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ADVANCE PROGRAM

Data Compression Conference (DCC'96)

(Sponsored by the IEEE Computer Society TCCC)

Snowbird, Utah
April 1 - 3, 1996

GENERAL CHAIR: J. Storer, Brandeis U.
PROGRAM CHAIR: M. Cohn, Brandeis U.
PROGRAM COMMITTEE: R. Arps (IBM), T. Bell (U. Canterbury), J. Cleary (U. Waikato), M. Cohn (Brandeis U.), M. Effros (CalTech), R. Giancarlo (U. Palermo), R. M. Gray (Stanford U.), P. Howard (AT&T), A. Kiely (NASA), G. Langdon (UC Santa Cruz), A. Lempel (Technion), R. Lindsay (Loral), A. Moffat (U. Melbourne), M. Orchard (Princeton U.), J. Reif (Duke U.), R. Renner (Ball Aerospace), A. Rodriguez (Scientific Atlanta), E. Riskin (U. Washington), D. Sheinwald (IBM), J. Storer (Brandeis U.), M. Vetterli (UC Berkeley), J. Villasenor (UCLA), I. Witten (U. Waikato), K. Zeger (U. Illinois), J. Ziv (Technion).

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, 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.

SCHEDULE OVERVIEW:

Sunday Evening: Wine and Cheese Reception and Registration

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

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

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

Thursday: NASA / Industry Workshop

SUNDAY, MARCH 31
Registration / Reception, 7:00-10:00pm (Golden Cliff Room)

MONDAY, April 1

Welcome: 7:45am

Session 1: 8:00am - 10:05am

8:00am
"Robust Quantization for Image Coding and Noisy Digital Transmission"
Q. Chen and T.R. Fischer
Washington State University

8:25am
"Symmetric Trellis Coded Vector Quantization"
B. Belzer and J. Villasenor
UC Los Angeles

8:50am
"Joint Image Classification and Compression
using Hierarchical Table-Lookup Vector Quantization"
N. Chaddha, K. Perlmutter, and R.M. Gray
Stanford University

9:15am
"Designing Vector Quantizers in the Presence of Source Noise or Channel Noise"
T. Linder, G. Lugosi, and K. Zeger
University of Budapest, University of Illinois

9:40am
"Lossy Compression of Noisy Cardiac Image Sequences"
O.K. Al-Shaykh and R.M. Mersereau
Georgia Institute of Technology

Break: 10:05am - 10:30am

Session 2: 10:30am - 12:35pm

10:30am
"The Entropy of English using PPM-Based Models"
W.J. Teahan and J.G. Cleary
University of Waikato

10:55am
"Compressing Semi-Structured Text using Hierarchical Phrase Identification"
C.G. Nevill-Manning, I.H. Witten, and D.R. Olsen
University of Waikato, Brigham Young University

11:20am
"Free Energy Coding"
B.J. Frey and G.E. Hinton
University of Toronto

11:45am
"Exploiting Clustering in Inverted File Compression"
L. Stuiver and A. Moffat
University of Melbourne

12:10pm
"On the Average Redundancy Rate of the Lempel-Ziv Code"
G. Louchard, W. Szpankowski
Universite Libre de Bruxelles, Purdue University

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

Mid-Day Invited Presentation: 2:00pm - 3:30pm
"Data Compression Patents"
Wayne Barsky, The Law Firm of Irell & Manella

Session 3: 4:00pm - 5:15pm

4:00pm
"Efficient Cost Measures for Motion Compensation at Low Bit Rates"
D.T. Hoang, P.M. Long, and J.S. Vitter
Duke University

4:25pm
"Morphological Motion Field Representation for Region-Based Image Sequence Coding"
X. Yang and K. Ramchandran
University of Illinois

4:50pm
"Rate-Distortion Based Temporal Filtering for Video Compression"
O.G. Guleryuz and M.T. Orchard
University of Illinois, Princeton University

Break: 5:15pm - 5:40pm

Session 4: 5:40pm - 6:55pm

5:40pm
"Lossless Compression of Grayscale Images via Context Tree Weighting"
N. Ekstrand
Lund University

6:05pm
"Loco-I: A Low Complexity, Context-Based, Lossless Image Compression Algorithm"
M.J. Weinberger, G. Seroussi, and G. Sapiro
Hewlett-Packard Laboratories

6:30pm
"An Algorithmic Study on Lossless Image Compression"
X. Wu
University of Western Ontario

TUESDAY, April 2

Session 5: 8:00 - 10:05

8:00am
"An Adaptive Data Compression Method Based on Context Sorting"
H. Yokoo
Gunma University

8:25am
"On the Implementation of Minimum-Redundancy Prefix Codes"
A. Turpin and A. Moffat
University of Melbourne

