Data Compression Conference (DCC'95)

(Sponsored by the IEEE Computer Society TCCC)

Snowbird, Utah
March 28-30, 1995

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THEME: An international forum for current work on data compression and related areas. Topics of interest include but are not limited to: Source coding, quantization theory, parallel compression algorithms and hardware, lossless and lossy compression algorithms for specific types of data (including text, images, video, speech, music, maps, instrument data, graphics, animation, and bit-maps), data compression standards, bi-level coding, transform methods, wavelet and fractal techniques, string searching and manipulation, closest-match retrieval, theory of minimal length encoding and applications to learning, system issues relating to data compression (including error control, data security, indexing, and browsing), medical imagery, scientific and space data.

WORKSHOPS: Associated with the conference is a NASA workshop on Monday (contact Kar-Ming Cheung, kmcheung@shannon.jpl.nasa.gov, 818-393-9480) and an industrial applications workshop on Friday (contact Rob Renner, 310-812-4868, renner@spf.trw.com).

SCHEDULE:

Monday: NASA Workshop

Monday Evening: Registration and Reception

Tuesday
Morning: Technical Sessions
Mid-Day: Invited Presentation
Afternoon: Technical Sessions

Wednesday
Morning: Technical Sessions
Mid-Day: Invited Presentation
Afternoon: Poster Session and Reception

Thursday
Morning: Technical Sessions
Mid-Day: Invited Presentation
Afternoon: Technical Sessions

Friday: Industry Workshop

PROGRAM

MONDAY, MARCH 27: Registration / Reception, 7:00-10:00pm, In the Golden Cliff Room

TUESDAY, MARCH 28

Welcome: 7:45am

Session 1: 8:00am - 10:05am
Chaired by E. Riskin, U. Washington

8:00am
"Hierarchical Vector Quantization of Perceptually Weighted Block Transforms"
N. Chaddha, M. Vishwanath, P. Chou
Stanford University, Xerox Parc Research Center

8:25am
"Quantization of Overcomplete Expansions"
V. Goyal, M. Vetterli, N. Thao
University of California, Berkeley

8:50am
"Constraining the Size of the Instantaneous Alphabet in Trellis Quantizers"
M. Larsen, R. Frost
Brigham Young University

9:15am
"Tree-Structured Vector Quantization with Significance Map for Wavelet Image Coding"
P. Cosman
University of Minnesota

9:40am
"Constrained-Storage Vector Quantization with a Universal Codebook"
S. Ramakrishnan, K. Rose, A. Gersho
University of California, Santa Barbara

Break: 10:05am - 10:30am

Session 2: 10:30am - 12:35pm
Chaired by T. Bell, U. Canterbury

10:30am
"Unbounded Length Contexts for PPM"
J. Cleary, W. Teahan, I. Witten
University of Waikato

10:55am
"Nonmonotonic Context Models in the MDL Framework"
E. Ristad, R. Thomas
Princeton University

11:20am
"The Structure of DMC"
S. Bunton
University of Washington

11:45am
"Universal Coding for Arbitrarily Varying Sources and for Hierarchies of Model Classes"
M. Feder, N. Merhav
Tel-Aviv University, Technion-Israel Institute of Technology

12:10pm
"Coding with Partially Hidden Markov Models"
S. Forchhammer, J. Rissanen
Technical University of Denmark, IBM Research Division

Lunch Break: 12:35pm - 2:00pm

Mid-Day Invited Presentation: 2:00pm - 3:30pm

"Video Coding: Quality Evaluation and System Design"
Prof. John Villasenor
School of Engineering and Applied Science, UCLA
(talk abstract follows this program)

Session 3: 4:00pm - 6:30pm
Chaired by K. Cheung, NASA

4:00pm
"Quadtree Based JBIG Compression"
B. Fowler, R. Arps, A. El Gamal, D. Yang
Stanford University

4:25pm
"Lossy Compression of Clustered-Dot Halftones Using Sub-Cell Prediction"
R. Vander Kam, R. Gray
Stanford University

4:50pm
"Efficient Error Free Chain Coding of Binary Documents"
R. Estes, V. Algazi
University of California, Davis

5:15pm
"New Algorithms for Optimal Binary Vector Quantizer Design"
X. Wu, Y. Fang
University of Western Ontario, Bell Northern Research

5:40pm
"Finite State Methods for Compression and Manipulation of Images"
K. Culik, J. Kari
University of South Carolina, Academy of Finland

6:05pm
"A Derailment-free Finite-State Vector Quantizer with Optimized State Codebooks "
X. Ginesta, S. Kim
Polytechnic University

