



Reflections on 1999 Prize Paper Award – Space-Time Codes for High Data Rate Wireless Communication

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We are honored to receive the 1999 Information Theory Prize Paper Award for our 1998 paper that introduced space-time codes for wireless communication. In the two years since publication this form of coding has progressed from theory to incorporation in important 3rd generation wireless standards. This progress would not have happened without the contributions of many members of the Information Theory community, both inside and outside AT&T Labs, and we would like to express our appreciation for these efforts.

We begin with a quotation from Marconi:

It is dangerous to put limits on wireless.

This is an opinion expressed in 1932, but it remains true today in the middle of a gold rush to provide wireless Internet access. The difficulty in providing attractive data rates is that bandlimited wireless channels are narrow pipes that do not readily accommodate rapid flow of data, but these pipes can be broadened by deploying multiple transmit and receive antennas. Foschini [F] and Telatar [T] provide outage capacity curves under the assumption that fading is quasistatic, that is constant over a long period of time, and then changing in an independent manner. Figure 1 shows the potential gain on narrowband 30kHz TDMA channels (IS-136) employed by AT&T Wireless Services — with only two antennas at

the base station and the mobile, there is the potential to increase the achievable data rate by a factor of 6.

Two antennas at the base station provide two independent paths from the base station to the mobile, and by spreading

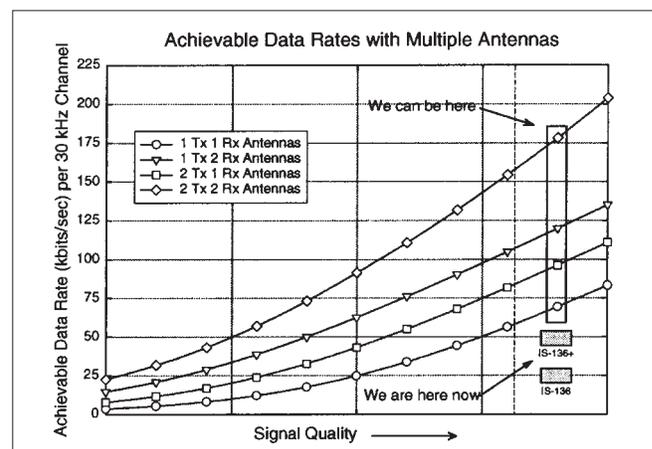


Figure 1. Potential data rates on the IS-136 narrowband TDMA channels employed by AT&T Wireless Services. Recall that 10% outage capacity is the transmission rate that can be supported 90% of the time, and that radio link protocols use ARQ retransmission to correct frames or packets that are received in error.

From the Editor

In this issue of the *IEEE Information Theory Society Newsletter*, I hope you'll enjoy the article by Vahid Tarokh, Nambi Seshadri, and Rob Calderbank on their paper "Space-time Codes for High Data Rate Wireless Communications: Performance Criterion and Code Construction," which received the 1999 IT Society Prize Paper Award. Also, to mark the occasion of his 80th birthday, David Middleton was invited to share some thoughts with our readers; his article appears on page 3. There are also enjoyable and informative columns by IT Society President Vijay Bhargava, Historian Anthony Ephremides, and Editor-in-Chief of the *IEEE Transactions on Information Theory* Alexander Vardy, as well as Sol Golomb's puzzle column. In addition, there are announcements of prestigious awards recently won by members of our Society, and reports from various workshops and symposia.

Please help me to make the Newsletter as interesting and informative as possible

IEEE Information Theory Society Newsletter

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sible by offering suggestions and contributing news. The deadlines for the next few issues are as follows:

Issue	Deadline
September 2000	July 15, 2000
December 2000	October 15, 2000
March 2001	January 15, 2001
June 2001	April 15, 2001

Electronic submission, especially, in LaTeX, PDF, Postscript, ascii, and Word formats, is encouraged. I may be reached at the following address:

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Letters to the Editor

To the Editor, IEEE IT Society Newsletter:

I protest the high fee of our ISIT 2000, to be held in Sorrento in June. The before-March-31 fee for members of IEEE is 1,300,000 Italian lire, equal to \$650 US at the current rate of 2000 lire per dollar, a close approximation. Yes, we have to pay for what we get; but I question whether we must pay this much.

The registration form lists admittance to all sessions, Symposium proceedings, welcome reception, 4 lunches, concert, gala dinner, & farewell party as covered by the fee. It further prices extra tickets at 56,000 lire (lunch) and 160,000 lire (banquet). Let's subtract those prices from the fee:

4 lunches	224,000
1 banquet	160,000

384,000 from 1,300,000 = 916,000 lire

That is, we have \$458 US left to cover rental of meeting rooms, welcome reception, concert, & farewell party. There

are also administrative costs for setting up the conference. If we assume 500 paid fees, that gives us \$229,000 US to cover these latter items.

Many hotels give the meeting rooms free in return for the large number of customers brought by a conference. How much can the concert cost? \$2000 total? The welcome party? Let's say \$20 per person at 600 guests: \$12,000. The farewell party may have 100 guests, and at \$15 that's another \$1,500. We are all the way up to \$15,500, leaving \$213,500 for administrative costs.

Of course, I am estimating from the outside. But I think the members of the Information Theory Society deserve a full accounting of how this huge fee has been spent. I call on the Board of Governors to publish such an accounting in the next issue of this Newsletter.

Sincerely,
H. F. Mattson, jr.

A Brief Personal History in Science and Information Theory: David Middleton, April 19, 1920-

At the kind invitation of the Editor and a number of professional friends, and having reached a certain measure of antiquity, I was asked to share a few past moments of my career in our common field of study. I thought also that a little bit of personal history along the way might induce some life into an otherwise dull recitation of such facts and events. My attempt at interest and brevity follows.

1920 - 1929: I was born in New York City on April 19, 1920, and spent my earlier years there. My mother was an accomplished musician, trained in Berlin under Leopold Aiser, on the violin (also piano and voice). [I still have some of the music, dated 1905, 1906.] My father was a poet, writer, and editor, at one time an editor under Harold Ross of the *New Yorker*. Science, however, was not in the family history: in this respect I am a "sport" on the family tree.

1929 - 1939: (*The Great Depression*), I recall this period as difficult and turbulent. One quarter of the labor force was out of work and a real possibility of revolution existed, from both the Left (action) and the Right (reaction). Compared to so many we were comparatively well off, although it was the sale of my mother's violin (a Guanerius) which helped put me through school and college (Harvey, Deerfield Acad-



David Middleton

emy, and Harvard 1939-1942): for the latter, tuition then was only \$400/year and living expenses, \$800!

1942 - 1945: World War II: I led a very unheroic war: my war years were spent at Harvard, after graduating in June, 1942. [Ours was the last full Class to graduate, until 1948.] First, those of us with a physics background, who hadn't been drafted (and sent to Los Alamos), were employed to teach three months of electronics to junior officers of the Army (Signal Corps), Navy, and Marines, in the "pre-radar" course at Harvard, before going down the river to MIT for their final three months, to become (that new

thing) radar officers.

In December of 1942 I joined the newly initiated Radio Research Laboratory (RRL), also at Harvard, and directed by Prof. Terman from Stanford. I was assistant to Prof. J.H. Van Vleck (later to be a Nobel Laureate in 1977, as was Felix Bloch a little later, another number of our group). Professor Van Vleck was the head of our small Research Group [1]. This was in addition to his many other duties, e.g. S-1 Committee on the feasibility of the A-bomb, and liaison with MIT Radiation Laboratory ("RadLab"). Our basic task was to provide analysis and guidance for the main purpose of RRL, which

was radar countermeasures (ECM), both passive (“chaff”, and “rope”) and active (narrow and wide band electronic noise). [For the Laboratory’s success in support of the electronic war effort, see [2].]

WWII for everyone involved, in and out of the military, had a critical influence upon our subsequent lives. In my own case, my work in “noise” during WWII proved to be the guiding vector of my technical career, the opening to my interests and development in later years, in the rapidly expanding field of statistical communication theory (and its multifarious applications). Just as television was the principal technical and economic offspring of radar, the concomitant problems of the noisy channel and signal extraction from it became for me the challenge and concern of my later efforts, a challenge which shows no signs of abating in the present, so-called Information Age.

It was during WWII that the concept of the “matched filter” was born, circa 1943 and 1944 [3] simultaneously and independently at RRL and RCA Princeton [4]. It was also at this time during which we became aware of Rice’s seminal work on noise [5], this in manuscript form, which we were permitted to see and for which we made a “pilgrimage” to Bell Labs (then at 463 West St. New York City). Rice’s work proved very stimulating to our noise efforts at RRL, and for my own doctoral work later [6]. In fact, we interacted long after the war was over [7].

1947 - 1949: After the war, at the end of 1945 I went back to full time effort on my Ph.D. thesis with Prof. Van Vleck. During the period 1947-1949 I worked as a postdoctoral researcher with Prof. Leon Brillouin, who had left France recently and was associated with the newly created Department of Engineering Sciences and Applied Physics (ESAP), 1947-, as well as being its consultant to IBM. [His book, *Science and Information Theory* [8] was a product of this time, when Shannon’s work was being recognized.] My own noise studies focused on developing and expanding various results coming out of our wartime efforts [9], [10]. The year 1947 was an “historical” year for me personally: at Commencement, to receive my doctorate, to see my Headmaster [Frank L. Boyden] receive what was his *third* honorary LLD that spring (the others from Yale and Princeton that same June), and that afternoon at Harvard, to be present when Secretary of State, General Marshall, made his history-altering offer to Europe - and to the USSR, as well, of what became known eventually as the Marshall Plan. As we all know, Stalin rejected the offer, and Europe was eventually saved from Communism.

1949 - 1955: I was appointed Assistant Professor of Applied Physics (Harvard.), which gave me the opportunity in addition to research, to have students and teach some of the material which evolved from the war effort.