8:50am
"Parsing with Prefix and Suffix Dictionaries"
M. Cohn and R. Khazan
Brandeis University

9:15am
"Extended Application of Suffix Trees to Data Compression"
N. J. Larsson
Lund University

9:40am
"Parallel Compression with Cooperative Dictionary Construction"
P. Franaszek, J. Robinson, and J. Thomas
IBM Watson Research Center

Break: 10:05am - 10:30am

Session 6: 10:30am - 12:35Pm

10:30am
"Lossless and Lossy Compression of Text Images by Soft Pattern Matching"
P.G. Howard
AT&T Bell Laboratories

10:55am
"Constrained and Recursive Hierarchical Table-Lookup Vector Quantization"
N. Chaddha, P. A. Chou, and R. M. Gray
Stanford University

11:20am
"Fast Reconstruction of Subband Decomposed Signals for Progressive Transmission"
H. Jafarkhani and N. Farvardin
University of Maryland

11:45am
"Optimum Pre- and Post filters for Robust Scalar Quantization"
P.W. Wong, N. Moayeri, and C. Herley
Hewlett-Packard Laboratories

12:10pm
"Fixed-Rate Successively Refinable Scalar Quantizers"
H. Brunk and N. Farvardin
University of Maryland

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

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

"Unplugging computer science for children:
Playing games with information, compression, communication and encryption."

Tim Bell, U. Canterbury
Ian Witten, U. Waikato
Mike Fellows, U. Victoria

POSTER SESSION AND RECEPTION

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

(Abstracts of each presentation appear in the proceedings.)

WEDNESDAY, April 3

Session 7: 8:00am - 10:05am

8:00am
"Piecewise Linear Tree-Structured Models for Lossless Image Compression"
M. Slyz and D.L. Neuhoff
University of Michigan

8:25am
Bi-level Image Compression with Tree Coding"
B. Martins and S. Forchhammer
University of Denmark

8:50am

"Finite Automata Based Compression of Bi-level Images
K. Culik II and V. Valenta
University of South Carolina

9:15am
"Lossless Image Compression Using Generalized LZ1-Type Methods"
J. A. Storer
Brandeis University

9:40am
"Pattern-Based Compression of Text Images"
A. Broder and M. Mitzenmacher
Digital Systems Research Center, UC Berkeley

Break: 10:05am - 10:30am

Session 8: 10:30am - 12:35pm

10:30am
"Predictive Vector Quantization with Ridge Regression"
C. Nash, R. Olshen, and R. M. Gray
Stanford University

10:55am
"Lapped Orthogonal Vector Quantization"
H.S. Malvar, G.J. Sullivan, and G.W. Wornell
PictureTel Corporation, Massachusetts Institute of Technology

11:20am
"Stochastic Vector Quantization,
and Stochastic VQ with State Feedback Using Neural Nets"
E. Levine
Stanford University

11:45am
"Distortion-Limited Vector Quantization"
P.J. Hahn and V.J. Mathews
University of Utah

12:10pm
"Optimal Bit Allocation under Multiple Rate Constraints"
A. Ortega
University of Southern California

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

Mid-Day Invited Presentation: 2:00pm - 3:30pm
"Update for an International Standard for Lossless and Near-Lossless Still Image Compression and Convergence"
(Panel Discussion - G. Langdon, N. Memon, G. Seroussi, D. Speck, M. Weinberger, X. Wu)

Session 9: 4:00pm - 5:15pm

4:00pm
"Refining Image Compression with Weighted Finite Automata"
U. Hafner
Universitat Wurzburg

4:25pm
"Arbitrary Tilings of the Time-Frequency Plane Using Local Bases"
R. Bernardini and J. Kovacevic
University of Padova, AT&T Bell Laboratories

4:50pm
"Extending RD-OPT with Global Thresholding for JPEG Optimization"
V. Ratnaker and M. Livny
University of Wisconsin

Break: 5:15pm - 5:40pm

Session 10: 5:40pm - 6:55pm

5:40pm
"Optimal Bit Allocation for Biorthogonal Wavelet Coding"
B. Usevitch
University of Texas

6:05pm
"Seismic Data Compression Using High-Dimensional Wavelet Transforms"
J.D. Villasenor and R.A. Ergas
UC Los Angeles, Chevron Petroleum Technology Company

6:30pm
"Quadtree-Guided Wavelet Image Coding"
C.Y. Teng and D.L. Neuhoff
University of Michigan

THURSDAY, April 4: NASA/Industry Workshop
(see separate program)

Abstracts of Mid-Day Invited Talks

MONDAY

The Undersea World of High Technology:
How the new patent law regime affects "submarine" patents
and other bottom dwellers.

