IEEE Information Theory Society Newsletter

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IEEE Information Theory Society Golden Jubilee Awards for Technological Innovation and Golden Jubilee Paper Awards

To commemorate the 50th Anniversary of Information Theory, the Board of Governors of the IEEE Information Theory Society instituted the IEEE Information Theory Society Golden Jubilee Awards for Technological Innovation and the Golden Jubilee Paper Awards. The awards were given at the 1998 International Symposium on Information Theory, Cambridge, Massachusetts, August 1998.

IEEE Information Theory Society Golden Jubilee Awards for Technological Innovation

The Golden Jubilee Awards are given to the authors of discoveries, advances and inventions that have had a profound impact in the technology of information transmission, processing and compression. The recipients of the 1998 IEEE Information Theory Society Golden Jubilee Awards for Technological Innovation are:

1. **Norman Abramson:**
   For the invention of the first random-access communication protocol.
2. **Elwyn Berlekamp:**
   For the invention of a computationally efficient algebraic decoding algorithm.
3. **Claude Berrou, Alain Glavieux and Puna Thitimajshima:**
   For the invention of turbo codes.
4. **Ingrid Daubechies:**
   For the invention of wavelet-based methods for signal processing.
5. **Whitfield Diffie and Martin Hellman:**
   For the invention of public-key cryptography.
6. **Peter Elias:**
   For the invention of convolutional codes.
7. **G. David Forney, Jr:**
   For the invention of concatenated codes and a generalized minimum-distance decoding algorithm.
8. **Robert M. Gray:**
   For the invention and development of training mode vector quantization.
9. **David Huffman:**
   For the invention of the Huffman minimum-length lossless data-compression code.
10. **Kees A. Schouhamer Immink:**
    For the invention of constrained codes for commercial recording systems.
11. **Abraham Lempel and Jacob Ziv:**
    For the invention of the Lempel-Ziv universal data compression algorithm.
12. **Robert W. Lucky:**
    For the invention of pioneering adaptive equalization methods.

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From the Editor

Michelle Effros

The highlight of this issue is the announcement of the IEEE Information Theory Society Golden Jubilee Awards for Technological Innovation and the Golden Jubilee Paper Awards, which recognize some of the accomplishments of the first 50 years of information theory. Also included in this issue are messages from the society President Thomas Ericson, society Historian Tony Ephremides, and new Editor-in-Chief of the *IEEE Transactions on Information Theory* Alex Vardy.

Since this issue went to press before ISIT 1998, photos and articles concerning the Symposium will appear in the December issue of the Newsletter.

Please help me to make the Newsletter as interesting and informative as possible by contributing suggestions, news, and articles. The deadlines for receiving material for the next few issues are as follows.

Issue	Deadline
December 1998	October 15, 1998
March 1999	January 15, 1999
June 1999	April 15, 1999
September 1999	July 15, 1999

Michelle Effros

Electronic submission, especially in LaTeX format, is encouraged. I may be reached at the following address.

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President's Column

Thomas Ericson

When you read this column we have just recently finished ISIT'98, the Golden Jubilee Symposium. I am sure we will be able to conclude that it was a great success. At the current moment, as I am writing this letter in mid-July, we are just making the final preparations. Many people are working hard in order to make this symposium a very special one. It is, of course, especially exciting that the Jubilee Symposium could be arranged at the place which more than any other place is closely tied to the pioneering achievements of information theory, namely at MIT.

Thomas Ericson

One of the special features of ISIT 98 is the Golden Jubilee Awards. The idea with these one-time awards is to recognize some of the most important of the many scientific and technological contributions from the first 50 years of Information Theory. The awards are divided into two categories. The first category recognizes significant papers that have not been previously awarded. The second category recognizes technological innovations. The lists of awards in both categories are published elsewhere in this Newsletter.

Looking at these lists, one striking observation is how close to each other the theoretical and practical achievements have evolved within our field. Highly abstract mathematical ideas have very rapidly found their ways to practical applications, and new technological achievements have often inspired new theoretical development. It seems to me that one of the salient features of information theory is this close relation between theory and practice.

Another striking observation is the wide range of technology and ideas. Among the awarded innovations we find Norman Abramson's random-access communication protocol, Bob Lucky's adaptive equalizer, the Lempel-Ziv universal data compression algorithm, the Diffie-Hellman public-key encryption, Ungerboeck's trellis coded modulation, and the Viterbi algorithm — just to mention a few of them. As we are all aware there are many further important contributions — both the remaining ones on the list of Golden Jubilee Awards and many other ones outside this list. Together they span over a very broad range of technologies, many of which are of indispensable importance to modern society. The common feature of these achievements is that they are all based on a common family of theoretical ideas regarding representation, processing and utilization of information — information theory.

The paper awards also span a wide range. Here first of all we find Golay's classical paper, presenting for the first time the famous codes which by now are referred to as the Golay codes. Very seldom are such beautiful mathematical objects discovered. The paper in itself is extremely short — just half a page. In contrast the number of subsequent papers it has inspired is almost endless. As we know now there are beautiful connections to group theory (Mathieu groups), lattice theory (Leech lattice), design theory and many other topics. As codes, the Golay codes are outstanding: they are the only non-trivial multiple-error correcting codes. In addition to all of this, they are practical: many efficient algorithms are available for the practical implementation of Golay codes.

Among the other awarded papers we find Shannon's also by now classical paper on the zero-error capacity. This beautiful paper brings together information theory and graph theory and has had an enormous impact on both areas.

In order to illustrate the breadth of the ideas involved, let us mention just a few of the other awarded papers. We have Gallager's paper on low-density parity-check codes, Kailath's paper on a general likelihood-formula, Forney's paper on the structural properties of convolutional codes and the McEliece-Rodemich-Rumsey-Welch paper on the linear programming bound. All of these — and of course also all of the other now and previously awarded papers — present fundamental theoretical insight with an enormous impact on both the theoretical and practical evolution of telecommunication and related areas.

One might reflect about the interaction between theory and practice. Which comes first? One view is that theory always comes first and that practical applications are all based on insights first gained by theoretical investigations. The opposite view is that technological evolution arises out of practical needs, that solutions are normally obtained without any theory at all and that theory is only an academic game which at best is able to explain in retrospect certain practical results already achieved.

I think that experience tells us that neither of these extreme views is correct and that the relation between theory and practice is extremely complex. Looking at the two lists of awarded papers and innovations I think we must conclude that technological evolution at its best occurs as a mutual interaction between theory and practice, where new theoretical insights pave the road for new practical applications and where practical experience and needs inspire new theory and deeper insights. My personal view is that the development within information theory during the 50 years since the publication of the fundamental papers by Shannon provides beautiful and very convincing support to this view.

Historian's Column

A. Ephremides

A. Ephremides

One aspect of the history of the Society's activities is of course the long series of Symposia, workshops, and other meetings that have taken place over the last fifty years and have brought together various subsets of us for interaction, communication, and fellowship. A great deal of technical information exchange has taken place during these meetings and most of the fundamental developments in our field have been fostered at these conferences. However, when scores or hundreds of people get together in one location for several days, there are other, more basic functions and events that also take place to support their less lofty, yet equally important, needs and desires.

Today, I would like to focus on one of these "human needs" which is as central to the nourishment of the body, as our technical sessions are to the nourishment of our minds. It simply concerns food! Over the years there have been thousands of communal meals that have provided sustenance to our conference attendees. Personally, I have no difficulty suppressing in me any suggestion that this topic might be perceived as frivolous or flippant. Much before the hippie leader's pronouncement in the sixties that "you are what you eat," it was Hippocrates himself who said "let thy mind be thy food and thy food be thy mind." Popular folklore in many parts of the world points out that "you won't make the monkey perform unless you feed him first" and I would paraphrase this by saying that you can't do good research if you are poorly fed. I need, though, to point out in this time of plenty that by "poorly fed" I am not referring to quantity but rather to quality.

Like most of us, I have had my share of bad meals at technical meetings. The pressure of standardization (alas, for any line of products) has produced certain despicable culinary combinations that dominate conference fodder nowadays (especially in the United States). I know that, at least subconsciously, most of us would like to suppress memories of such needs, but let me refresh your memory. Uncooked, yet strongly "soft", vegetables (like cauliflower, carrots, etc.), served alongside heavily colored, flavorless, but calorie rich dips, iceberg lettuce leaves, the legendary "fruit cup" (right out of the can), minestrone soup, the (aagh!) "rubber" chicken breast, that has undergone a series of irradiation-induced transformations (from sickly, hormone-rich, force-fed bird, to rotting carcass, to electrocuted parts, to microwaved end product), with boiled green beans and rice, the "gooey" thick brownie, and the glass of "iced tea", which is mainly ice sprinkled with a yellowish brown liquid, all constitute the "ultimate" conference meal and attest to the glory of the institutionalized meal served proudly by the food industry.