WEDNESDAY, MARCH 29

Session 4: 8:00 - 10:05
Chaired by P. Howard, AT&T

8:00am
"Parallel Algorithms for the Static Dictionary Compression"
H. Nagumo, M. Lu, K. Watson
Texas A&M University

8:25am
"Near Optimal Compression with Respect to a Static Dictionary
on a Practical Massively Parallel Architecture"
D. Belinskaya, S. DiAgostino, J.A. Storer
Brandeis University

8:50am
"An Efficient Variable Length Coding Scheme for an IID Source"
K. Cheung, A. Kiely
Jet Propulsion Laboratory

9:15am
"Space-Efficient Construction of Optimal Prefix Codes"
A. Moffat, A. Turpin, J. Katajainen
University of Melbourne, Copenhagen University

9:40am
"Arithmetic Coding Revisited"
A. Moffat, R. Neal, I. Witten
University of Melbourne, University of Toronto, University of Waikato

Break: 10:05am - 10:30am

Session 5: 10:30am - 12:35Pm
Chaired by G. Langdon, UCSC

10:30am
"CREW: Compression with Reversible Embedded Wavelets"
A. Zandi, J. Allen, E. Schwartz, M. Boliek
RICOH California Research Center

10:55am
"Accelerating Fractal Image Compression by Multi-Dimensional Nearest Neighbor Search"
D. Saupe
Universität Freiburg

11:20am
"Self-Quantized Wavelet Subtrees: A Wavelet-Based Theory for Fractal
Image Compression"
G. Davis
Dartmouth College

11:45am
"Convergence of Fractal Encoded Images"
J. Kominek
University of Waterloo

12:10Pm
"Embedded Wavelet Zerotree Coding with Direct Sum Quantization Structures"
C. Barnes, P. Watkins
Georgia Institute of Technology

Lunch Break: 12:35pm - 2:00pm

Mid-Day Inivted Presentation: 2:00pm - 3:30pm

"Quality and Utility in Lossy Compressed Medical Images"
Prof. Robert M. Gray
Information Systems Laboratory, Electrical Engineering Department Stanford University
and Vinton Hayes Visiting Scholar, Harvard University
(talk abstract follows this program)

POSTER SESSION AND RECEPTION

4:00-7:00pm
In the Golden Cliff Room

(Abstracts of each presentation appear in the proceedings.)

THURSDAY, MARCH 30

Session 6: 8:00am - 10:05am
Chaired by I. Witten, U. Waikato

8:00am
"Generalized Lempel-Ziv Parsing Scheme and its Preliminary Analysis of the Average Profile"
G. Louchard, W. Szpankowski
Université Libre de Bruxelles, Prudue University

8:25am
"Multiple-Dictionary Coding Using Partial Matching"
D. Hoang, J. Vitter, P. Long
Duke University

8:50am
"Fast Pattern Matching for Entropy Bounded Text"
S. Chen, J. Reif
Duke University

9:15am
"An Improved Hierarchical Lossless Text Compression Algorithm"
C. Teng, D. Neuhoff
University of Michigan

9:40am
"The Effect of Non-Greedy Parsing in Ziv-Lempel Compression Methods"
R. Horspool
University of Victoria

Break: 10:05am - 10:30am

Session 7: 10:30am - 12:35pm
Chaired by M. Vetterli (UC Berkeley)

10:30am
"A Comparison of the Z, E8, and Leech Lattices for Image Subband Quantization"
Z. Gao, B. Belzer, J. Villasenor
University of California, Los Angeles

10:55am
"Compression of Hyperspectral Imagery
Using Hybrid DPCM/DCT and Entropy-Constrained Trellis Coded Quantization"
G. Abousleman
Hughes Space and Communications

11:20am
"RD-OPT: An Efficient Algorithm for Optimizing DCT Quantization Tables"
V. Ratnakar, M. Livny
University of Wisconsin-Madison

11:45am
"JPEG Optimization Entropy-Constrained Quantization Framework"
M. Crouse, K. Ramchandran
University of Illinois at Urbana-Champaign

12:10pm
"Multiplication-Free Subband Coding of Color Images"
W. Chung, F. Kossentini, M. Smith
Georgia Institute of Technology

Lunch Break: 12:35pm - 2:00pm

Mid-Day Invited Presentation: 2:00pm - 3:30pm

"Image coding: Where Has It Been; Where Is It Going?"
Prof. Michael Orchard
Beckman Institute, University of Illinois at Urbana-Champaign
(talk abstract follows this program)