1955 - Present: After Harvard I became a full-time consultant, mainly with industry and various components of DoD and Commerce [11], [12], along with a number of adjunct professor-

ships, and occasional students; (see [12]). *An Introduction to Statistical Communication Theory (ISCT)*, McGraw-Hill Series in Pure and Applied Physics (1960-1972) was published, followed by several reprint editions 1987-1996 and the current Classic Edition (1996-) by the IEEE Press. In addition to some 170 papers (1943-), a small volume, *Topics in Communication Theory* (McGraw-Hill) appeared in 1965 and is still surviving under the imprint of the Peninsula Publishing Co. (Los Altos, CA).

Currently, I am deeply engaged in a sequel to ICST, titled *NonGaussian Statistical Communication Theory*, for the IEEE Press. This work extends the material of ICST to include nongaussian noise and spatial processing, and special topics which came originally out of many consulting activities of the last forty-five years. New topics and new results stem from the following principal areas with which I have been and am currently concerned:

1. *Signal Replica Structures* - (i.e., Matched Filters) - stemming from threshold detection and estimation algorithms.
2. *The Canonical Nongaussian Channel* and its physical foundations, for example [13]. This includes:
3. *Nongaussian Noise Models* - Physical (i.e., finite variance processes and fields), and non-physical, i.e., numerical (infinite variance processes and fields), such as Internet traffic, f^{-1} noise, economic models, viz. -stable and fractal phenomena. The first include the author’s Class A and B noise models [14].
4. *Signal Processing:* Coupled (Joint) detection and estimation [15] [16], and related topics developed from the original application of Bayesian Statistical Decision Theory to communication problems [17], and ISCT above.
5. *New Approaches to Scattering*, which can provide the probability distributions, especially for strong scatter, needed in 4) above, [13].
6. *Canonical Threshold Detection and Estimation* processes and performance in nongaussian regimes [18].

Finally, it should be emphasized that all of the above has fundamentally been a collaborative effort with many friends and colleagues. Their critical evaluations and their many important contributions along the way have been and will continue to be invaluable. My thanks go to our Editor as well for this opportunity to present my (comparatively brief?) Bio.

I. A Few Credentials:

DM: *Harvard College:* AB (scl) Physics, ‘42, ΦBK; AM, 1945, Sigma Xi, 1945, Ph.D. (Physics), 1947.

Fellow: American Physical Society (1951-), IEEE (1958-1985 ; Life Fellow, 1986-); AAAS (1958-); Acoustical Society of America (1978-); Explorers Club (1978-); New York Academy of Sciences (1991-), Electromagnetic Academy, (MIT, 1990-)

Member: National Academy of Engineering (1998-).

[See [12] for additional personal activities, awards and memberships.]

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Awards

J. H. van Lint Receives Honorary Doctorate

On March 24, 2000, Jack van Lint received an honorary doctorate from the University of Ghent (Belgium).

Sergio Verdú Receives 2000 Frederick Emmons Terman Award of the American Society for Engineering Education

The American Society for Engineering Education (ASEE) has announced that Sergio Verdú, Professor of Electrical Engineering at Princeton University, is the recipient of the 2000 Frederick Emmons Terman Award. The Terman Award is sponsored by the Hewlett Packard Company and consists of a US\$4,000 honorarium, a gold-plated medal, a bronze replica, a presentation scroll, and reimbursement of travel expenses to attend the conference where the award is presented. The Terman Award is bestowed annually upon an outstanding young electrical engineering educator in recognition of the educator's contributions to the profession. The recipients of this award must meet the following requirements: (1) Be the principal author of an electrical engineering textbook published prior to June 1 of the year in which the author becomes 40 years of age, and

judged by peers to be outstanding by virtue of its original contribution to the field; (2) have outstanding achievements in teaching, research, and guidance of students and related activities; (3) be an electrical engineering educator under 45 years of age on June 1 of the year in which the award selection is made; and (4) be a full-time member of a college faculty and actively engaged in teaching in the United States or Canada at the time that the award winner is selected. The award will be presented at the 2000 ASEE Frontiers in Education Conference, which will be held in Kansas City, Missouri, from October 18-21, 2000.

This award has also been received by three other former IT Society Presidents: Toby Berger (1982), Jerry Gibson (1990), and Vince Poor (1992).

Ickho Song Receives Young Scientists Award

Dr. Ickho Song (isong@Sejong.kaist.ac.kr, <http://Sejong.kaist.ac.kr/~isong>), who is a Professor of the Department of EECS, Korea Advanced Institute of Science and Technology (KAIST), Korea, and a Senior Member of the IEEE and the IT Society, was awarded the 3rd Young Scientists Award on March 31, 2000. He was among the three recipients this year. The award was presented by the President of the Republic of Korea at the Blue House. A brief explanation of the award is given below.

The Young Scientists Award

1. Objective

1.1 To identify and recognize exceptionally outstanding young scientists/engineers in natural sciences and engineering

1.2 The award shall be presented by the President of the Republic of Korea to acknowledge the recipient for his/her excellence in research efforts and to encourage for further research effort, allowing the recipient to play a key role in the advancement of national sciences and engineering.

2. The recipients are selected at Korea Academy of Science and Technology (KAST), from a number of nominees in the

areas of natural sciences in odd-numbered years, and in the areas of engineering in even-numbered years.

3. Area and number of recipients: Not more than 4 each year

3.1 Natural Sciences: 1 recipient each in the following areas

Group 1: Mathematics

Group 2: Physics

Group 3: Chemistry

Group 4: Life Sciences

3.2 Engineering: 1 recipient each in the following areas

Group 1: Electrical Engineering, Electronics, Communications

Group 2: Mechanical, Metallurgy, Ceramics, Aerospace Engineering

Group 3: Chemical, Food, Polymer, Bio Engineering

Group 4: Architecture, Civil, Environmental Engineering

4. Scope and eligibility

5.1 Research achievements during the recent 5 years

5.2 Age 40 or younger person affiliated with a university or a research institute in Korea

5.3 Evaluated in 3 steps: specific area evaluation, group evaluation, and final over-all evaluation.

Te Sun Han and Sergio Verdú Receive Paper Award from the Telecommunications Advancement Foundation of Japan

The Telecommunications Advancement Foundation of Japan (TAF) announced that Te Sun Han and Sergio Verdú are the recipients of the 2000 TAF paper award for the fundamental contribution to Shannon Theory of their joint paper

“Approximation Theory of Output Statistics,” *IEEE Trans. Inform. Theory*, vol. 39, pp. 752-772, May 1993.

The TAF Honors Ceremony was held in Tokyo on 27, March, 2000, where Te Sun Han delivered an acceptance speech.

Call For Nominations: IEEE Medals, Service Awards, and Prize Papers

IEEE has many awards, ranging from prizes for technical achievement to recognition of service to IEEE. The Information Theory Society has many distinguished members, many of whom would be strong candidates for IEEE awards. In the past, when the Society has submitted completed nominations, it has been quite successful. Your help is needed to identify candidates and, equally importantly, help us find people who know the candidates and their work, so that nomination forms can be completed in a substantial way.

Below you will find a list of awards with a short description and recent winners. A complete list of 1999 awards appears in the December 1999 issue of *The Institute*. All of the awards listed have a NOMINATION DEADLINE of JULY 1, 2000. We strongly encourage suggestions and or nominations. Suggestions can be directed to Joachim Hagenauer at (email:

hagenauer@ei.tum.de. More information on awards and the nomination procedure is also available on the Web at <http://www.ieee.org/awards/>, or directly from IEEE Awards Department, 445 Hoes Lane, Piscataway, NJ, USA 08855-1331, Tel: (732) 562-3840, Fax: (732) 981-9019, email: awards@ieee.org.

The IEEE Medals and Awards most appropriate to the IT society are: The IEEE Medal of Honor; The Alexander Graham Bell Medal; The Richard W. Hamming Medal; The Edison Medal; The Medal for Engineering Excellence; The John Von Neumann Medal; The Founders Medal; The James H. Mulligan, Jr. Education Medal; Haraden Pratt Award; Richard M. Emberson Award; W.R.G. Baker Prize Award; Donald G. Fink Prize Award; and the Leon K. Kirchmayer Prize Paper Award

Information Theory Society Members Receive IEEE Third-Millennium Medals

Vijay Bhargava

Introduction

In 1999, the IEEE established a new Institute-wide medals program to mark the new millennium and honour members. Seventeen such medals were allocated to the IEEE Information Society to be awarded for outstanding contributions to the Society. A total of 3000 medals were allocated to various societies, sections, regions and boards.

To recommend medal recipients, 1999 President Biglieri established an adhoc committee consisting of Vijay Bhargava (Chair), Thomas Ericson, Joachim Hagenauer and Alex Vardy.

Selection Criteria

At the June 1999 Board Meeting the following three criteria were agreed upon:

1. Quality and quantity of research publications in our field.
2. Editorial service to the Society as Editor-in-chief of the Transactions and/or as associate editor.
3. Service to the IT Society as exemplified by service as a Society officer, as a member of the Board of Governors, and/or as an organizer of an ISIT and/or IT Workshop.

At the meeting there was consensus on the fact that the Shannon Awardees should not be considered for these medals, because it makes little sense to add a lesser honour to a higher one, and, since not all Shannon Awardees can get the medal, we would generate two tiers of them.

At the September 1999 meeting of the Board the recommendations of the adhoc committee was unanimously approved and the following seventeen members of our Society will receive the IEEE Third-Millennium Medals at the IEEE ISIT'2000 Awards Banquet in Sorrento: John B. Anderson, Toby Berger, Ezio Biglieri, Richard E. Blahut, Ian F. Blake, A. Robert Calderbank, Daniel J. Costello Jr., Lee D. Davisson, Anthony Ephremides, Robert M. Gray, Bruce Hajek, Carl W. Helstrom, Shu Lin, Robert J. McEliece, H. Vincent Poor, Sergio Verdú, and Jack K. Wolf.

The Medal of Honour is the highest IEEE Award. It was decided by the IEEE that all Medal of Honour recipients will automatically receive the Third-Millennium Medals. Therefore, two very distinguished members of our Society, Claude E. Shannon (1966 recipient) and Robert G.



