W., Gray, R. M.
  1990; 36 (4): 784-798
- **SPELLMODE RECOGNITION BASED ON VECTOR QUANTIZATION** *SPEECH COMMUNICATION*
  Huang, S. S., Gray, R. M.
  1988; 7 (1): 41-53
- **THE DESIGN OF JOINT SOURCE AND CHANNEL TRELLIS WAVEFORM CODERS** *IEEE TRANSACTIONS ON INFORMATION THEORY*
  Ayanoglu, E., Gray, R. M., Gray, R. M.
  1987; 33 (6): 855-865
- **ENCODING OF CORRELATED OBSERVATIONS** *IEEE TRANSACTIONS ON INFORMATION THEORY*
  Flynn, T. J., Gray, R. M.
  1987; 33 (6): 773-787
- **OVERSAMPLED SIGMA-DELTA-MODULATION** *IEEE TRANSACTIONS ON COMMUNICATIONS*
  Gray, R. M.
  1987; 35 (5): 481-489
- **SHAPE-GAIN MATRIX QUANTIZERS FOR LPC SPEECH** *IEEE TRANSACTIONS ON ACOUSTICS SPEECH AND SIGNAL PROCESSING*
  Tsao, C., Gray, R. M.
  1986; 34 (6): 1427-1439
- **BLOCK SOURCE-CODING THEORY FOR ASYMPTOTICALLY MEAN STATIONARY SOURCES** *IEEE TRANSACTIONS ON INFORMATION THEORY*
  Gray, R. M., Saadat, F.
  1984; 30 (1): 54-68
- **RATE-DISTORTION SPEECH CODING WITH A MINIMUM DISCRIMINATION INFORMATION DISTORTION MEASURE** *IEEE TRANSACTIONS ON INFORMATION THEORY*
  Gray, R. M., GRAY, A. H., REBOLLEDO, G., SHORE, J. E.
  1981; 27 (6): 708-721
- **SPEECH CODING BASED UPON VECTOR QUANTIZATION** *IEEE TRANSACTIONS ON ACOUSTICS SPEECH AND SIGNAL PROCESSING*
  BUZO, A., GRAY, A. H., Gray, R. M., MARKEL, J. D.
  1980; 28 (5): 562-574
- **DISTORTION MEASURES FOR SPEECH PROCESSING** *IEEE TRANSACTIONS ON ACOUSTICS SPEECH AND SIGNAL PROCESSING*
  Gray, R. M., BUZO, A., GRAY, A. H., Matsuyama, Y.
  1980; 28 (4): 367-376
- **FAKE PROCESS APPROACH TO DATA COMPRESSION** *IEEE TRANSACTIONS ON COMMUNICATIONS*
  Linde, Y., Gray, R. M.
  1978; 26 (6): 840-847

- **COMPARISON OF OPTIMAL QUANTIZATIONS OF SPEECH REFLECTION COEFFICIENTS** *IEEE TRANSACTIONS ON ACOUSTICS SPEECH AND SIGNAL PROCESSING*
  GRAY, A. H., Gray, R. M., MARKET, J. D.
  1977; 25 (1): 9-23
- **TIME-INVARIANT TRELLIS ENCODING OF ERGODIC DISCRETE-TIME SOURCES WITH A FIDELITY CRITERION** *IEEE TRANSACTIONS ON INFORMATION THEORY*
  Gray, R. M.
  1977; 23 (1): 71-83
- **SOURCE CODING FOR A SIMPLE NETWORK** *BELL SYSTEM TECHNICAL JOURNAL*
  Gray, R. M., WYNER, A. D.
  1974; 53 (9): 1681-1721
- **UNBOUNDED TOEPLITZ MATRICES AND NONSTATIONARY TIME SERIES WITH AN APPLICATION TO INFORMATION-THEORY** *INFORMATION AND CONTROL*
  Gray, R. M.
  1974; 24 (2): 181-196