Fortunately, the meetings of the Information Theory Society have not been plagued by as atrocious fare as that; but some meals have come close. An outstanding example of shameless assault on our taste buds has been the series of meals at the 1985 ISIT in Brighton. England has been much maligned about the blandness of its traditional food, but I beg to disagree. Fine game birds, excellent lamb, dover sole, wonderful cheeses, and the legendary English breakfast constitute compelling evidence of repudiation of this public misconception. However, the meals at the hotel Metropole in Brighton did nothing to dispel the ugly reputation of British food.

The road to mediocre food is very slippery. There are a few simple steps that assure the establishment of a secure base from which one can safely plunge to the depths of nutritional mediocrity and neutralized taste capability. First and foremost is the rule of selecting the lowest bidder. This assures that your fish will be nondescript frozen white fillets (thawed for your convenience), your meat will be overcooked lumps or slices of tough beef, your strawberries will be pear-size, white, and hardened, your sauces will come right from the bottle, your salads will consist of hormone-cured large green leaves with acrid vinaigrettes, and your desserts will be mainly "aged", flour-rich, jam-filled pies.

The next rule is to plan meals for huge groups and for minimal duration. This leads to "efficient," lean- and mean-service, "buffets," and pre-cooked stale food. Another rule is to either consider that alcohol accompanying a meal is sinful (and, hence, leads to colas, "f(l)ab" drinks, and the aforementioned iced tea) or to allow for "generic" wines (like "jug" chablis, burgundy, or (God forbid) "blush" wine). And the last rule is to persuade people that they should forget about their meals as quickly as possible (the culinary equivalent to "celibacy") since, after all, you only eat because you have to in order to stay alive (would such a life be worth living is a deeper, philosophical question that eludes the scope of this column).

I am afraid that many of these rules are increasingly followed in the organization of conference meals and are gradually intruding into the meetings of our Society. But there have been "counterexamples" to this trend that constitute moments of glory in our history. To balance the gloom that can set in from the review of bad meals, let me remember for you some of these brighter moments. The banquet at the 1979 ISIT in Grignano shines in my memory as a fine example where champions of elegant fare prevailed and served us a fine, multi-star meal. The banquet in Budapest in 1991 was also a fine example of what human talent can accomplish in food preparation. Even as recently as 1994 (in Trondheim)

the sumptuous, multi-access buffet was almost sinful! The only way to resolve the congestion around the serving table was to make aggressive use of your elbows. Strangely (and disappointingly), the banquet at the 1981 ISIT in LesArcs was much below expectations. And, unfortunately (but as expected), most of the banquet menus at the ISITs that were held in the United States were typical results of the standardized process of food preparation.

One can dwell on this subject in as much detail as one desires (and I can certainly go on without bound and without need of prodding). However, the point of this column is simply to alert the members of our community (who, as a group, have displayed a much higher standard of food appreciation than other professional groups) to resist the pervasive imposition of bad food (or, even worse, "ersatz" or phony "good" food). As with every human endeavor, the fight against the tyranny of the institutionalized palate can only profit from the study of history. Keeping records (and scores) of nutrition quality over the years provides a useful database and good training for future ... consumption. It may be a losing fight (the pressures are enormous). But the glory (and the pleasure) is in the strife.

Electronic Submission of Manuscripts to the IEEE Transactions on Information Theory

INFORMATION FOR AUTHORS

Overview:

The *IEEE Transactions on Information Theory* will now be supporting electronic submission of manuscripts. The electronic submission is optional, and is intended to expedite the review process.

Submission Procedure:

The author(s) should submit two e-mails to the Editor-in-Chief, one containing a cover letter and the other containing the postscript file of the paper. Alternatively, postscript files may be submitted via FTP (see below). All e-mails should be addressed to:

submit@it.csl.uiuc.edu

The cover letter must be submitted by e-mail. It should be phrased in the same way as it would be normally phrased for conventional hard copy submission. In addition, this letter must contain the following information items:

- Title and abstract of the paper. The abstract may be appended at the end of the cover letter, as plain text. Do *not* send the abstract as an attachment. In case the abstract contains mathematical expressions, LaTeX notation may be used.
- Information about the postscript file of the paper indicating whether it is submitted by e-mail or via FTP, including the file name (for FTP submission) or the subject line of the corresponding e-mail (for e-mail submission).
- Name, address, phone number, fax number, and e-mail address of all the authors.
- Manuscript type designation (regular paper or correspondence).
- Associate Editorial area suggested by the author(s).

Author submitting e-mail that contains the cover letter will be automatically assigned as the corresponding author for the paper.

The postscript file of the manuscript should be submitted in one of the following two ways. It may be sent by e-mail as plain unencoded ASCII text. The postscript file should be included in the body of the e-mail. Do *not* send it as an "attached" document. The subject line of the e-mail should be composed of the last name of the corresponding author, followed by the "ps" suffix. (For example, a subject line consisting of shannon.ps would be a valid one.) Alternatively, the postscript file may be submitted via FTP (Internet File Transfer Protocol). To do so, authors should access the following FTP site:

ftp.it.csl.uiuc.edu

login as "anonymous" using e-mail address as password, and put the postscript file in the it_submit directory. The file name should be composed of the last name of the corresponding author followed by the "ps" suffix (e.g., shannon.ps). More detailed instructions for the FTP submission procedure may be obtained by sending e-mail to the following address: help@it.csl.uiuc.edu.

Copyright:

Electronic submission implies a transfer of copyright to the IEEE in accordance with IEEE copyright agreement. If a submission is accepted for publication, a written and signed copyright form would have to be provided by the corresponding author.

Review Procedures:

Manuscripts submitted in electronic form will be reviewed according to the usual editorial procedures and standards of the *IEEE Transactions on Information Theory*. However, the intent is to have all communication between authors, editors, and referees by e-mail, thereby expediting the review process.

Hard Copies:

Hard copies of papers submitted in electronic form ordinarily will not be required. However, the authors should be ready to provide such hard copies at all stages of the editorial review process, upon request from the Editor-in-Chief or from the Associate Editor assigned to the paper. In addition, if and when a paper is accepted for publication, two hard copies of the final version of the paper will be requested from the authors.

From the Transactions Editor-in-Chief

Alexander Vardy

As the incoming Editor-in-Chief of the *IEEE Transactions on Information Theory*, I would like to express my appreciation to my predecessor Robert Calderbank for his service to the *Transactions* for the past three years. During this period of time, as always, the *Transactions* published the best papers in our field, and maintained its remarkable dominance in the core areas of information theory. In my role as Editor-in-Chief, I aim to keep the *IEEE Transactions on Information Theory* in its place as *the* premier journal covering all aspects of information transmission, processing, and utilization.

Alexander Vardy

In keeping up with this goal, I am fortunate to have the advice of an outstanding Editorial Board. In addition to:

Alexander Barg	Coding Theory
Ian F. Blake	Coding Theory
Michael Honig	Communications
Torleiv Kløve	Coding Theory
Frank R. Kschischang	Coding Theory
Neri Merhav	Source Coding
Pierre Moulin	Nonparametric Estimation, ClassifIcation, and Neural Networks
Shlomo Shamai	Shannon Theory
Emina Soljanin	Coding Techniques
Douglas R. Stinson	Complexity and Cryptography

eight new Associate Editors are joining the Editorial Board this year:

Venkat Anantharam	Communication Networks
Philip A. Chou	Source Coding
Imre Csiszár	Shannon Theory
Thomas E. Fuja	At Large
Sanjeev Kulkarni	Nonparametric Estimation, Classification, and Neural Networks
Upamanyu Madhow	Detection and Estimation
Joseph A. O'Sullivan	Detection and Estimation
Ron M. Roth	Coding Theory

These individuals bring broad scholarship and expert technical judgment in their respective areas to our *Transactions*. Working with each of them is a pleasure and a privilege.

I am inheriting from my predecessor a smoothly running operation. Extended backlog is ancient history—papers accepted for publication are now forwarded to the IEEE without further delay, and almost every issue of the *Transactions* is produced promptly on time. This is due in no small part to the devoted effort of Publications Editor Steve McLaughlin. I am delighted to announce that Steve has agreed to serve the *Transactions* as Publications Editor for one more year, through July 1, 1999. His successor has been already identified, and the details of this transition will be announced in the next issue of this Newsletter.