John B. Anderson



Toby Berger



Ezio Biglieri



Richard E. Blahut



Ian F. Blake



A. Robert
Calderbank



Daniel J. Costello,
Jr.

photograph
not
available

Lee D. Davisson



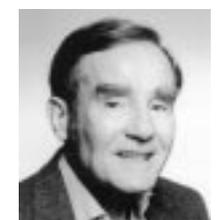
Anthony
Ephremides



Robert M. Gray



Bruce Hajek



Carl W. Helstrom



Shu Lin



Robert J. McEliece



H. Vincent Poor

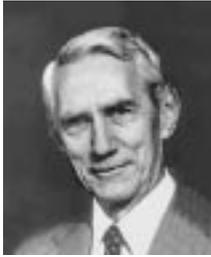


Sergio Verdú



Jack K. Wolf

Gallager (1990 recipient) are recipients of the Third-Millennium Medal:



Claude Shannon



Robert G. Gallager

Vijay Bhargava was nominated by IEEE Region 7 (Canada) and is also a recipient of the Third-Millennium Medal:



Vijay Bhargava

President's Column

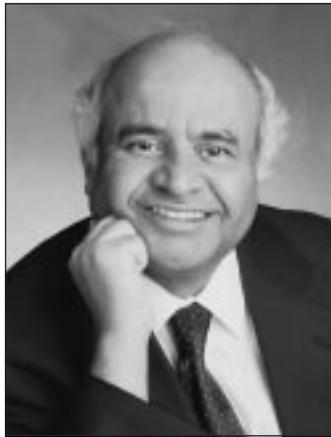
Vijay Bhargava

The first four months have been very busy and I would like to report to you on those items that impact our society.

During 11–12 February, I attended the IEEE Technical Activities Board Meeting (TAB) in New Orleans, Louisiana, USA. As you know one purpose of TAB is to oversee and coordinate the society activities, such as the establishment of new publications and other products, awards, conference policies and bylaws. TAB approved the constitution and bylaw changes proposed by our society. It also approved the joint paper award between the Communications and Information Theory Societies.

The TAB Periodicals Committee discussed the question of IEEE periodicals in the area of Wireless and commissioned a working group to consider the creation of a periodical on “Wireless _____” (the final name is to be decided later on). Several societies are participating in the working group: Antennas and Propagation, Communications, Computer, Information Theory, Microwave Theory and Techniques, Ultrasonics, Ferroelectrics and Frequency Control, and Vehicular Technology. I feel that it is extremely important for our society to participate in this working group. Many important breakthroughs for wireless communications, such as, Space Time Codes, Multi-user Detection, Trellis-Coded Modulation, Viterbi Decoding, Kasami and Gold Sequences, Public Key Cryptography, Adaptive Equalization, Data Compression, Random Access Communications, Turbo Codes, Reed-Solomon Codes (just to mention a few!), were made by our members. It is difficult to imagine the current and future state of wireless communications without them.

Preceding the TAB Meeting, I attended the IEEE Chapter Retreat. We do not have many chapters. It seems to me that Los Angeles and India Councils, San Diego, Hong Kong and Sweden Sections are very good candidates for forming an IT Chapter. The number of society members residing in these



Vijay Bhargava

IEEE entities is 194, 97, 149, 54 and 117 respectively. Only 12 members are needed to form a chapter.

The IEEE Membership Development Retreat was held during 25–27 February 2000 in Newark, New Jersey, USA. I learned that the IEEE membership has increased substantially. However, the membership in our society has more or less remained the same. This is of some concern and Tom Fuja is looking into this matter.

Our first meeting of the Board of Governors was held in Prospect House, Princeton University, 17 March 2000. It was an excellent meeting with the usual degree of collegiality

and mutual supportiveness that characterizes our society. Please consult the minutes of the meeting for further details. However, I would like to expand on one item—the true globalization of our society.

The current composition of our society membership is: 49% USA (Regions 1–6), 3% Canada (Region 7), 27% Europe, Middle East and Africa (Region 8), 3% Latin America (Region 9), and 18% Asia and Pacific (Region 10—the fastest growing region of the IEEE). Our International Symposia have alternated between US and non-US sites for more than 30 years. But “non US” has not included Region 10 (the only exception being ISIT’88 in Kobe, Japan). Similarly, the lack of Associate Editors and the under representation on the Board of Governors is rather glaring. I believe that our Board is sensitive to these issues and in the spirit of true globalization will ensure adequate representation from Region 10 (Asia-Pacific) in the very near future. In the words of our 1992 President G. David Forney Jr., “*Our hope and vision is that our field can be a model for worldwide cooperative enterprise sustained by contributions from able people everywhere.*”

I look forward to seeing you in Sorrento. In the meantime you can contact me via e-mail at v.bhargava@ieee.org

Historian's Column

A. Ephremides

In this issue it is with pleasure that I bow to, and welcome, a guest, who, not only is well known to everyone in our community, but who, like Toby Berger in the past, has fully earned the coveted title of historian-par-excellence. It is Jim Massey!

In February Jim was the speaker at the banquet of the International Zurich Seminar and I had the pleasure of listening to his talk which was a most entertaining, veritable immersion in History and which, with his permission, I will paraphrase in this column.

The theme of the 2000 International Zurich Seminar (which is a high-quality conference with a long tradition, held bi-annually at the ETH in Zurich) was "New Technologies for a New Millennium," and Jim selected the topic of his talk to be "Great Inventions of the Old Millenia," so as to juxtapose past and future, much in the manner of Janus, who has been in vogue this year in our Society.

As tribute to the hosting country, Jim chose to focus his review of great inventions of the past to those that occurred in Switzerland and in her "big neighbors" to the north, west, and south.

So he started with Germany and, of course, limited his survey to inventions that had an impact on the field of Communications. The first notable contributor to the field from the land of the Teutons was Heinrich Rudolf Hertz (1857-1894) who, in his brief passage through life, produced and measured electromagnetic waves and imparted his name on the unit of frequency and on the ... number-one rental car company in the United States. And then there was Wilhelm Edward Weber (1804-1891), whose life, by contrast, almost spanned the entire 19th century, and who, together with a friend, devised the first electromagnetic telegraph (much to the chagrin of his friend who was frightened by the thought of worldwide communication) and imparted his name on the unit of magnetic flux. And, of course, there was Max Planck (1858-1947), who lived to see half of each of the last two centuries and who was the originator of quantum theory (that led to LASERS among other things).

But, Jim noted, the greatest contribution from Germany came from Carl Friedrich Gauss (1777-1855) whose picture is carried in the pocket of every German today (by virtue of adorning the 10-Deutsch-Mark bill, until, alas, the Euro comes along). Jim went ahead and observed that Gauss was the inventor of no less a notion than ... noise. And he pointed out that it was in fact Gauss who was the skeptical friend of Weber. Perhaps the "invention" of noise was Gauss's way of applying the brakes to the spread of worldwide communication!



A. Ephremides

Next, came France; Claude Chappe (1763-1805) was the inventor of the semaphore optical telegraph. His rivals, however, contested the priority of his invention and contributed to his untimely death (by suicide).

Then came the all-too-well-known Simeon-Denis Poisson (1791-1840), the father of traffic theory. In addition to marveling at his first name (which, I am sure, no contestant in the "who wants to be a millionaire?" show would be likely to know), I also marveled at the well-known (to the insiders) paradox of the memorylessness of the exponential distribution that underlies the Poisson process. As Jim observed, if the average distance to the car in front of you is 100 meters

and the average distance to the car behind you is another 100 meters, and the average distance between these two cars is also 100 meters, then there is something ... *fishy* about it.

Other notables from France included Baron (title) Jean-Baptiste-Joseph Fourier (1768-1830) and Jean-Maurice-Emile Baudot (1845-1903). When I see these names I feel impoverished and scold my parents for being so stingy in giving me just one single first name. Well, Fourier is known to all of us as the father of series, transforms, and ... bandwidth, and Baudot as the inventor of time multiplexing and as the donor of his name to the ... baud. The way it works is that each symbol waiting for its turn to be transmitted, is waiting for ... Baudot! (Jim is not "guilty" of this one).

But, the greatest contribution from France, Jim noted, was the introduction of standardization (via the metric system), which was actually not imposed by Napoleon, who, in fact, thought that it would hamper the lives of many generations (how right he was!), but by Maximilien-Francois-Marie-Isidore de Robespierre (1758-1794), (talk about first names!), who will be remembered for saying "One single will is necessary," and who exemplified the dictum "You live by the guillotine, you die by the guillotine." And it was Jim's observation that ITU is considering Robespierre's methods of enforcing standards!

Italy was next. Count Alessandro Giuseppe Antonio Anastasio Volta (1745-1827) (what is your middle name, Sir?), who was born and died in the beautiful town of Como (remember the IT workshop in Bellaggio in 1987?), demonstrated his battery in 1809 before Napoleon, who made him a count and senator of the kingdom of Lombardy. And, of course, his name was chosen to designate the unit of electrical potential. As serendipity has it, the tram stop for the EE department at ETH, the host of the International Zurich Seminar, is located on ... Voltastrasse!

Then there is Guglielmo (that's all!) Marconi (1874-1937), the inventor of the radiotelegraph and 1909 Nobel Prize winner.

But, keeping with his punch line theme, Jim noted that the greatest contribution from Italy was SPQR! What is SPQR? Not "Sono Porci Questi Romani" (which translates to "they are pigs these Romans") as Asterix might assert, but *Senatus Populus Que Romanus* (the senate and the people of Rome), the quintessence of which is that Italy gave to the world (and, by extension, to our field) the notion of ... acronyms!

Which brought the speech to Switzerland, the host country (and site of the 2002 ISIT). I am sure that many of you, just like me, would not be able to name any Swiss contributors to our field. In fact, if asked to name a famous Swiss, we would all probably think of no one else than William Tell! And yet, there was Leonhard Euler (1707-1783), whose famous theorem is crucial to public-key cryptology, and Jakob Bernoulli (1655-1705) whose binomial distribution is essential to the description of random errors.