Wayne M. Barsky, *The Law Firm of Irell & Manella*

Until very recently, the life of virtually all United States patents was 17 years from the date of issuance. This 17-year term applied regardless of how long the application was pending in the Patent Office. One of the principal problems this rule occasioned was that some inventors and their counsel would intentionally delay the issuance of their patents for many years or even decades by filing numerous continuation, continuation-in-part (CIP) and divisional applications, while at the same time seeking to claim a priority from the earliest such application. Such patents are commonly referred to in the patent community as "submarine" patents, inasmuch as they lurk in secrecy within the Patent Office for years, surfacing only after entire industries have committed to the technology claimed in the patent.

In order to comply with the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) and its associated Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), the United States made several fundamental changes to our patent laws effective on June 8, 1995. This paper summarizes our nation's new patent law regime, and examines the effect such changes will have on the problems presented by "submarine" patents.

Mr. Barsky is a partner in the Intellectual Property and Litigation departments of Irell & Manella. He was one of the principal trial lawyers representing Stac Electronics in its recent patent infringement suit against Microsoft Corporation, which resulted in a $120 million jury verdict against Microsoft and a world-wide injunction against, and recall of, the MS-DOS 6 operating system.

TUESDAY

"Unplugging computer science for children:
Playing games with information, compression, communication and encryption"

Tim Bell, *University of Canterbury*
Ian H. Witten, *University of Waikato*
Mike Fellows, *University of Victoria*

Although living in the information age and witnessing the rocketing growth of computing technologies, many people have a grossly distorted understanding of what the technology is capable of, and what its limitations are. An ideal place to address this misunderstanding is at elementary school. Just as it is important for children to study elementary biology in order to be informed about environmental issues, it is valuable for them to gain an elementary understanding of computer science in order to understand the issues that surround the use of technology. Much of the "computer education" that children receive tends to be focused on using the computer as a tool, rather than understanding the potential - both good and bad - of the tool.

This talk will describe a unique approach to exposing young children to concepts of computer science. We have developed a series of activities that give children some exposure to key issues and techniques in these areas. The activities do not use computers at all, but instead rely on low-

tech items that children are familiar with, such as cards, crayons, and string. It turns out that this "technology-free" approach to computing emphasizes topics of information representation and compression far more than the traditional computer science curriculum. We begin with binary numbers, and progress through picture representation to text compression, error control, and foundations of information theory - a rather unusual introduction to computer science. These topics provide a view of computing that young children can relate to, and they lend themselves naturally to simple but intriguing activities.

The activities have been tested in several elementary schools, and have had a very favorable reception. They are particularly useful to the computing professional who is invited to give a presentation to children, or even adults who have little technical background. They have been used in the classroom, in science center demonstrations, in the home, and even for community fun days in a park!

WEDNESDAY

"*Update for an International Standard for Lossless and Near-Lossless Still Image Compression and Convergence*"

Xiaoln Wu, *U. West Ontario*
Nasir Memon, *Northern Illinois U.*
Marcelo Weinberger & Gadiel Seroussi, *HP Labs Palo Alto*
Glen Langdon & Don Speck, *UC Santa Cruz*

On March 8, 1994, the international standards Working Group 1 of Standards Committee 29 of ISO/IEC JTC 1 issued a Call for Contributions for project 1.29.12 titled “Next Generation Lossless Compression of Continuous-tone Still Pictures”. The specification is for lossless or near-lossless compression of still images of from 2 to 16 bits per sample. This new standard would supplement and/or replace what is commonly known as the “lossless mode” of the JPEG standard.

Nine technical proposals were submitted in response to the call, originating from various universities and industrial research centers. These proposals were discussed and refined at meetings in July 1995 in Epernay, France, and in November 1995 in Dallas, Texas. From these discussions, a consensus emerged to develop two variants for the standard: one emphasizing low *complexity solutions* while maintaining excellent compression performance, and one aiming to achieve the *highest possible compression* ratios, while allowing for higher although still reasonable levels of complexity. In a natural evolution, the first variant evolved to schemes based on Huffman-type coding, while the second one will use arithmetic coding.

The proposed schemes were tested using a new set of benchmark images from a wide variety of sources, including natural and aerial photographs, compound documents, scanned, computer graphics, and medical images. The results presented as of the Dallas meeting show an average difference of about 4\% in compression between the leading higher and lower complexity versions under consideration. The improvement over the current lossless JPEG averages about 30% for the Huffman version, and about 15% for the arithmetic coding version. This improvement is significantly higher for certain types of images (e.g. compound documents) for which the current JPEG lossless standard is inadequate.

The panel will discuss the technical approaches being considered, the properties of the new test set, the convergence efforts in the standardization process, as well as report on the most recent information following the February 1996 meeting of SG29 Working Group 1 in Geneva.