Later in this article, I would like to discuss the general state of the *Transactions*. But first, let me describe some specific developments that will affect the *Transactions* in the near future.

Electronic submission: Although the backlog that was present a number of years ago is now gone, the overall delay from submission to publication continues to be a major concern. The current average delay of about 22 months for regular papers and 19 months for correspondence items is unacceptably high, and we have already taken concrete steps to reduce this delay. In the June 1996 issue of the Newsletter, my predecessor wrote:

> *It is not hard to imagine the day when all steps in the editorial process (submission of original manuscript, reviews, revisions, and final manuscript) are done electronically.*

That day is today. Elsewhere in this Newsletter, you will find detailed instructions for optional electronic submission of manuscripts to the *Transactions*. For papers submitted electronically, the intent is to have all communication between authors, editors, and referees by e-mail, thereby expediting the review process. We estimate that electronic submission and review will reduce the delay to publication by up to three months. Furthermore, additional measures to reduce the time to publication will be implemented in the future.

Notice that the electronic submission option is just that — optional. Conventional submission of manuscripts — on paper — will certainly still be supported. Nevertheless, I expect that most authors will soon embrace this option, and the majority of manuscripts submitted to the *Transactions* will be submitted and reviewed electronically.

Special issues: This is an exciting time for information theory, distinguished by the 50-year anniversary of Shannon's seminal paper *A mathematical theory of communication*, which gave birth to our field. As an appropriate tribute, we will publish a special 50-th Anniversary Commemorative Issue in October 1998, the month of publication of Shannon's work. This special issue will contain survey articles by leading experts in diverse areas of information theory, and will undoubtedly become an essential reference for anyone interested in our field. Another special issue, devoted to the subject of multiscale statistical analysis, is scheduled for early 1999.

Contributor biographies: As of January 1999, each issue of the *Transactions* will contain the biographies of *all* contributors to the issue, regardless of whether the contribution is a regular paper or a correspondence item. David Forney, during his term as Editor-in-Chief twenty-five years ago, gave a precise definition of the distinction between regular papers and correspondence items. He wrote:

> *The distinction is not one of quality, but of nature; normally a correspondence item will have one point to make briefly and without adornment, whereas a regular paper will be a more well-rounded treatment of a problem area.*

These words have appeared on the inside back cover of our *Transactions* ever since, and some of the best research reported in the *Transactions* was reported in the form of correspondence items (indeed, two of the 15 papers selected for the *Golden Jubilee Paper Award* by our Society are correspondence items). I wholeheartedly subscribe to the point of view that the quality of a correspondence should be just as high as the quality of a regular paper. As always, both forms of submission will be reviewed by the *Transactions* using the same criteria. Thus the disparity between regular papers and correspondence items in the *Contributors* section sends the wrong message to our authors and our readership.

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The change of Editors might be an appropriate time to reflect on the state of the *Transactions* in the past and present, and identify the trends that will shape its future. The table below contains some numerical data that I gathered by counting the number of regular papers and correspondence items published in the *Transactions* over the past 10 years.

The data is here for you to peruse, and you can draw your own conclusions. For example, you can compute from Table 1 the average acceptance rate during the past 10 years, which stands at about 52%. Notice, however, that because the acceptance rate for papers submitted to special issues is usually higher, the average acceptance rate for ordinary submissions is only about 50%.

You may also notice certain trends that particularly stand out in Table 1. While the number of submissions has fluctuated, it has not increased significantly since 1991 (the total number of manuscripts submitted in 1997 was 423, and the number of submissions during the first six months of 1998 is about 240). Furthermore, the total number of papers published in the *Transactions* remained remarkably steady since 1993, although a substantial increase is expected this year. What has been steadily growing over the years is the average *length* of both correspondence items and regular papers. As a result, our *Transactions* has reached a formidable size, and significant further growth is expected this year. Extrapolating from the first five issues, we anticipate publishing close to 3000 pages in 1998, and our estimated page budget for 1999 exceeds 3000 pages for the first time in the history of the *Transactions*. Only two or three IEEE journals publish more pages, and it costs us money to publish each page. Thus the growth of the *Transactions* places a financial burden on our Society.

Nevertheless, I am strongly opposed to page limits on papers. I believe that each paper should be just as long as it needs to be in order to present its results in a lucid and succinct manner. However, as the average length of papers grows, the *Transactions* is clearly in a position to place very high demands on the quality of papers it accepts. A manuscript submitted to the *Transactions* has to

TABLE 1. Statistics on the state of the *Transactions*

YEAR	I	#R	Rpa	#C	Cpa	#S	#A	Tp
1989	6	100	10.3	76	3.6	351	176	1396
1990	6	71	14.1	109	4.1	356	180	1560
1991	7	96	11.0	141	4.4	386	237	1804
1992	7	94	13.3	123	4.3	434	217	1908
1993	6	121	11.6	119	4.4	481	240	2056
1994	6	116	12.2	134	4.8	420	250	2176
1995	7	122	12.3	119	4.4	496	241	2232
1996	7	128	12.9	120	4.7	467	248	2344
1997	6	107	12.4	133	5.2	554	240	2144
1998	5	89	14.6	126	5.6	482	215	2040

Legend:

I	number of issues
#R	number of regular papers published
Rpa	average length of a regular paper
#C	number of correspondence items published
Cpa	average length of a correspondence item
#S	total number of manuscripts submitted *two years prior*
#A	total number of papers / correspon dences published
Tp	total number of pages published

be novel, significant, and of interest to our readership, in order to be publishable. Furthermore, papers in publishable form must be understandable without undue effort by their intended audience, which should be as broad as possible. As such, they have to be reasonably self-contained, well-polished, and absolutely clear. Writing such papers necessarily requires more effort, but not necessarily more pages.

Although the *Transactions* will continue to apply stringent selection criteria to the papers it accepts for publication, we will publish the best of the papers we can find in the field of information theory, very broadly interpreted. In fact, I would like to see the scope of the *Transactions* broaden as our discipline broadens and attracts contributions from diverse areas of scholarship. A good example of this are key contributions to coding theory that have come from the computer science community in recent years. Such papers often provide a different and valuable perspective that enriches our community, and they are most welcome in the *Transactions*. As always, the *Transactions* will also welcome papers in such areas as signal processing and applied probability, with relevance to information theory, but only if these are the best papers in their fields.

Ensuring the status of *IEEE Transactions on Information Theory* as the premier journal in our field has to be a team effort. I welcome your suggestions regarding all aspects of the *Transactions*. Please send your comments to eic@it.csl.uiuc.edu.

The reputation and the vibrancy of our *Transactions* are the legacy of editors past, and continuing this tradition of excellence is a challenge. We are fortunate that information theory is a field in which profound theoretical investigation often has immediate and far-reaching impact on technology and practice. This spirit of truly fundamental innovation has pervaded the *Transactions* throughout the years, and will keep advancing the frontiers of information theory. It is also fortunate that our field has inherent intellectual beauty that has always attracted, and continues to attract, some of the best minds to information theory. At the core, it is this ceaseless flow of exciting first-rate research that makes our *Transactions* what they are, and makes my job as Editor-in-Chief most rewarding.

CALL FOR NOMINATIONS:

NSF Alan T. Waterman Award

A call for nominations has recently been released for the Alan T. Waterman Award. The Waterman Award, given annually by the National Science Foundation and National Science Board, recognizes an outstanding young researcher from any field of science or engineering funded by the National Science Foundation. The 24th Waterman Award, including a citation, a bronze medal, and a nonrestrictive grant of $500,000 over 3 years for scientific research or advanced study in the biological, mathematical, medical, engineering, physical, social or other sciences, will be awarded in May 1999.

According to the award committee regulations:

"Candidates must be U.S. citizens or permanent residents and must be 35 years old or younger, or not more than five years beyond receipt of the Ph.D. degree by December 31 of the year in which they are nominated. Candidates should have demonstrated exceptional individual achievements in scientific or engineering research of sufficient quality to place them at the forefront of their peers. Criteria include originality, innovation, and significant impact on the field."

Further information about the Waterman award may be found at:

http://www.nsf.gov/pubs/1998/nsf98129/nsf98129.htm

or by contacting the Committee's Executive Secretary, Mrs. Susan Fannoney, by email at sfannone@nsf.gov or by telephone (703-306-1096). Nominations and references for the Waterman Award must be postmarked by October 31, 1998.