And then there is Gustav Guanello of Brown, Boveri, and Company, among whose 100 patents is one, filed in 1938, that contains all the essential characteristics of a stored reference, spread-spectrum radar. And, also, Marcel Golay (1902-1989), who discovered the only two non-trivial perfect

codes and who, along with R.W. Hamming, was the co-founder of coding theory.

But, again, the most significant contribution from Switzerland, according to Jim, came from none other than the most famous Swiss, William Tell. As I am sure you know, but, like me, have to be reminded, William Tell refused to bow to a hat on a pole as the tyrannical Austrian governor Gessler had required the Swiss people to do back in 1307. As punishment, Gessler asked him to place an apple on his only son's head and shoot it with an arrow from a distance of 100 paces. If he missed, he would perish. And if he missed the wrong way, he would kill his son. So, William Tell drew a first arrow and put it in his belt. Then, he drew a second one, took aim, and sliced the apple in two, gaining the admiration of his countrymen and of the world, as well as that of Gessler, who asked him why he had put the first arrow in his belt. William Tell's answer was "To slay you, tyrant, had I killed my son"! Which exemplifies, as Jim put it, the greatest engineering idea, that of the ... "backup solution"!

With that, the applause and pandemonium that followed sealed the account of an excursion into the past, but with an eye into the future, that combined humor, substance, erudition, and a unique knack for knowing what is right at the right time and the right place.

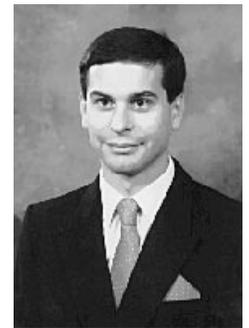
IEEE Information Theory Society Board of Governors Meeting

*Saturday, September 25, 1999, 8:30 am
Hotel Chicago Marriott O'Hare*

Attendees: Ezio Biglieri, Michelle Effros, Tony Ephremides, Marc Fossorier, Thomas Ericson, Tom Fuja, Ralf Koetter, Steve McLaughlin, Greg Pottie, Vince Poor, Ramesh Rao, Alex Vardy, Sergio Verdú, Kimberly Wasserman, Victor Wei, Raymond Yeung, Bin Yu, Ken Zeger

1. The meeting was called to order at 9:01 AM by Ezio Biglieri, and the members of the Board were welcomed, and introduced themselves.
2. The agenda was approved.
3. The minutes of the previous meeting at Kruger Park, June 20, were approved.
4. Various announcements were made by Society President Ezio Biglieri. Vijay Bhargava was elected president, Joachim Hagenauer was elected 1st Vice-President and Tom Fuja was elected 2nd Vice-President. It was further announced that Solomon Golomb has been selected for the IEEE Hamming Medal. Prof. Hideki Imai of the University of Tokyo, Japan, received the honorary degree of Ph.D from Soonchunhyang University, Korea, for his significant contributions to promoting research in communications and information security both in Japan and Korea. The award ceremony was held in Soonchunhyang University on August 9th, 1999. Victor Wei has condensed 11 hours of video from the 50th Anniver-

sary IT Symposium down to two hours. One suggestion is to edit it further down to 1 hour for video CDs, for further distribution. A question was raised as to the best means to distribute the material, since downloading over the Internet is very time-consuming. The problem with tapes is that there are many different formats. The DVD or DCD options appear to be the most economical, possibly for distribution to all participants at ISIT 2000. Options will be explored.



Ezio Biglieri also brought attention to the IEEE Board and Executive Committee meetings. IEEE is considering a plan to offer executive office support for small and mid-sized Societies, on the basis of shared cost. A full-time person costs \$120,000. Concern was raised that part-time staff may not necessarily be occupied with Society affairs.

5. Information Theory Awards:

5.1 Thomas Kailath has won the 2000 Claude E. Shannon Award.

5.2 1999 IEEE Third-millennium medals. This was discussed as the previous BoG meeting, to decide upon the distribution

of the 17 medals allocated to this Society. Criteria are quality and quantity of research publications, editorial service to the Society, and service to the Society through the BoG and in organizing conferences for the Society (excluding Shannon Award Winners). A ranked list has been generated, including some alternates since some on our list may be nominated by other Societies. Awards will be announced by the IEEE.

5.3 Information Theory/ComSoc Joint Paper Award. At the last meeting it was decided to move forward, and a committee was formed to prepare a formal proposal to the IEEE. Normally, the award would consider papers published in the preceding year, although exceptions can be made to look back further. The paper must cover the interests and achieve the values of both the Information Theory Society and the Communications Society. Sergio Verdú proposed that the proposal be modified to strike the two sentences regarding consideration of papers published in previous years. The motion carried with one against. Victor Wei then moved that the proposal be modified to allow for consideration of papers published for up to three years in the past. This will enable papers whose ideas take time to propagate across the two Societies to be considered. The motion carried.

5.4 Activities of the Award Committee. The Society paper award went to V. Tarokh, N. Seshadri, and A.R. Calderbank for their paper "Space-time codes for high data rate wireless communications: performance criteria and code construction," which appeared in the March 1998 Transactions on Information Theory. The committee also wrote letters of endorsement for a number of IEEE honors.

6. Ramesh Rao reported on the activities of the ad-hoc committee on electronic submissions to IT conferences. There is now a working demonstration of an authors' form for submitting papers, with much of the work done on the remote end. This will help with prototyping. Later there will be some resource issues for the BoG to consider.

7. Ramesh Rao also reported on progress for the IEEE Information Theory Society Web Site and Digital Library. He proposed that our digital library should begin to include conferences and workshops of the Society in the future. There is now also interest by Parity Computing to have a non-exclusive royalty access to our meta-data to establish a separate site to provide an improved user interface to our database (e.g., personal interest profiles). This would be made available to members for free, for a trial two-year period. A letter will be drafted by Ramesh Rao and Ezio Biglieri with our counterproposal, after checking on legalities with IEEE. Our Associate Editors will be contacted for assistance in setting up the ontology, through the Editor in Chief.

8. A request for a financial contribution to IMA for an "electronic binder" on "Codes, Systems and Graphical Models" was made by Alex Vardy. The last workshop had very much of an IT flavor, and so it is proposed that a web site be prepared for the basic papers that were collected for the workshop. The IMA would like to put it on the web, after

assembling the copyright permission, and would like \$2000 in support of this project. Ramesh Rao proposed that the Society in turn should receive rights to be able to host the contents of the site if the IMA discontinues its service, and further that Information Theory Society members should receive free access. The motion carried unanimously.

9. The IEEE History Center has made a request for a contribution of \$20,000 from each Society. The Board did not feel that a contribution was warranted.

10. Amendments to the Constitution/ Bylaws. Sergio Verdú proposed a series of amendments to the Constitution and Bylaws. The amendments are intended to deal with recent decisions of the Board and changes in practice over time, and also some substantive changes to the manner of operation. The text of the amendments as approved is given below, followed by the rationale for the change from the previous version.

Amendments to Constitution:

Article V. Section 8.

The President of the Society is a member of the IEEE Technical Activities Board, and when notified of a meeting of said Board, he/she shall insure representation of the Society at such a meeting by himself/herself or by an alternate. If an alternate cannot be found, the President may present the views of the Society by letter or proxy.

(The President is removed as an ad hoc member of all committees.)

Article VI. Section 6.

Business of the Board of Governors may be handled by correspondence, telephone, computer mail, or other media where in the opinion of the President matters requiring action can be adequately handled in that manner. A majority of the members of the Board is necessary for approval of actions handled in this manner.

(Although it includes an historically significant compression code, this removes the venerable telegraph as a preferred means of communication, and allows for new media.)

Article VIII. Section 2.

The Board of Governors shall direct the appointment of such editors as may be required to implement the publications program.

(The President used to have formal authority to appoint the Editor in Chief, but practice has been for the BoG to approve all such appointments.)

After some discussion, these amendments carried unanimously.

Bylaws

Article IV.1 Nominations and Elections. Section 1.

No later than two weeks prior to the Annual Meeting of the Board, the Nominations Subcommittee shall forward to the

Board the biographies of at least 12 Society members for election by mail ballot by all of the members of the Society.

The list must also include any Society members endorsed by twenty or more members of the Society in response to a Newsletter solicitation published in the first issue of the current year. This list must also include any Society member endorsed by five or more members of the Board.

In order to ensure adequate international representation from regions which have been historically under-represented in the Board of Governors, in addition to the six nominees receiving the largest number of votes, the top nominee (not among the six) from every under-represented region shall be elected to the Board.

For purposes of the previous paragraph, an under-represented region refers to each of regions 8,9, and 10 with at least 5% (on December 31 of the year preceding the election) and at most one Board member (after the election of the top six nominees).

In preparing its list of nominees for election to the Board, the Subcommittee shall ascertain the eligibility and willingness to serve of each nominee.

(This establishes a more formal procedure than we now have for Board members adding nominees.

It carried unanimously.)

Article V. Standing Subcommittees. Section 2.

The Nominations subcommittee shall consist of the Junior Past President, the Senior Past President, and a former President of the Society appointed by the current President. The Senior Past President shall chair the subcommittee.

(This change was made to allow for a more diverse membership of the committee, and to ensure that someone who has served before is the chair. The change was unanimously approved.)

V.4 Standing Subcommittees. Section 4.

The Claude E. Shannon Award Selection Subcommittee shall consist of the President, First Vice-President, Second Vice-President, and four other members appointed by the Nominations Subcommittee before January 31st. At least three of the appointed members shall be former Claude E. Shannon Award winners, and at least one of the appointed members shall be the current, or a former, Editor-in-Chief of the IEEE Transactions on Information Theory. The Subcommittee is charged with deciding whether to name a Claude E. Shannon Award winner for the following year, and to select a winner. The President of the Society shall serve as Chairperson of the Claude E. Shannon Award Selection Subcommittee.