Session 8: 4:00pm - 6:30pm
Chaired by R. Renner, TRW

4:00pm
"An Automatic System for Model-Based Coding of Faces"
B. Moghaddam, A. Pentland
Massachusetts Institute of Technology

4:25pm
"A New Model of Perceptual Threshold Functions of Application in Image Compression Systems"
K.S. Prashant, V. J. Mathews
University of Utah

4:50pm
"A New Approach to Scalable Video Coding"
W. Chung, F. Kossentini, M. Smith
Georgia Institute of Technology

5:15pm
"New Relationships in Operator-Based Backward Motion Compensation"
A. Nosratinia, M. Orchard
University of Illinois at Urbana-Champaign

5:40pm
"Optimal Representation of Motion Fields for Video Compression"
J. Gisladottir, M. Orchard
University of Illinois at Urbana-Champaign

6:05pm
"Matching Pursuit Video Coding at Very Low Bit Rates"
R. Neff, A. Zakhor
University of California, Berkeley

ABSTRACTS OF MID_DAY INVITED PRESENTATIONS

Video Coding: Quality Evaluation and System Design

Prof. John Villasenor
School of Engineering and Applied Science, UCLA

Designers of video coding algorithms invest significant energy developing techniques to enable improvements in reconstructed video quality. This raises issues of how quality of compressed video should be measured, and more fundamentally, of the specific ways in which quality assessments are used in the overall design process of an algorithm, system, or product. This presentation will give an overview of video quality evaluation techniques, and will use examples drawn from entertainment, communications, defense, and medicine to illustrate how decisions regarding which algorithms are "better" are made. Of particular interest is the perspective gained by considering a high level view that image quality is only one of many technological and market factors that are important in the development and ultimate commercial success of an application. The relative importance of these factors varies greatly among fields. For example in medicine, diagnostic accuracy must not be sacrificed, whereas users of future handheld wireless video devices will probably accept significant image quality loss in exchange for mobility. An understanding of how quality should be measured across different video applications leads to conclusions about the nature of evaluation metrics that are needed, and also suggests some directions for future coding research.

Quality and Utility in Lossy Compressed Medical Images

Prof. Robert M. Gray
Information Systems Laboratory, Electrical Engineering Department Stanford University and Vinton Hayes Visiting Scholar, Harvard University

Digitization of analog images such as x-rays causes a loss of information, as does lossy compression of such images and other forms of digital image processing. Even signal processing having as a goal the improvement of the image, such as segmentation and enhancement, changes the image and hence might cause damage as well as harm. Traditional engineering quality measures such as signal-to-noise ratio and mean opinion scores are not generally adequate for measuring the quality and utility of an image used for screening or diagnosis, although both can be useful in developing image processing algorithms. This talk will be devoted to the design and statistical analysis of clinical simulations intended to quantify the quality and utility of digitized and lossy compressed medical images in screening and diagnostic applications. In particular, how does one verify that one algorithm (or modality or bit rate) is at least equal and possibly superior to another in a general clinical task? Are there statistically significant differences between competing modalities? Are these differences smaller and larger than the differences among radiologists or even for a given radiologist? The historically dominant technique, receiver operating characteristic (ROC) analysis, will be described, along with recently developed resampling methods which provide alternative statistical tests based on computer-intensive resampling techniques. Past examples and experiments in progress will be described, along with some thoughts on differences in convincing colleagues vs. convincing the FDA.

Image coding: Where Has It Been; Where Is It Going?

Prof. Michael Orchard
Beckman Institute, University of Illinois at Urbana-Champaign

Several current projects in image and video coding involve drastically different approaches to coding algorithms than have been considered before. The exciting part is that they seem to work very well! I will discuss some high-level beliefs about why ideas related to our new approaches have not be explored more fully. I believe that the image coding community has been too quick to converge on a few data-structures that provide the framework for characterizing distributions of images (i.e. block VQ, block-based transform coding, subband coding, motion-compensated hybrid video coding, etc.) Almost ALL work in the field concentrates how to most efficiently represent distributions of images within the constraints of these data-structures, whereas. it is often the data-structure itself which is most critical in determining the performance of algorithms. Thus, just when we think we understand the best way to code images, new algorithms are defined which outperform previous approaches, and redefine the game. Most often, these new algorithms do not find better answers to old questions, but instead redefine the questions in terms of better data-structures. Wavelets and zero-trees are some examples of this phenomenon. It is also interesting to note that issues surrounding the data-structure take on added significance when incorporating coding into systems applications which have their own reasons for preferring one data-structure over another.