CALL FOR PAPERS

1999 IEEE Information Theory Workshop on Detection, Estimation, Classification and Imaging (DECI)

February 24–26, 1999
Santa Fe, New Mexico (USA)

Detection and estimation theory have historically been closely linked to Information Theory. Analysis of communication systems relies heavily on and contributes to advances in detection and estimation theory. Considerable theoretical and practical advances in this area have been made possible by the fostering of ideas from Statistics and Information Theory. This workshop will complement those activities by seeking contributions from researchers in signal processing, image processing, image understanding, pattern recognition, and communication theory, whose work is heavily influenced by information theoretic considerations. While novel applications will play important roles, new theoretical results are expected to dominate.

The workshop will feature three plenary speakers: Andrew Barron (Yale), H. Vincent Poor (Princeton), and Michael I. Miller (Washington University). Invited talks and contributed talks will be presented in the following areas:

Detection Theory

Estimation Theory

Classification

Statistical Imaging

Regularization for Inverse Problems

Random Processes

Inference Based on Compressed Data

Signal Processing Applications of IT

Of particular interest are papers dealing with nonparametric and robust methods, methods for non-euclidean spaces, alternating maximization methods, high-dimensional inverse problems, and dimensionality reduction. Authors interested in submitting a contribution should mail four copies of a 2-3 page summary to Prof. J. O'Sullivan (address below) by October 9, 1998. Papers will be presented either as 20-minute talks or as posters. One-page abstracts of all papers will appear in the proceedings of the workshop and will be posted to the workshop web site prior to the workshop.

The workshop will be held in historic Hotel Loretto, in the heart of Santa Fe. Santa Fe possesses a rich Spanish and Native American culture and is located in the vicinity of excellent ski resorts. It is expected that a small number of student travel grants to the workshop will be available. Detailed information will be included in the final call for papers and will be posted to the workshop web site:

http://www.ifp.uiuc.edu/itw-deci

Inquiries about the workshop should be directed to one of the three co-chairs:

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CALL FOR PAPERS

1999 Canadian Workshop on Information Theory

Kingston, Ontario, June 15-18, 1999

The sixth Canadian Workshop on Information Theory will be held at The Holiday Inn, in Kingston, Ontario, from Tuesday evening, June 15, 1999, through Friday afternoon, June 18, 1999. This Workshop provides an opportunity for Canadian as well as international researchers in Information Theory to meet and discuss aspects of their work in an informal setting.

Papers presenting new results in (but not limited to) the following areas are solicited:

Applications of information theory	Error-control coding
Coded modulation	Image and speech coding
Communication systems	Neural networks
Cryptography	Pattern recognition
Data compression	Shannon theory
Data networks	Signal processing
Detection and estimation	Source coding

Papers will be reviewed on the basis of a 500 word summary. All summaries should be sent to one of the Workshop Chairs listed below, and should include the authors' names, complete mailing addresses, telephone and fax numbers, and e-mail addresses (as applicable). Electronic submission of PostScript or LATEX files is encouraged. The deadline for submission is December 18, 1998. Acceptance will be announced by January 22, 1999. Authors of papers accepted for the Workshop will be requested to submit a four page paper no later than March 27, 1999.

Invited Speakers:

Toby Berger, Cornell University,
Ezio Biglieri, Politecnico di Torino,
Gilles Brassard, Universitj de Montreal,
Jon Mark, University of Waterloo,
Peter McLane, Queen's University.

Correspondence regarding the Workshop should be addressed to one of the Co-Chairs:

Prof. Alajaji
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For further information about the workshop, please visit the workshop web page:

http://markov.mast.queensu.ca/~fady/CWIT99/cwit99.html

Sponsored by: The Canadian Society for Information Theory and The Kingston Chapter of the IEEE.

Note: The workshop is scheduled to follow the IEEE International Conference on Communications, ICC'99, June 6–10, 1999, Vancouver, Canada. It also precedes the 1999 IEEE Information Theory Workshops that will be held respectively in South Africa on June 20–25, 1999 and in Greece on June 27 to July 1, 1999.

TWIN INFORMATION THEORY WORKSHOPS IN 1999

Two Information Theory Workshops are planned for June 1999. The first will be held in Kruger National Park in South Africa, June 20–June 25, 1999. The second will take place just after the first in Metsovo, Greece, June 27–July 1, 1999. The South Africa workshop will focus on issues of communications while the Greece workshop will focus on networking topics.

The organizers of both workshops have coordinated their efforts to ensure that the programs of the two workshops will be complementary in nature. This will enable interested parties to attend both workshops. Such parties should note that there is direct, non-stop service connecting Johannesburg and Athens that will facilitate linking the two venues.

Web pages were established for both workshops and can be reached from the IT Web Site at
http://www.itsoc.org
They can also be found by visiting
http://www.wits.ac.za/ITW99/
and http://www.cs.purdue.edu/homes/spa/itw99.html respectively.

Short descriptions of the two workshops follow.

1999 INFORMATION THEORY WORKSHOP

Kruger National Park, South Africa, June 20–25, 1999

Venue: The Berg-en-Dal rest camp in the The Kruger National Park, situated approximately 400km East of Johannesburg, South Africa, provides an ideal wildlife setting for the 1999 IEEE Information Theory Workshop.

Technical Program: The following sessions are planned with the persons indicated acting as session organizers:

Technical program chairman:	Han Vinck
Plenary speakers:	Jim Massey and Te Sun Han
Identification:	Te Sun Han and Rudi Ahlswede
Cryptology and communication security:	Henk van Tilborg
Source coding theory and techniques:	Frans Willems
Modeling and performance of high speed networks:	Tony Ephremides
Multiuser communication:	David Tse and Sergio Verdú
Coding and modulation for fading channels:	Ezio Biglieri
Spread-spectrum communication theory and techniques:	Michael Pursley
New Results in information theory and coding:	Mario Blaum

Recent Results Session: Those interested in a presentation in the new results session are invited to submit a summary, ISIT style, by January 31, 1999, to Dr. Mario Blaum, IBM Research Division, Almaden Research Center K65/C2, 650 Harry Road, San Jose CA 95120, USA, E-mail: blaum@almaden.ibm.com, Tel: +1 408 927-2179, Fax: +1 408 927-4110. Two recent results sessions are planned, one focusing on coding the other on information theory in general.

Organizing Committee:

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Social Program: Reception, cocktail, banquet and a day excursion in the Kruger National Park. In addition to this, daily game drives will also be available.

Further Information: Please contact any of the organizers or visit http://www.wits.ac.za/ITW99.

1999 INFORMATION THEORY AND NETWORKING WORKSHOP

Metsovo, Greece, June 27–July 1, 1999

An Information Theory Workshop will be held in the beautiful mountain resort village of Metsovo. Off the beaten path and perched at an altitude of 1115 meters (3345 feet) in the magnificent mountain range of Pindos in northwestern Greece, Metsovo will provide a tranquil, and comfortable environment in a friendly setting of traditional Greek hospitality.

The workshop will embrace the main themes of Information Theory, but will also place an emphasis on Communication Networks in an attempt to bring together researchers from both fields.

Technical Program: The technical program will include:

Plenary Talk:	P. Flajolet, J. Kieffer, and P. Varaiya.
Panels:	Role of IT in Multimedia (G. Seroussi, M. Weinberger) Pricing in Networks (C. Courcoubetis, B. Prabhakar) Role of IT in Networking (A. Ephremides, R. Rao)
Invited Sessions:	Network Shannon IT (A. Lapidoth, Z. Zhang) Source Coding (I. Kontoyiannis, N. Merhav) IT and Queueing (V. Anantharam, D. Tse) Fundamentals of Networks (L. Tassiulas) Cryptography and Security (C. Cachin, H. Tilborg) Coding and Communications (D. Forney, A. Vardy)
Recent Results:	There will be a poster session to accommodate recent results.
Program Committee:	Leonidas Georgiadis Philippe Jacquet Wojciech Szpankowski Tony Ephremides (Advisor)
Local Arrangements:	Niovi Pavlidou Apostolos Traganitis
Further Information:	The registration fee is expected to be about $200. For further information please contact either of the Co-Chairs:

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Golomb's Puzzle Column™ Number 43:
Questions About Numbers

Solomon W. Golomb

1. Consider the perfect squares, n^2, as n runs through the positive integers.

   (a) How many distinct values are there of n^2 modulo 10? What are they?

   (b) How many distinct values are there of n^2 modulo 100? What are they?