Ordinarily, the decision of the Subcommittee shall be made public at the IEEE International Symposium on Information Theory of the year preceding the award.

(Broader membership is specified than in the past, including increased requirements for including past Shannon Award recipients. The bylaw change carried unanimously.)

Article V. Standing Subcommittees. Section 5.

The Awards Subcommittee shall be responsible for submitting a recommendation to the Board for the Information Theory Society Paper Award according to Article VIII Section 2, and for the solicitation, processing and submission on behalf of the Society of nominations for the W.R.G. Baker Award, the Browder J. Thompson Award, Donald Fink Award, and all other appropriate IEEE Awards.

The Subcommittee shall consist of at least nine members representing all major technical areas in the Society. At least four members shall have served as Associate Editors of the Transactions within the past three years. The First and Second Vice Presidents of the Society serve as ex-officio voting members of this Subcommittee, with the First Vice President serving as Chair. The Subcommittee will be appointed by the Nominations Committee no later than January 31.

(The composition of the committee is established in more detail, to ensure representation of all the technical areas of the society. The bylaw change carried.)

Article V. Standing Subcommittees. Section 6.

The Membership and Chapters Subcommittee shall consist of the 2nd Vice-President of the Society, who shall serve as chairperson, and of such other Society members appointed by the 2nd Vice-President. This Subcommittee shall be responsible for maintaining up to date membership records, a roster of Chapter officers, and a summary of current Chapter activity.

The Subcommittee shall recommend measures for disseminating information about the Society and for encouraging interest in Society activities among prospective members. It shall respond to membership inquiries and shall periodically ascertain the opinions of the membership with regard to group policies and activities.

(This was cleaned up to eliminate sexist language. The bylaw change carried.)

Article V. Standing Subcommittees. Section 7.

The Publications Subcommittee shall consist of the Society Transactions Editor-in-Chief who serves as chairperson, the Associate Editors of the Society Transactions, and the Newsletter Editor.

The President, First Vice-President, and Second Vice President of the Society are ex-officio members of the committee. The subcommittee shall generate yearly nominations for the Information Theory Society Paper Award, as per Article VIII, Section 1, oversee the solicitation and review of papers for publication, and shall edit, prepare and publish the Transactions, Special Issues, Monographs, and Newsletter as directed by the Board, with the assistance of the IEEE Editorial Office.

The Subcommittee shall recommend changes in publication policy to the Board.

The term of office of the Editor-in-Chief shall be three years. The Associate Editors are appointed by the Editor-in-Chief subject to approval by the Board.

The Transactions Editor-in-Chief shall be nominated by the Nominations Committee and shall be appointed by the Board at an Annual Meeting.

The Newsletter Editor shall be appointed by the Board, upon nomination by the Society President.

(The role of the subcommittee and its membership is expanded, to include generation of nominations for the IT Society Paper Award. The bylaw change carried.)

Article VIII. Information Theory Society Paper Award. Section 1.

The Information Theory Society Paper Award shall be given annually for an outstanding publication in the fields of interest to the Society appearing anywhere during the preceding two calendar years.

The purpose of this Award is to recognize exceptional publications in the field and to stimulate interest in and encourage contributions to fields of interest of the Society.

The Award consists of an appropriately worded certificate(s) and an honorarium of \$10,000 equally split among the authors of the paper.

(The dollar amount of the paper award is increased to \$10,000. The bylaw change carried.)

Article VIII. Information Theory Society Paper Award. Section 2.

An open call for nominations to this award shall be published in the Newsletter.

By March 15, the chair of the Publications Subcommittee or designee shall forward to the Second Vice President a list of at least nine articles, published in the previous calendar year, for the consideration of the Awards Subcommittee. Each nomination shall be accompanied by a statement outlining the contribution of the paper.

The Awards subcommittee shall take into account

- (a) all nominations submitted in response to the open call for nominations in the last two years;
- (b) the nominations supplied by the Publications Committee in the last two years;
- (c) any nomination that its members may want to submit for consideration.

The Awards Subcommittee shall submit to the Board a list of two or three selected nominations for the Information Theory Society Award at least three weeks in advance of the first Board meeting following June 1 of the award year, and shall enclose a rationale for each nominated paper explaining its contribution to the field.

The Board shall then vote for the nominees by mail ballot, conducted by the Society President, or designee. A four

week period shall be allowed for the return of ballots. The paper receiving the highest total number of points in the balloting shall be declared the winner of the Information Theory Society Paper Award.

(The Publications subcommittee is now obligated to generate at least nine nominations for papers to be considered by the Paper Awards Subcommittee. The bylaw change carried.)

A lunch break of one hour was held. Discussion continued on bylaws afterwards.

Article V. Standing Subcommittees. Section 8.

The Fellows Subcommittee shall be responsible for providing the IEEE Fellow Committee with the Society evaluation of nominations to Fellow grade.

The subcommittee shall consist of at least five IEEE Fellows who hold membership in the Society, and representing all major technical areas in the Society.

(The change is that the committee is named by the nominations committee, according to a deadline, rather than by its chairperson. This brings the bylaws into conformance with IEEE policy. A motion to approve the bylaw change carried.)

Article VI. International Symposia. Section 1.

The Society shall sponsor an annual International Symposium on Information Theory. The Board will select the venue and dates for the Symposium, and shall direct the appointment of the Symposium Chair or two Co-Chairpersons. The Symposium Chairpersons will have the entire responsibility for planning and executing the Symposium subject only to appropriate IEEE regulations and such guidance as the Board wishes to provide.

(This changes the bylaws to require a yearly symposium. A motion to approve the change carried.)

Article VII. Claude E. Shannon Award. Section 1.

The purpose of the Claude E. Shannon Award is to honor consistent and profound contributions to the field of information theory. The selection is governed by Article V. Section 4.

An honorarium of \$10,000 and a suitable memento are awarded to the Claude E. Shannon Award winners. Each Shannon Award winner is expected to present a Shannon Lecture at the IEEE International Symposium on Information Theory of the year of the award. In addition to the honorarium, the Information Theory society will pay the winner's travel expenses.

(The mechanism for selection of the committee was moved to the appropriate section of the bylaws, and the award amount was increased to \$10,000. The bylaw change was approved unanimously.)

11. The IEEE Information Theory Society Newsletter report was made by Kimberly Wasserman. A discussion was held to the effect that the Newsletter should include a standing

list of announcements that should appear, to make actions expected in the bylaws and elsewhere to take place. Everything is running smoothly.

12. Alex Vardy made the IEEE Transactions on Information Theory Report. The Transactions are published on time, including the November issue which has traditionally been much delayed. The November issue is now on time because the reference index is now on line as part of the digital library project. Electronic submissions are now up to 80% of papers, with a rapid recent increase in submissions in this format. This reduces the delay to publication significantly. The Associate Editors' load has now largely evened up with the new appointments. Four new appointments were proposed: Andrew Klapper replacing Solomon Golomb (sequences), Neal Koblitz replacing Douglas Stinson (Complexity and Cryptography), Gábor Lugosi replacing Sanjeev Kulkarni (Nonparametric Estimation, Classification, and Neural Networks), and Prakash Narayan replacing Shlomo Shamai (Shannon Theory). In addition, a new editorial Associate Editor was proposed. A motion to approve all the nominations by the Editor-in-Chief carried.

13. Thomas Ericson presented a report on Electronic publications. A new ad hoc subcommittee is suggested, because there have been many board discussions and we need to move forward. Many important decisions will need to be taken to moving forward to publications in electronic form, and so this will need some study. A small committee is proposed (Transactions and Publications Editor, plus Steve McLaughlin as chair). All have agreed to serve. At some point consideration to forming a permanent committee may be warranted, and a larger committee may be needed to bring in some fresh ideas. A motion to accept the establishment of the ad hoc subcommittee to report to the BoG the state of electronic publications and recommend to the BoG actions it should take pertaining to electronic publications, carried.

14. Marc Fossorier presented the Treasurer's report. As of July 31, 1999, cash directly available was \$243,980, Long Term Investments were \$1,148,370, Loans Receivable \$79,450, no prepaid expense, and Fixed Assets of \$9,510 for a net worth of \$1,481,320. The report included a monthly status report on expenses, with big dips typically occurring in summer time. Some discussion took place to the effect that some funds need to be transferred from long term investments to current accounts, given that a minimum of only \$40,000 was reached. Further discussion was to the effect that revenue needs to be increased through some combination of conference fees, increased membership, and page charges for the Transactions. A transfer of \$150,000 from

long term investments was approved by the BoG. There was a consensus on the BoG that, in the current climate of slightly-declining membership and non-member subscriptions, the Society finances bear close watching; moreover, it is important in 2000 to increase Society membership, especially the non-member fee as suggested by IEEE.

15. Tom Fuja introduced three items concerning IT Society participation in meetings:

15.1 A request for technical co-sponsorship of the Conference on Applications of Information Theory in Biology, Finance, and Physics to be held at the Banach Center in Warsaw was approved.

15.2 A request for co-sponsorship of the IEEE International Conference on Personal Wireless Communications in December 2000 in Hyderabad, India was approved.

15.3 A preliminary proposal from Dr. Lei Wei to hold an Information Theory Workshop in Cairns, Australia in the summer of 2001 was discussed. While the BoG was enthusiastic about an Australian workshop, there was concern about the timing conflict with the 2001 ISIT, to be held June 2001 in Washington DC. The BoG asked Tom Fuja to relay their concerns to Dr. Wei and to see if he would consider re-scheduling.

16. The BoG approved a cooperation agreement between IEEE societies and the Technisch-Wissenschaftlicher Verband der Elektronik Informationstechnik E. V. (VDE/ITG).

17. The final version of the newly-chosen Information Theory Society logo is being prepared; four final "candidates" will be sent in electronic form to the BoG for their input.

18. Dave Neuhoff gave a report to the BoG on the status of the Shannon marker to be placed in "Shannon Park" in Gaylord, Michigan, hometown of Claude Shannon. He passed around preliminary sketches of a possible statue and a diagram showing the layout of the park. The BoG was enthusiastic about the project; it was agreed that a firm proposal would be communicated to the BoG through Dave Neuhoff and the Society president.

19. Steve Wicker gave a brief report regarding an ad hoc committee set up to respond to IEEE's New Technology Directions initiative. IEEE is asking each society to draw up a list of products derived from that society's technological base.

20. Vijay Bhargava, Society president in 2000, announced that the BoG meetings in 2000 will be held at CISS in March, at the ISIT in Sorrento, and at the ISITA in Hawaii.

Items 1-13 recorded by Greg Pottie, 14-20 by Tom Fuja.

From the Transactions Editor-In-Chief

Alexander Vardy

This article is being written at the completion of about one half of my 3-year term as the Editor-in-Chief of the IEEE TRANSACTIONS ON INFORMATION THEORY. This might be an appropriate time to reflect on the state of the TRANSACTIONS, to discuss what has changed in the past 1.5 years, and to speculate upon where the TRANSACTIONS is headed in the future.

When I assumed the role of Editor-in-Chief, my primary goal was to keep the IEEE TRANSACTIONS ON INFORMATION THEORY in its place as *the* premier journal covering all aspects of information transmission, processing, and utilization. A year-and-a-half later, I am happy to see that the TRANSACTIONS maintains its remarkable dominance in all the core areas of information theory. The quality of papers we publish is as high as ever, while the content and scope of these papers follow closely, and often lead, the development of our field.

What makes this possible is a tremendous effort of an outstanding Editorial Board. Expert and devoted Associate Editors have always been the mainstay of the TRANSACTIONS. In particular, I had the pleasure to work with:

Solomon W. Golomb	Sequences
Torleiv Kløve	Coding Theory
Sanjeev Kulkarni	Nonparametric Estimation
Neri Merhav	Source Coding
Pierre Moulin	Nonparametric Estimation
Shlomo Shamai	Shannon Theory
Douglas R. Stinson	Complexity and Cryptography

whose terms have by now expired. The current Editorial Board consists of nineteen Associate Editors, as follows:

Venkat Anantharam	Communication Networks
Alexander M. Barg	Coding Theory
Ian F. Blake	Coding Theory
Philip A. Chou	Source Coding
Imre Csiszár	Shannon Theory
Thomas E. Fuja	At Large
Michael L. Honig	Communications
Andrew M. Klapper	Sequences
Neal I. Koblitz	Complexity and Cryptography
Frank R. Kschischang	Coding Theory
Gábor Lugosi	Nonparametric Estimation
Upamanyu Madhow	Detection and Estimation
Prakash Narayan	Shannon Theory
Joseph A. O'Sullivan	Detection and Estimation
Ron M. Roth	Coding Theory
Peter Shor	Quantum Information Theory
Patrick Solé	Coding Theory
Emina Soljanin	Coding Techniques
Marcelo Weinberger	Source Coding

In addition, in the Summer/Fall of this year, the following Associate Editors will be joining the Editorial Board:

Jørn Justesen	Coding Theory
Ralf Koetter	Coding Theory
Simon Litsyn	Coding Theory

replacing Ian Blake, Frank Kschischang, and Alexander Barg, respectively. I consider myself very fortunate to have the advice of such an exceptional group of people. The TRANSACTIONS has benefited a great deal from their service, and I would like to use this opportunity to express my gratitude to all of them. Special thanks are also due to our Publications Editors Erik Agrell and Ramesh Rao, to the outgoing Publications Editor Steven W. McLaughlin, as well as to our Senior Editor at IEEE Nela Rybowicz. These are the people that are responsible for having the TRANSACTIONS run as smoothly as it did for the past 1.5 years.



Let me now discuss several topics that pertain to the current state of the TRANSACTIONS, and review some of the changes that took place in the past 1.5 years.

New editorial areas: In the September 1998 issue of this Newsletter, at the beginning of my term, I wrote that:

... 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.

Since that time, we have added two new editorial areas: the area of *Sequences* with Solomon Golomb as the founding Associate Editor (now replaced by Andrew Klapper), and the area of *Quantum Information Theory* with Peter Shor as the founding Associate Editor. These editorial areas have been introduced in part in response to the flow of submissions and in part because I believe that the subjects are of interest to our readership. I hope that the TRANSACTIONS will continue to publish the best papers in these areas for years to come.

It is also worth mentioning two recent research topics that are attracting a steady stream of submissions to the TRANSACTIONS, even though they have not been singled out as separate editorial areas. One of these topics is *codes on graphs and iterative algorithms*, with papers in this area handled by Frank Kschischang, and the other is *space-time coding*, handled by Michael Honig and Emina Soljanin.

Time to publication: Ensuring the high quality of papers published in the TRANSACTIONS and making sure that these

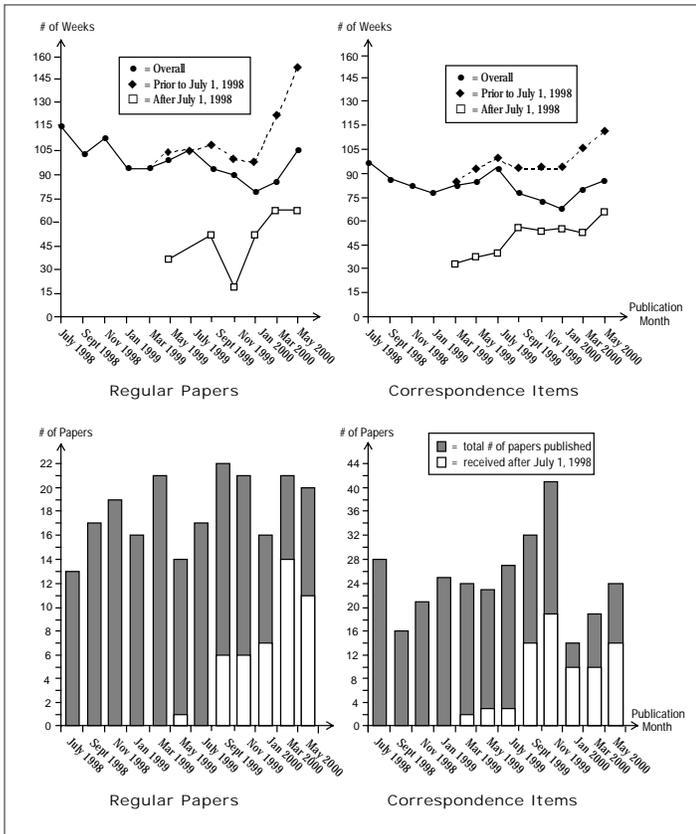


Figure 1. Average time from submission to publication

papers are published quickly are conflicting goals. On the other hand, it is clear that an average delay of over 2 years from submission to publication is unacceptably high.

We have implemented several concrete measures designed to reduce the time to publication, without compromising the editorial standards of the TRANSACTIONS in any way. Since the review process is a (highly nonlinear) system with time-constants on the order of years, it is still somewhat early to judge the effectiveness of these measures. Nevertheless, Figure 1 above does show a reduction in the overall delay from submission to publication, for both regular papers and correspondence items, despite the fact that submissions received prior to the beginning of my term still constitute a large percentage of papers published today.

It appears that the improvement is due, at least in part, to the electronic submission procedure introduced in the Summer of 1998. As expected, although electronic submission remains entirely optional, the majority of our authors have by now embraced this option, and over 90% of submissions received in the past 3 months have been electronic. Papers submitted electronically are usually reviewed electronically, with most (or all) communication between authors, editors, and referees conducted by e-mail.

Editorial load: Table 1 below shows the distribution of editorial load among the various areas from July 1, 1998 until the end of the past millennium. One can see from this table that (with the exception of Tom Fuja, Associate Editor at Large, and some aberrations due to insufficient sample size)

none of the Associate Editors is handling more than 3 papers per month. This is a significant improvement over earlier years, when a number of Associate Editors, myself included, had to handle over 50 papers per year.

Associate Editor	Editorial Area	#P	#M	PpM
Andrew M. Klapper	Sequences	4	1	4.00
Marcelo Weinberger	Source Coding	14	4	3.50
Thomas E. Fuja	At Large	56	18	3.11
Torleiv Kløve	Coding Theory	18	6	3.00
Alexander M. Barg	Coding Theory	52	18	2.88
Michael L. Honig	Communications	52	18	2.88
Frank R. Kschischang	Coding Theory	52	18	2.88
Joseph A. O'Sullivan	Detection and Estimation	52	18	2.88
Patrick Solé	Coding Theory	28	10	2.80
Emina Soljanin	Coding Techniques	50	18	2.77
Gábor Lugosi	Nonparametric Estimation	11	4	2.75
Philip A. Chou	Source Coding	48	18	2.66
Ron M. Roth	Coding Theory	48	18	2.66
Douglas R. Stinson	Complexity & Cryptography	37	14	2.64
Ian F. Blake	Coding Theory	46	18	2.55
Upamanyu Madhow	Detection and Estimation	46	18	2.55
Neri Merhav	Source Coding	34	13.5	2.52
Neal I. Koblitz	Complexity & Cryptography	10	4	2.50
Sanjeev Kulkarni	Nonparametric Estimation	19	8	2.38
Imre Csizsár	Shannon Theory	39	18	2.16
Shlomo Shamai	Shannon Theory	38	18	2.11
Solomon W. Golomb	Sequences	28	15	1.86
Pierre Moulin	Nonparametric Estimation	11	6	1.83
Venkat Anantharam	Communication Networks	24	18	1.33
Peter Shor	Quantum Information Theory	3	3	1.00

Legend:
 #P total number of papers handled
 #M total number of months of service
 PpM number of papers per month

Table 1. Distribution of editorial load up to Dec. 31, 1999

Special issues: The IEEE TRANSACTIONS ON INFORMATION THEORY is a special IEEE journal: it is the only IEEE publication that publishes 7 issues per year. The seventh issue is the special issue, which is usually awaited with great anticipation. In particular, in October 1998, we have published the 50-th Anniversary Commemorative Issue that turned out to be very special indeed! The April 1999 special issue was devoted to multiscale statistical analysis. Three more special issues are now scheduled. The special issue on *Information-Theoretic Imaging*, edited by Al Hero, Pierre Moulin, Jose Moura, Jody O'Sullivan, and Don Snyder, is on track for publication in August 2000. The next special issue is devoted to *Codes on Graphs and Iterative Algorithms*, and edited by Dave Forney, Brendan Frey, Ralf Koetter, Frank Kschischang, Bob McEliece, and Dan Spielman. This special issue closed in January 2000 with over 30 submissions, some of them reporting breakthrough results in the area. The submissions are currently undergoing rigorous review, and the special issue is scheduled for publication in February 2001. Finally, a special issue on *Shannon Theory: Perspectives, Trends and Applications*, edited by Henry Landau, Jim Mazo, Shlomo Shamai, and Jacob Ziv, is tentatively scheduled for

April 2002. This special issue will focus upon the numerous developments in information theory that have crystallized around, and were inspired by, the work of Aaron D. Wyner.