   (c) How many distinct values are there of n^2 modulo 1000? What are they?

2. Jack has n blank index cards, and writes the numbers from 1 to 2n randomly, placing one number on each side of each card. Jill also has n blank index cards, and randomly and independently of Jack writes the numbers from 1 to 2n, placing one number on each side of each card.

   Given the full set of 2n cards from Jack and Jill, is it always possible to place them on a table in such a way that the 2n numbers which are visible (face up) are all the numbers from 1 to 2n?

3. A "Pythagorean triple" (a, b, c) is a set of positive integers for which $a^2 + b^2 = c^2$.
   Clearly at least one of a, b, c must be even.
   Find all such triples where two of a, b, c are prime and the third is twice a prime.

4. Take any positive integer n, and multiply by 8 to get 8n = m. Add all the digits of 8, n, and m together, then add the digits of this sum together, and continue the process until only a single digit remains.

   For example, with n = 17, we have 8n = 136 = m, and adding the digits of 8, n, and m, we get 8 + 1 + 7 + 1 + 3 + 6 = 26, and then 2 + 6 = 8.

Minutes of the IEEE IT Society Board of Governors Meeting

Greg Pottie

La Jolla, California, February 8, 1998

Attendees:

Ezio Biglieri, Robert Calderbank, Sean Coffey, Michelle Effros, Thomas Ericson, Dave Forney, Jerry Gibson, Joachim Hagenauer, Michael Honig, Bob McEliece, Steven McLaughlin, Greg Pottie, Ramesh Rao, Alexander Vardy, Sergio Verdú, Frans Willems, Ken Zeger

1. The meeting was called to order at 1:10 PM by Thomas Ericson, and introductions were made.

2. The agenda was approved.

3. The minutes of the previous meeting were approved.

4. Announcements

a. Dave Forney reported that the reorganization at NSF has been approved. Communications is now grouped together with computing and signal processing; networking is in advanced networking and research (with internet). There had been a question of whether communications research would flourish in a CS dominated division, but in fact the budget has apparently gone up for communications. A replacement is required for Tom Fuja at NSF. Communications proposals now have a 33% acceptance rate, which is high by NSF standards. The special projects program has also been renewed (three awards in each special project), but from now on must include a networking component.

b. Thomas Ericson reported on Russian membership. A list of the twelve researchers to receive complimentary memberships has been received.

c. IEEE membership is declining. The membership for the past year for the Information Theory Society is 5636, a decline of 45, one of the smaller losses. IEEE wants to reverse the trend and will be holding a membership development meeting. Tom Fuja will represent IT.

d. A TAB meeting will discuss a proposal from the Circuits and Systems Society re: group membership. Many people in foreign countries cannot pay individual fees; a group of four people could join for the price of one in underdeveloped countries. The group would need to be in same small geographic area, and would get only one copy of the transactions and other publications, but otherwise would receive full membership benefits. The BOG expressed general approval of this concept.
e. A new IEEE periodical on multimedia is shortly to appear. It will initially be a bimonthly publication with about 500 pages per year.

5. Bob McEliece presented the report of the ISIT Scheduling Committee, which was four to one in favor of changing the schedule of symposia to one per year. Arguments in favor of the change included that attendance is growing at ISIT and many workshops. There seem to be enough people to do ISITs, and an 18 month schedule is inconvenient for US academics. Additionally, it is better to have one Shannon lecturer at each ISIT. Arguments against were that the current system seems to work and recent committees have studied this. Other societies have annual conferences, but there is no need to follow the crowd, and an increased number could water down the quality.

Bob McEliece presented a motion to change to a 12 month schedule, following ISIT 2000, with symposia to be held in (the northern hemisphere's) summer. It carried unanimously. A special note will be made in the Newsletter. Issues of rotation of location, precise scheduling, possible consequences for workshops, etc. will be considered by the committee.

6. Approval of committees. A list of standing and ad hoc committees was circulated by Society President Thomas Ericson. The few remaining slots will be filled soon. The BoG approved the list, with the amendment that Dan Costello will serve as chair of the Jubilee paper committee.

7. Upcoming BoG meetings. The next BoG meeting will be in Killarney, Monday June 22, at 4:30 PM, and the third meeting of 1998 will be Sunday, August 16 at 9:00 AM in Cambridge, MA.

8. It was moved by Thomas Ericson that Alexander Vardy be the new Transactions Editor in Chief, beginning July 1. The motion carried unanimously. Thomas Ericson expressed the appreciation of the BoG to Alexander for taking on the job.

9. Thomas Ericson reviewed the Treasurer's report. The Society has a net worth of $1,141 K, as of 10/30/97. The budget for the coming year may have been marginally optimistic; however the financial position is strong.

10. Robert Calderbank gave the IT Transactions report. There will be a higher page count this coming year, in part due to the commemorative issue. The BoG authorized paying for our IEEE editor Nela Rybowicz to attend the banquet at ISIT 98 in Cambridge to meet the people who submit papers, in appreciation for her diligent service. Nominations for reviewer appreciation awards are to be received in June. Web access to Transactions papers on Opera is low and needs to be increased; this can give members quicker access to papers.

11.The IT Newsletter report was given by Michelle Effros.
a. An informal survey made of Newsletter delivery times indicates that the quoted times for expedited delivery are not entirely accurate. IEEE will look into the complaints.
b. At present, we do not have registration forms for conferences and workshops in regular pages of the Newsletter, but do allow inserts at the expense of conference organizers. The expense is around $250. Discussion supported continuing this policy.
c. Obituaries are unfortunately becoming more common, and consequently there will now be a regular page in the Newsletter.

12. Steven McLaughlin presented the report on the digital library project, and also a demo. The project is a month or two ahead of schedule, and at the low end of the budget range. We will have a collection of disks before ISIT 98, and should be able to have a few rounds of beta testing before ISIT. The BoG has authorized 100K in spending; 90K has been spent. An extra 60K is needed to complete the project, which is a little below budget. 1000 copies of the library are to be produced for ISIT attendees at a cost of roughly 30K. The 9 disk version is full text searchable, whereas a six disk set is much less flexible. A full text-searchable version should fit on a single DVD. Preference was expressed by Board members for the full-text searchable versions. A report will be made in June on the marketing strategy, e.g., pricing and distribution method to members/libraries, whether it should be bundled with hardcover special publications such as the 50th anniversary special Transactions issue. A motion to approve the additional $60K in funding for the project carried unanimously.

13. Eastern European Library program. The IT Society has been participating for the last three years, and we have been requested by IEEE to renew our participation; the cost is $475 over the three years, plus shipping. A motion of renewal was approved, with the stipulation that the BoG requests a letter be sent to include our concern that the geographical scope of the program ought to be expanded, and that IEEE should also look into access to existing digital libraries such as OPERA.

14. Information Theory Golden Jubilee Awards. So far there are relatively few nominees, and the committee requested guidance from the BoG on several matters. Consensus from the discussion is that there should be around 20 awards, and decisions need to be made in the next few months to enable printing of awards, and informing recipients in time to make travel arrangements. Committee members and BoG mem-

bers should take an active role in soliciting nominations. Paper awards are to be IT papers of quality comparable to IT prize papers, and technical innovations are to be highly significant, as indicated in the announcement appearing in the December Newsletter. The committees have final decision making authority on the awards.

15. Ezio Biglieri presented the report of the ad hoc committee on the 50th anniversary. Announcement of the Murray Hill celebrations in May is in the Newsletter. The Amsterdam colloquium in June is set. There will be a special issue of the Newsletter. The suggestion was made to help prepare an article in Spectrum on the 50th anniversary, perhaps using some combination of the contributions of Shannon, the innovations the theory inspired, and future prospects. A similar approach may be tried with the popular press, with the emphasis on the next 50 years.

16. Logo contest. There will be a page published in the Newsletter of the best logos, and there will be a pull-out card that people can mail in with their choices. There is already a web site, pointed to in the announcement.

17. Mailing lists on the web. While there are relatively few names on the formal IT e-mail list at the web site, there are 500-600 names on an informal email list. Downloading and / or replying in bulk to this list was felt to be undesirable, but having it available to our own events and being included in an upgraded directory were both felt to be worthwhile. A motion was made to put the above list on the web site, with Ramesh Rao to have control over posting of messages to the list. The motion carried.

18. Ezio Biglieri suggested we consider joint awards with other IEEE societies for papers contributing to both disciplines, e.g. SP and Comm. There was general agreement that this is worth exploring. Ezio will prepare a formal proposal.

19. Symposia and Workshops
a. ITW San Diego, Feb. 1998. Paul Siegel reported. There is a $5K award from NSF, and others totaling $2K. 164 were registered so far, with the organizers expecting another 20 or so.
b. ITW Killarney, June 1998. Sean Coffey reported. The travel budget is 5K from NSF for US researchers and 5K for overseas. The registration fees were raised 10% to supplement the overseas travel funds, and further support is being pursued. The technical sessions are going well, with final decisions to be made by Feb 21. In addition to the general directions on travel, the organizers will soon produce a recommended set of travel arrangements.
c. ISIT MIT, August 1998. Dave Forney reported that the contracts are basically done. The banquet will be in the Park Plaza Hotel in Back Bay. The Provincetown ferry has been chartered on Wednesday for whale watching, and included in the registration fee. There will be a Sunday afternoon session on the history of IT. 700-800 people are expected. The web site has been recently updated, and it is planned to post papers to it. Final fees will be around $350. A need exists for memorabilia of all types (old photos, conference kitsch, etc.). Plenary speakers have been selected: C.R. Rao, I. Jacobs, L. Kleinrock, and R. Karp. The technical program will be finalized by the end of March or beginning of April. There is a possibility of using all of Friday, rather than going to 8 parallel sessions.
d. ITW Santa Fe, Feb 24-26, 1999. A proposal from Jody O'Sullivan, Pierre Moulin, and Al Hero was circulated. The dates, hotel, and plenary speakers have been selected and a preliminary budget produced. Ramesh Rao moved that we approve the plan and authorize a loan of up to $5000 for organizing the conference, the amount to be decided by the Society President. The motion carried.
e. ITW Metsovo, June 27-July 1, 1999. A report by Wojciech Szpankowski was circulated. The preparations are on schedule, and some external funding has already been secured. A detailed presentation will be made at ISIT.
f. Bob McEliece reported that the UK and Ireland Information Theory Chapter proposes either a workshop or ISIT for the summer of 2001. They have been doing a successful series of small conferences in the Lake District, and are looking to run a larger conference. There was general support for proceeding with planning.

20. Additional issues.
a. Ezio Biglieri raised the issue of the IT Society supplying an official nomination for the Japan Award Prize, which this year will encompass topics such as information processing, cryptography, etc. We have a few months to suggest someone. Members should send nominations to the awards committee, stressing recent accomplishments of the candidate.
b. Thomas Ericson suggested that we revise the designation of Technical Information Profile listings for IEEE. The collective result was:

1210	Error control coding
1220	Shannon Theory
1230	Communications and Signal Processing
1240	Detection, Estimation & Identification
1250	Source coding, Data Compression and Quantization
1260	Pattern Recognition and Learning
1270	Cryptography
1280	Communication and Computer Networks
1290	Data Storage.

21.The meeting was adjourned at 5:07 PM.

Workshop Report – ITW'98 San Diego

The IEEE 1998 Information Theory Workshop, San Diego (ITW'98) was held February 8-11 at the Radisson Hotel and Conference Center in La Jolla, California, adjacent to the campus of the University of California, San Diego (UCSD). This workshop represented the first of several meetings sponsored by the IEEE Information Theory Society during this golden anniversary year.

The Workshop attendees included 167 participants and 22 accompanying guests, representing 20 countries. The meeting, sponsored by the IT Society, received generous financial support from the National Science Foundation, the Center for Wireless Communications at UCSD, IBM Corporation, and TRW. Travel grants and registration assistance were provided to 11 participants.

Workshop organizers: (L to R) Alon Orlitsky, Paul Siegel, Ramesh Rao, Randy Paterno, Pamela Cosman, Christina Whitehead, and Ken Zeger.

The technical program spanned three full days and an array of research areas. Session topics reflected the wide scope of information theory and, with a UCSD faculty member among the organizers of each session, they highlighted the breadth of interests of the growing UCSD faculty in information theory and communications, which now includes A. Acampora, P. Cosman, R. Cruz, R. Lugannani, E. Masry, L. Milstein, A. Orlitsky, B. Rao, R. Rao, P. Siegel, A. Vardy, J.K. Wolf, and K. Zeger.

Monday was Channel Coding day, featuring a plenary lecture by Prof. Jim Massey (ETH) and invited sessions on Channel Coding Theory and Channel Coding Applications. The focus of Tuesday's program was Networking and Communications, beginning with plenary speaker Prof. Bruce Hajek (Illinois) and a morning session on CDMA. The afternoon session, entitled "Information Theory: 50 Years and Beyond," offered a broader perspective on some of the past developments and future possibilities in the field of information theory and its applications. The final day of the Workshop was devoted to Source Coding, including a plenary address by Prof. Bob Gray (Stanford), and invited sessions on Lossy Source Coding and Universal and Lossless Source Coding. During the latter session, Prof. Jack K. Wolf (UCSD) paid tribute to the many achievements of Dr. Aaron D. Wyner — pioneering information theorist, gifted teacher, colleague, and friend — to whose memory the Workshop was dedicated. On Wednesday evening, the technical program concluded with two parallel Recent Results sessions, each featuring 12 presentations.

The Workshop social program reflected the varied elements — natural, historical, cultural, academic, and technological — that form the unique character of modern San Diego. On Sunday afternoon, the Board of Governors meeting was held in the Martin Johnson House at UCSD's Scripps Institution of Oceanography overlooking La Jolla shores. The Workshop reception and buffet dinner was held a short walk away at the Stephen Birch Aquarium-Museum. Docents, including Toby Wolf (wife of Jack Wolf), conducted informative tours of the beautiful and imaginative exhibits of sea creatures housed at the aquarium. (If you've never seen a "field" of garden eels or a sea dragon's astounding imitation of a strand of kelp, you should!)

Monday evening's event was held in the rotunda of the San Diego Museum of Art in historic Balboa Park, where attendees could complement their dinner with a stroll through the Museum's attractive galleries. The Tuesday evening Workshop Banquet took place in the Price Center Ballroom on the UCSD campus. The banquet speaker, Dr. Irwin M. Jacobs, co-founder and Chairman of Qualcomm, Inc. and one of the first faculty members at UCSD, gave a fascinating account of his experiences in academia and industry, along with his perspectives on the future of wireless communications technology.

The Workshop participants showed their appreciation for all of the technical and social events, and the meeting was made all the more enjoyable by a well-timed break in the stormy weather associated with the notorious "El Nino" phenomenon. The members of the organizing committee, the administrative support staff, and the contributors to the technical program deserve our congratulations for making the Workshop such a success, as well as our thanks for their considerable efforts on behalf of the IT Society.

Symposium Report

19th Symposium on Information Theory In the Benelux Venue

P.H.N. de With, Mannheim, June 25th, 1998

Congresshotel "Koningshof" Veldhoven, The Netherlands May 28-29, 1998.

The symposium was organized by Prof.Dr.ir. Peter H.N. de With from the University Mannheim, Germany, and Ir. Mihaela v.d. Schaar-Mitrea from Philips Research Labs Eindhoven, The Netherlands. The symposium is a yearly event and brought about 40 information and communication theory researchers and scientists from the Benelux together. The symposium lasted two days and included two invited lectures and a conference dinner on Thursday evening.

The program of this symposium consisted of 8 sessions in total, covering the following topics: source coding and video compression (2 sessions), channel coding (2 sessions), security, audio compression and signal processing, information theory and signal modeling, and networks. In total, 25 technical papers were presented, including the invited lectures. Contributions were given by Technical Universities of Delft and Eindhoven, University of Twente (all Netherlands), Katholieke University of Leuven (Belgium), Philips Research Labs Eindhoven, Universities of Essen and Mannheim (Germany), Technical University of Budapest (Hungary), the IPPI from Moscow (Russia), and the University of California. The invited lectures were covered by Prof. dr. J. Biemond from the Technical University Delft (NL) and Prof. dr. O. Boxma (CWI, now with Technical University of Eindhoven).

On May 28th, the program covered video coding and compression and the first channel coding session. The compression session opened with a paper on the context weighting algorithm using a switching method for creating more adaptivity to the source statistics. Two papers followed discussing embedded compression in MPEG coders for reduction of the memory applied. One paper discussed the relation between error robustness in the network and the video compression applied. Another paper, discussing coding of X-ray images, described how quantization noise can be introduced, fitting the decorrelation step in the coding system. The last paper of the video coding session discussed the information flow of various image processing operators. In the first invited lecture, Prof. Biemond presented an interesting survey of various video compression methods of the nineties, and expressed an expectation of new techniques for the upcoming five years.