What lies ahead for the TRANSACTIONS? It is my personal view and hope that, in the near term, the TRANSACTIONS will continue to flourish. The field of information theory is as thriving as ever. We have assembled a superb group of Associate Editors. We have made the TRANSACTIONS available on-line via the Digital Library, and implemented electronic submission and tracking procedures. All these will ensure that the TRANSACTIONS remains in great shape for the next few years.

Looking further afield, the situation is not so clear. The number of pages published annually and the annual number of submissions have both increased significantly in the past decade (see Table 2 below). The total number of submissions during 1999 was 616. Even discounting for the 52 papers submitted to the two special issues whose deadlines fell in 1999, this still leaves 564 submissions in one year, which is a new record.

This growth clearly puts us in a position to place very high demands on the papers we accept for publication. Nevertheless, we cannot afford to become an elitist journal that will only publish breakthrough results. Papers submitted to the TRANSACTIONS that are novel, significant, well-written, and of interest to our readership, will continue to be accepted for publication.

If so, then perhaps the IEEE TRANSACTIONS ON INFORMATION THEORY should become a monthly publication? Or maybe the field of "information transmission, processing, and utilization" has grown to the point where it would support two journals rather than one, as suggested in the March issue of the Newsletter by our President Vijay Bhargava? One cannot and should not avoid careful consideration of these questions. However, I would like to warn against rushing to

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	7	133	16.3	148	5.6	482	281	3400
1999	7	123	13.0	176	4.9	423	299	2760
2000	3	57	14.2	57	5.6	505	114	1180

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 <i>two years prior</i>
#A	total number of papers/correspondences published
Tp	total number of pages published

Table 2. Statistics on the state of the TRANSACTIONS

conclusions on such heady issues. The formula known as the IEEE TRANSACTIONS ON INFORMATION THEORY has worked successfully for 46 years. Introducing drastic changes to this formula could change the very fabric of our field.

Finally, I would like to conclude this article on a personal note. Being at the helm of the TRANSACTIONS is a challenging position that requires a lot of effort. However, looking back at the first half of my term, I can say that the time devoted to the TRANSACTIONS turned out to be every bit as interesting and enjoyable as I imagined it to be. I am grateful to the Editorial Board, to the authors, and to the readership of the TRANSACTIONS for making my job so rewarding.

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@ece.ucsd.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:

ieee-it.ucsd.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:

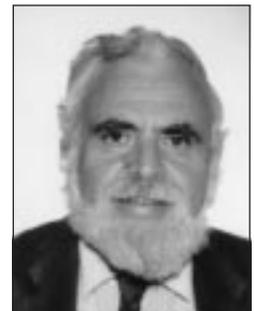
Hard copies of papers submitted in electronic form ordinarily will not be required. However, the authors should be ready to provide such hard copies at all stages of the editorial review process, upon request from the Editor-in-Chief or from the Associate Editor assigned to the paper. In addition, if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

GOLOMB'S PUZZLE COLUMN™ PUZZLE NO 50:

Elementary Number Theory

Solomon W. Colomb

1. If $p > 7$ is prime, prove that $p^6 - 1$ is a multiple of 504.
2. Examples in positive integers of $a^2 + b^2 = c^2$ are numerous, and are called “Pythagorean triplets.” Are there examples of $a^2 + b^2 = 2c^2$, where a , b , and c are *distinct* positive integers?
3. Let $L(n) = \text{l.c.m.}(1, 2, 3, \dots, n)$, and let p_k be the k^{th} prime number.
 - (a) If $p_{k+1} = p_k + 2$, does it follow that $L(p_{k+1}) = p_{k+1} L(p_k)$?
 - (b) Show that the binomial coefficient $\binom{2n}{n}$ divides $L(2n)$, and is divisible by $L(2n)/L(n)$, for all positive integers n .
 - (c) Show that $\binom{2n}{n} = \prod_{k=1}^n L\left(\frac{2n}{k}\right)^{a_k}$, where $a_k = (-1)^{k+1}$, and $L(x) = L(\lfloor x \rfloor)$ when x is real but not necessarily an integer.
4. Let $M_n = n! + 1$, and let (u, v) denote the greatest common divisor of u and v .
 - (a) Show that, if a is fixed, there are at most a finite number of values of b for which $(M_a, M_b) > 1$.
 - (b) Show that there are infinitely many pairs of positive integers a and b for which $(M_a, M_b) > 1$, with $a < b$.
5. If $p_{n+1} = p_n + 2$, the pair of prime numbers p_n, p_{n+1} is called a *twin prime*. Show that there are infinitely many twin primes if and only if there are infinitely many positive integers n with $n \neq 6ab \pm a \pm b$ for all positive integers a and b , and all four choices of the \pm signs.



CONFERENCE REPORT

ITG/IEEE Conference on Source and Channel Coding

January 17-19, 2000
Munich, Germany

The 3rd IEEE conference “Source and Channel Coding” took place from January 17 to January 19, 2000 in Munich, Germany. The conference had been held previously in 1995 in Munich and in 1998 in Aachen, Germany, but for the first time it was an international conference, co-sponsored by the IEEE Information Theory Society, the German “Informationstechnische Gesellschaft im VDE (ITG)” and the Munich University of Technology. The general chairman was Professor Joachim Hagenauer. Prof. Joachim Hagenauer, Munich University of Technology, Prof. Johannes Huber, University Erlangen-Nürnberg, and Prof. Peter Vary, RWTH Aachen, served as co-chairs of the technical program committee, which consisted of members of the ITG group “Informations und Systemtheorie.” Full paper sessions and poster sessions took place, where the posters were presented in short talks of three minutes before they were displayed in the foyer. The majority of presenters was from Europe but there were also presentations from the USA, China and Israel.

Each session started with invited talks by internationally recognized experts, being members of the International Symposium on Information Theory (ISIT) program committee which had met at Munich University of Technology the week before.

The opening presentation on “Codes on Graphs” was given by Prof. G. David Forney, Jr., Massachusetts Institute of Technology (MIT), Boston, MA.

Further invited talks were given by:

Bixio Rimoldi, Ecole Polytechnique Federale de Lausanne, Switzerland (“Up-Conversion by Sampling”),

Nariman Farvardin, University of Maryland, USA (“Joint Source-Channel Coding for Progressive Image Transmission”),

Thomas Ericson, Linköping University, Sweden (“Spherical Codes and the Kissing Number Problem”),

Daniel J. Costello, University of Notre Dame, USA (“Some Reflections on the Mythology of Turbo Codes”)

Frans M.J. Willems, Eindhoven University of Technology, The Netherlands (“Some Challenges in Source Coding”)

Rolf Johannesson, Lund University, Sweden (“Tailbiting: A Bridge between Block and Convolutional Codes”).

Stephan Bruhn, Ericsson Radio Systems, Sweden, (“Adaptive Multi-Rate - a new Speech Standard not only for GSM”).

From a large number of submissions the program committee had selected contributions which covered the whole range

from information theory and theoretical topics to applications of coding and detection schemes in systems like GSM, UMTS and DVB-T. Many presentations emphasized joint aspects of topics, which are traditionally treated separately, e.g. joint source and channel coding. In contradiction to Shannon’s separation theorem we can obtain interesting improvements in practical systems not fulfilling Shannon’s conditions by applying those ideas.

In the first session “Detection and Channel Coding” new bounds for error probability as well as aspects of channel coding in an OFDM-CDMA system were presented.

Two sessions on joint source and channel coding dealt with new methods of iterative MAP decoding for variable length codes and with a new optimization criterion for channel coding, which does not minimize the BER but guarantees that the first error appears as close to the end of the block as possible. This is desired in systems with variable length source coding. Another presentation in this session had been stimulated by two contributions at the previous conference “Source and Channel Coding” in Aachen. It reported on a “competition” between an approach called “Source-Controlled Channel Decoding,” which is based more on channel coding, and “Soft Bit Source Decoding” which emphasizes source coding. The entertaining talk was jointly given by the authors from the RWTH Aachen and the Munich University of Technology.

A session on “Coded Modulation” covered contributions on generalized concatenation of coded CPM, coded modulation for differential coding and non-coherent detection on fading channels as well as a talk on transmit diversity with space-time coded modulation for high data rate transmission in mobile systems with multiple transmit antennas. Of course there was also a session on iterative channel decoding (Turbo decoding) with theoretical contributions and an interpretation of turbo decoding as an analog network. Pipeline decoding of Woven Codes was presented in a separate session on “Convolutional Codes.” The main emphasis of a CDMA session was on design criteria for coded CDMA transmission over fading channels. The last session on “Speech and Image Coding” was dominated by contributions on the GSM AMR speech codec but also covered Multiple Description Coding.

The conference location was the Munich Amerika Haus, which generously had offered its auditorium. The stage even made possible to have a concert for the conference delegates and accompanying persons at the first evening of the conference. The “Ensemble Sinfonietta,” a chamber orchestra with amateurs and students of the Munich School of Music, per-



formed Vivaldi's "The Four Seasons" and two arias from Mozart's opera "Idomeneo," which was composed and played for the first time in Munich. After the concert the re-

ception with Bavarian food gave opportunity for discussions about music and research topics.