The second part of the day was devoted to channel coding. Two papers discussed concatenated channel coding schemes followed by a paper about a special construction technique for binary coding using BCH codes. The session was concluded with multiple repetition feedback schemes and a special case of constructing a Hamming space. In the early evening, all WIC members had a plenary member meeting, where a.o. new board members were elected. The program was concluded with a reception and cozy conference dinner.

May 29th started with a session on security hash functions, advanced search techniques and a paper about how data protection works out with publicly available electronic watermark detectors. In the audio session, a paper about lossless audio compression was presented. The information theory session covered a.o. theoretical results for communication over channels with weak inputs, hypothesis testing for AR models, neural function classifiers and coding bounds of superimposed codes. Prof. Boxma presented in a humorous way recent results in queuing models and their applications in a.o. traffic jams. The models are used in so-called stochastic networks. A paper concerning queuing models was presented directly thereafter. The session was concluded with a paper concerning optical orthogonal codes. A second session on channel coding covered soft multiplexers for a "soft" Viterbi decoder and a multiple feedback scheme for soft-output discrete channels.

Prof. A.J. Vinck (University Essen) assigned a prize to the best paper of the conference: P. Volf and F. Willems (TU Eindhoven) about their contribution regarding switched context-weighted compression. This prize, sponsored by the Gauss foundation, commemorated the 50-years existence of Shannon's key papers about Information Theory.

The Proceedings of the Symposium are printed in an elegant booklet and are referenced as: "Proceedings of the 19th Intern. Sympos. on Information Theory in the Benelux", Veldhoven, The Netherlands, May 28-29, 1998. ISBN 90-71048-13-6. The proceedings can be obtained at the Technical University of Delft, The Netherlands, Dept. of Information Theory, Fac. Electrical Engineering, Mekelweg 4, 2626 CD Delft, The Netherlands, Tel: +31 15-278-6052, Fax: +31 15-278-1843, Email: bosch@it.et.tudelft.nl.

COLLOQUIUM REPORT:

Scientific Colloquium on xDSL

Ole Harmjanz
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July 7, 1998
Institute for Experimental Mathematics
University Essen, Essen, Germany

The IEEE German chapter on Information Theory and the postgraduate school CINEMA organized the Scientific Colloquium on xDSL - High Speed Transmission Over Ordinary Telephone Lines for Multimedia Applications. Five tutorial presentations showed the state of the art in the developments of xDSL. As Gottfried Ungerboeck summarized, the existing copper-cable infrastructures offer more "bandwidth" than believed possible when they were installed. He added that the last mile technologies still present a hot topic for research and development. The talks also showed that the success of one technology over another is often determined in the standardization groups. The 50 participants from industry and academia enjoyed a day full of lively discussions.

Gottfried Ungerboeck, Johannes Huber, Norbert Fliege discussing the latest results on precoding.

A list of the presentations follows.

- *Dr. Thierry Pollet (Alcatel, Antwerpen,Belgium):* DMT for transmission over time invariant channels: application to VDSL.
- *Prof. Dr. Johannes Huber (University Erlangen, Germany):* Dynamics Limited Precoding, Shaping and Blind Equalization for Fast Digital Transmission over Twisted Pair Lines.
- *Dr. ir. Rob van den Brink (KPN Research, The Netherlands):* Standardization of xDSL Transmission Performance Tests.
- *Dr. Gottfried Ungerboeck (IBM Zurich Research Laboratory, Switzerland):* Network Access Technologies: High-Speed LAN Transmission.
- *Dr. Werner Henkel (Deutsche Telekom, Darmstadt):* The competing xDSL transmission schemes CAP and DMT — an overview.

Further information can be obtained by sending an email to the chairman of the colloquium Han Vinck (vinck@exp-math.uni-essen.de).

Solutions to Golomb's Puzzle Column™ Number 42: Six Easy Problems

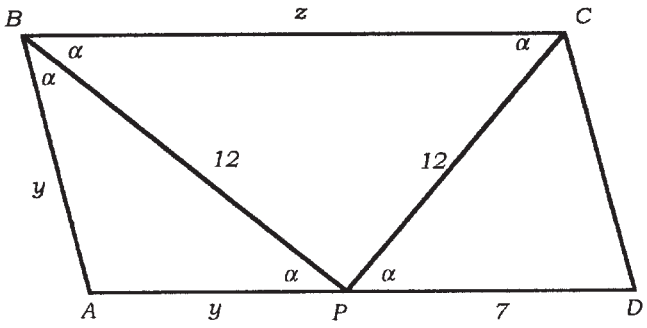
Solomon W. Golomb

1. Since $\frac{1}{x^2}$ is monotone decreasing for x on $(0, \infty)$, it is easy to see that $\sum_{k=n}^{\infty}\frac{1}{k^2} < \frac{1}{n^2} + \int_n^{\infty}\frac{dt}{t^2} = \frac{1}{n^2} + \frac{1}{n} = \frac{n+1}{n^2}$.

This is a very good approximation to the "tail" in the sum of the series $\sum_{k=n}^{\infty}\frac{1}{k^2} = \zeta(2) = \frac{\pi^2}{6}$.

2. If there are any real solutions (x, y, z) to $x + \frac{1}{x} = y$, $y + \frac{1}{y} = z$, $z + \frac{1}{z} = x$, we must have $x \neq 0$, $y \neq 0$, $z \neq 0$. We then rewrite the equations as $x^2 + 1 = xy$, $y^2 + 1 = yz$, $z^2 + 1 = zx$, and multiplying we get $(x^2+1)(y^2+1)(z^2+1) = x^2y^2z^2$, which is impossible, since $x^2 + 1 > x^2$, $y^2 + 1 > y^2$, $z^2 + 1 > z^2$ for real x, y, z.

3. Given $\binom{m+n}{n+k}$ with $k+n \le m$, we take j of the objects from n objects, and the remaining $(n+k)-j$ objects from the remaining m objects, for every $j, 0 \le j \le n$, to obtain $\binom{m+n}{n+k} = \sum_{j=0}^{n}\binom{n}{j}\binom{m}{n+k-j} = \sum_{i=n}^{0}\binom{n}{n-i}\binom{m}{k+i} = \sum_{i=0}^{n}\binom{n}{i}\binom{m}{k+i}$, where we used the substitution $i = n-j$, and $\binom{n}{i} = \binom{n}{n-i}$.



4. In the diagram, ABCD is a parallelogram, BP is the bisector of the angle ABC, and we are told that BP = CP = 12, PD = 7. Since BCP is isosceles, its base angles PBC and PCB are equal (say, α). Since BP is an angle bisector, angle ABP is also α. So too are angles APB and DPC by alternate interior angles of parallel lines. Thus, triangle ABP is isosceles (AP = AB = y), and since they have the same angles, triangles ABP and BCP are similar. From similar triangles, $\frac{y}{12} = \frac{12}{z}$, $yz = 144$, but $z = y + 7$ (opposite sides of a parallelogram), so $y^2 + 7y - 144 = 0$. By the quadratic formula, the positive root is $y = \frac{\left(-7+\sqrt{49+576}\right)}{2} = \frac{(25-7)}{2} = 9$, and then $z = y + 7 = 16$.

5. To find the number of ways, f_n, that $n1\times 2$ rectangles can be used to fill a $2\times n$ rectangle, we observe that $f_1 = 1$ and $f_2 = 2$. (In a 2×2 rectangle, we can place two 1×2 rectangles either horizontally or vertically.) For n > 2, we note that $f_n = f_{n-1} + f_{n-2}$, because the right end of the $2\times n$ rectangle holds either one vertical 1×2 piece, or two horizontal 1×2 pieces. In the former case there are f_{n-1} ways to fill the remaining $2\times(n-1)$ rectangle, and in the latter case there are f_{n-2} ways to fill the remaining $2\times(n-2)$ rectangle, and these two situations are disjoint and encompass all possibilities. But $f_1 = 1$, $f_2 = 2$, $f_n = f_{n-1} + f_{n-2}$ for all $n > 2$ *defines the famous Fibonacci sequence.*

6. A monic polynomial f (x) of degree 4 with integer coefficients and four distinct roots summing to 0 can easily be formed with the four roots $\alpha = a+bi, \bar{\alpha} = a-bi, -\alpha = -a-bi, -\bar{\alpha} = -a+bi$, all of magnitude $\left(a^2+b^2\right)^{\frac{1}{2}}$ where a and b are positive integers. Then

$$f(x) = (x-\alpha)\left(x-\bar{\alpha}\right)(x+\alpha)\left(x+\bar{\alpha}\right) = \left(x^2-\alpha^2\right)\left(x^2-\bar{\alpha}^2\right)$$
$$= x^4 - \left(\alpha^2+\bar{\alpha}^2\right)x^2 + |\alpha|^4 = x^4 - 2\left(a^2-b^2\right)x^2 + \left(a^2+b^2\right)^2$$

which is monic, with integer coefficients, with roots summing to 0, and for every odd k the k^{th} powers of the roots also sum to 0. With $a = 4$, b = 3, we get $f(x) = x^4 - 14x^2 + 625$, with roots $\pm 4 \pm 3i$. These roots normalize to $\frac{(\pm 4 \pm 3i)}{5}$, which are all on the unit circle, but are not roots of unity. (Their phase angles are not rational multiples of 360°, although the sines and cosines of these angles are simple rational numbers.)

Note. Several of these problems were based on the Undergraduate Mathematics Competition at Memorial University, St. John's, Newfoundland, as reported in *CRUX* MATHEMATICORUM for December, 1997.

IEEE IT Society Golden Jubilee Awards for Technological Innovation and Golden Jubilee Paper Award

Continued from page 1

13. **Dwight O. North:**
For the invention of the matched filter.

14. **Irving S. Reed:**
For the co-invention of the Reed-Solomon error correction codes.

15. **Jorma Rissanen:**
For the invention of arithmetic coding.

16. **Gottfried Ungerboeck:**
For the invention of trellis coded modulation.

17. **Andrew J. Viterbi:**
For the invention of the Viterbi algorithm.

Editor's Note

It is with great sorrow that we note the death of Dwight O. North, who passed away after learning of, but before receiving, the Golden Jubilee Award for Technological Innovation.

IEEE Information Theory Society Golden Jubilee Paper Awards

The Golden Jubilee Paper Awards are given for outstanding articles published in the *IEEE Transactions on Information Theory* whose impact on the development of the fields of interest to the Information Theory Society is now widely recognized. Papers that have received the Information Theory Society Paper Award are not eligible. The IEEE Information Theory Society Golden Jubilee Paper Awards go to:

1. **M. J. E. Golay**, "Notes on digital coding," Proc. IRE, vol. 37, p.637, 1949.

2. **C. E. Shannon**, "The zero-error capacity of a noisy channel", IEEE Transactions on Information Theory, IT-2, pp. 8-19, 1956

3. **R. Price**, "A Useful Theorem for nonlinear devices having Gaussian inputs", IEEE Transactions on Information Theory, IT-4, pp. 69-72, June 1958.

4. **R.G. Gallager**, "Low-Density Parity-Check Codes," IRE Transactions on Information Theory, IT-8, pp. 21-28, January 1962

5. **R. G. Gallager**, "A simple derivation of the coding theorem and some applications", IEEE Transactions on Information Theory, IT-11, pp. 3-18, Jan. 1965

6. **T. Cover and P. Hart**, "Nearest neighbor pattern classification", IEEE Transactions on Information Theory, IT-13, pp. 21-27, 1967.

7. **J.L. Massey**, "Shift-register synthesis and BCH decoding,"' IEEE Transactions on Information Theory, IT-15, pp.122-127, 1969.

8. **T. Kailath**, "A general likelihood-ratio formula for random signals in Gaussian noise,"' IEEE Transactions on Information Theory, IT-15, pp.350 - 361, 1969.

9. **G.D. Forney, Jr.**, "Convolutional codes I: Algebraic structure," IEEE Transactions on Information Theory, IT-16, pp. 720-738, 1970.

10. **G. D. Forney, Jr.**, "Maximum Likelihood Sequence Estimation of Digital Sequences in the Presence of Intersymbol Interference", IEEE Transactions on Information Theory, IT-18, pp. 363-378, May 1972

11. **L. R. Bahl, J. Cocke, F. Jelinek, J.Raviv**, "Optimal Decoding of Linear Codes for Minimizing Symbol Error Rate", IEEE Transactions on Information Theory, IT-20, pp. 284-287, March 1974

12. **R.J. McEliece, E.R. Rodemich, H.C. Rumsey, and L.R. Welch**, "New upper bounds on the rate of a code via the Delsarte-MacWilliams inequalities," IEEE Transactions on Information Theory, IT -23, pp.157-166, 1977.

13. **H. Imai and S. Hirakawa**, "A new multilevel coding method using error-correcting codes," IEEE Transactions on Information Theory, IT -23, pp. 371-377, 1977.

14. **R.M. Tanner**, "A recursive approach to low-complexity codes," IEEE Transactions on Information Theory, IT-27, pp.533-547, 1981.

15. **S. Verdú,** "Minimum probability of error for asynchronous Gaussian multiple-access channels," IEEE Transactions on Information Theory, IT-32, pp. 85 - 96, 1986.

Conference Calendar

DATE	CONFERENCE	LOCATION	CONTACT/INFORMATION	DUE DATE
October 5–7, 1998	DIMACS Workshop on Codes and Trees: Algorithmic and Information Theoretic Approaches	Rutgers University, Piscataway, NJ, USA	Julia Abrahams DIMACS/CoRE Bldg./Busch Rutgers University 96 Frelinghuysen Rd. Piscataway, NJ 08854-8018 Phone: 732-445-5931 Fax: 732-445-5932 Email: abrahams@dimacs.rutgers.edu WWW: http://dimacs.rutgers.edu/Workshops/Codes/index.html	
February 17–19, 1999	1999 IEEE International Conference on Personal Wireless Communications (ICPWC'99)	Jaipu, India	Dr. Vijay K. Bhargava Dept. of Elec. & Comp. Eng. University of Victoria, P.O. Box 3055 Victoria, BC, Canada V8W 3P6 Tel: +1-250-721-8617 Fax: +1-250-721-6048 e-mail: bhargava@ece.uvic.ca Tel: +1-250-721-8617 Dr. Ram Gopal Gupta Dept. of Electronics, Govt. of India 6 CGO Complex, Lodhi Road New Delhi 110 003 India Tel: +91-11-436-3095 Fax: +91-11-436-3079 e-mail: guptarg@xm.doe.ernet.in http://www.citr.ece.uvic.ca/icpwc99	September 15, 1998
February 24–26, 1999	IEEE Information Theory Workshop on Detection, Estimation, Classification and Imaging (DECI)	Santa Fe, New Mexico	Prof. Alfred O. Hero III EECS Department U. of Michigan 1301 Beal Avenue Ann Arbor, MI 48109 hero@eecs.umich.edu http://www.ifp.uiuc.edu/itw-deci	
March 15–19 1999:	IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)	Phoenix, Arizona	Conference Management Services 3109 Westchester Ave. College Station Texas 77845-7919 Tel: (409) 693-6000 email: mercer@conf-mgmt.com http://icassp99.asu.edu	September 14, 1998
June 15-18, 1999	1999 Canadian Workshop on Information Theory	Kingston, Ontario, Canada	Prof. F. Alajaji Dept. of Mathematics & Statistics Queen's University Kingston, Ontario K7L 3N6, Canada Tel: (613) 545-2423 Fax: (613) 545-2964 Email: fady@polya.mast.queensu.ca Web: http://markov.mast.queensu.ca/~fady/CWIT99/cwit99.html	

Conference Calendar

DATE	CONFERENCE	LOCATION	CONTACT/INFORMATION	DUE DATE
June 20–25, 1999	1999 Information Theory Workshop Kruger National Park, South Africa	Kruger National Park, South Africa	Prof. Hendrik C. Ferreira Dept. of Electrical Engineering Rand Afrikaans University P.O. Box 524 Auckland Park, 2006, South Africa E-mail: hcf@ing1.rau.ac.za Web page: http://www.wits.ac.za/ITW99	January 31, 1999 (recent results)
June 27–July 1, 1999	1999 Information Theory and Networking Workshop	Metsovo, Greece	Prof. Wojciech Szpankowski Department of Computer Science Purdue University W. Lafayette, IN 47907, USA Email: spa@cs.purdue.edu Phone: (765) 494 6703 Fax: (765) 494 0739 Web: http://www.cs.purdue.edu/homes/spa/itw99.html	January 31, 1999 (recent results)
August 2–13, 1999	Workshop on "Codes, Systems and Graphical Models"	Minneapolis, Minnesota, USA	http://www.ima.umn.edu/csg	

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