Another highlight was the banquet at the second conference evening in Munich's Augustiner Beerhall. The banquet speaker was the past president of the IEEE Information Theory Society Professor Ezio Biglieri from the Politecnico di Torino, Italy. He talked about Shannon's Theorems with a coefficient of seriousness smaller than one, as he stated.

The very positive feedback expressed by many delegates encouraged the organizers to continue having the conference "Source and Channel Coding" on a biannual basis. The next conference will be organized by Prof. Peter Noll in 2002 in Berlin, Germany.

More information and pictures can be found under http://www.lnt.e-technik.tu-muenchen.de/itg/itg_main.html.

Gerhard Bauch and Joachim Hagenauer

MEETING REPORT

Midwinter Meeting of the *Werkgemeinschaft* for Information and Communication Theory on "High Quality Audio"

*University of Technology Eindhoven, The Netherlands
January 18, 2000*

The annual midwintermeeting of the Benelux "Werkgemeinschaft on Information and Communication Theory" was this year dedicated to "High quality Audio". The meeting was cosponsored by the Audio Engineering Society and the IEEE Benelux Chapter on Consumer Electronics. The interesting theme in a time of exciting communication developments such as Internet and new emerging standards as MP3, attracted a large number of attendants: about 160 people. As in the past years, the meeting took place in the beautiful "Blue Room" of the Auditorium, thanks to the support of Dr. Frans Willems and Dr. Tjalling Tjalkens of the University of Technology Eindhoven.

The program was organized by Dr. Ronald Aarts (Philips Research Labs Eindhoven, Netherlands), Prof. Kees Immink (University Essen, Germany) and Prof. Peter de With (University Mannheim, Germany). Prof. de With chaired the morning session and Dr. Aarts chaired in the afternoon.

The program contained the following lectures:

1. "Overview of Audio Coding", Dr. Karl-Heinz Brandenburg (Fraunhofer Gesellschaft, Germany)
2. "Internet and audio", Dr. Warner ten Kate (Philips Research Labs, Eindhoven, The Netherlands)
3. "Psycho acoustics", Prof. Adrian Houtsma (IPO / Center for User-System Interaction, Eindhoven)
4. "Lossless Coding of Audio Signals", Ing. Fons Bruekers, (Philips Research Labs, Eindhoven)

5. "Subjective and objective quality of audio and interaction with video", Dr. John Beerends, KPN Research Leidschendam, Netherlands.

The overview lecture of Dr. Brandenburg provided an excellent overview of ongoing developments and standards. Furthermore, fundamental research breakthroughs of the past decade, such as the masking property of the human ear, were indicated and shown by demonstrations. Dr. ten Kate discussed important system aspects when communicating coded audio signals over the Internet. Examples of important control issues are the buffering of audio packets, in order to provide full decoding quality, despite the rather varying quality of the Internet, and the timing of decoding and representation. Prof. Houtsma of the Eindhoven Center for User-System Interaction presented key properties of human listening to audio signals, perfectly accompanied by meaningful demonstrations. His talk provided the bridge between psychoacoustical phenomena and emerging audio systems of the past decade. Ing. Bruekers gave an excellent tutorial on the various ways to build a lossless audio coding system and the cornerstones and techniques of such systems. Finally, Dr. Beerends presented a new vision on how to judge audio and speech signals. Instead of recovering the original quality as closely as possible, he proposed to perform restoration of audio signals in such a way that they are perceived and assessed as being of high quality. Prof. de With closed the day by challenging people to transfer ideas



The organizing committee and WIC chair; from left to right: Prof. Peter de With, Dr. Ronald Aarts, Prof. Kees Immink, Prof. Han Vinck (WIC chair).

to the video domain and vice versa, and thanking all speakers and audience for their attendance.

This successful midwintermeeting is part of a series in which new developments are presented to a broad audience in tutorial form. In the past years, general themes such as the above and e.g. object-oriented AV coding (last year) prove to be a useful and attractive concept for drawing a large audience. This is also supported by the excellent facilities of the University Eindhoven which can be reached easily, and the support of co-organizing societies such as the AES and IEEE Benelux Chapters.

**Prof. Peter H.N. de With,
Mannheim, January, 2000.**

34th Conference on Information Sciences and Systems

The 34th Conference on Information Sciences and Systems took place at Princeton University on March 15-17, 2000. The technical program can be found in <http://www.ee.prince->

[ton.edu/ciss](http://www.ee.princeton.edu/ciss). To purchase copies of the Proceedings, please send email to ciss@ee.princeton.edu.

SYMPOSIUM REPORT

2000 International Symposium on Power-Line Communications and its Applications

April 5-7, 2000

University of Limerick, Ireland

By A.J. Han Vinck

The fourth International Symposium on Power-Line Communications and its Applications took place April 5-7, 2000 in the Business Centre of Castletroy Park Hotel, located adjacent to the University of Limerick on the outskirts of Limerick city, a historic centre in the beautiful west of Ireland region.

The Symposium was organized by Prof. Tom Coffey from the University of Limerick in Limerick, Ireland, with the help of the local community under the supervision of Sean McGrath. Tom Coffey and Han Vinck acted as Co-chairmen for the symposium. The meeting was sponsored by the IEEE UK and Ireland Section, the Institution of Engineers of Ireland and the IEE.

About 100 participants from 25 countries discussed the actual topic of power-line communications and its applications. The objective of the symposium is to stimulate research and help in solving new problems encountered by engineers and scientists working in this field. The Symposium covered a range of communication topics from a practical as well as a theoretical point of view.

The technical programme included the following sessions

- OFDM: Regularity aspects; Transmission properties; Comparisons with CDMA.

- Measurements: Coexistence algorithms; Characteristics for indoor communications.
- CDMA: Applications and Hardware design.
- Protocols: Access Control; Local Area Networks; Authentication Protocols.
- Simulation and Modelling: Communication models; Channel models.
- Applications: Practical implementations for broadband transmission; Modem designs; Bus systems; Home networking.
- Modulation and Coding: Development of techniques suited for the power line channel.

The guest speaker David Healey, Vice President, ENIKIA Inc. New York, USA gave an excellent lecture entitled: "Review of the Future Opportunity for Broadband PLT; Both Access and Home Networking".

All 41 papers presented at ISPLC2000 are published in the 300 pages of the 'Proceedings of the 2000 International Symposium on Power-Line Communications and its Applications'.

The participants were very pleased with the announcement that the 5-th symposium will be organized by Prof. Goran Lindell and Hans Ottoson in April 2001 in Malmo, Sweden.

The social program included a get-together dinner and a medieval banquet in the 750-year-old Bunratty castle. For fur-

ther information regarding the symposium and the proceedings of the symposium (ISBN 1-87 4653-60-7) please contact Prof. Tom Coffey, email: tom.coffey@ul.ie or look at the home page: <http://www.ul.ie/~isplc2000/>.

CALL FOR PAPERS

Thirty-Eighth Annual Allerton Conference on Communication, Control, and Computing

October 4 - 6, 2000

The Thirty-Eighth Annual Allerton Conference on Communication, Control, and Computing will be held from Wednesday, October 4 through Friday, October 6, 2000, at the Allerton House, the conference center of the University of Illinois. Allerton House is located twenty-six miles southwest of the Urbana-Champaign campus of the University, in a wooded area on the Sangamon River. It is part of the fifteen-hundred acre Robert Allerton Park, a complex of natural and man-made beauty designated as a National natural landmark. The Allerton Park has twenty miles of well-maintained trails and a living gallery of formal gardens, studded with sculptures collected from around the world.



Papers presenting original research are solicited in the areas of communication systems, communication and computer networks, detection and estimation, information theory and error-correcting codes, source coding and data compression, multiple-access communications, queueing networks, control systems, robust and nonlinear control, adaptive control, optimization, dynamic games, large scale systems, robotics and automation, manufacturing systems, discrete event systems, intelligent control, multivariable control, adaptive signal processing, numerical methods for signals and systems, learning theory, neural networks, combinatorial and geometric algorithms, parallel and distributed computation, computational complexity, VLSI design algorithms, VLSI architectures for communications and signal processing, and automated highway systems. Also solicited are organized sessions for the Conference; prospective organizers should discuss their plans with the Conference co-chairmen before sending a formal proposal.

This year the plenary lecture will be delivered by Professor Robert J. McEliece of the California Institute of Technology. It is scheduled for Friday, October 6, and is entitled "Achieving the Shannon Limit: a Progress Report."

Information for authors: Regular papers, suitable for presentation in twenty minutes, as well as short papers, suitable for presentation in ten minutes, are solicited. The purpose of the short paper category is to encourage authors to present preliminary results of their work. Regular papers will be published in full (subject to a maximum length of ten 8.5" x 11" pages) in the Conference Proceedings, while short papers will be limited to two-page summaries in the Proceedings.

For regular papers, a title and a five-to-ten page extended abstract, including references and sufficient detail to permit careful reviewing, are required. For short papers, a title and a three-to-five page summary are required. Manuscripts that are submitted as regular papers but cannot be accommodated in that category will be considered in the short paper category, unless the authors indicate otherwise.

Three copies of the manuscript should be mailed to 38th Annual Allerton Conference, Coordinated Science Laboratory, University of Illinois, 1308 West Main Street, Urbana, Illinois 61801-2307, USA, in time to be received by July 7, 2000. Submissions by e-mail or fax will not be accepted.

Submissions should specify the name, e-mail address, and postal address of the author who is to receive all subsequent correspondence. Authors will be notified of acceptance via e-mail by August 11, 2000, at which time they will also be sent detailed instructions for the preparation of their papers for the Proceedings. Full camera-ready versions of accepted papers will be due the last day of the Conference.

Conference Co-Chairmen:

R.S. Sreenivas and Douglas L. Jones

Email: allerton@csl.uiuc.edu

URL: <http://www.comm.csl.uiuc.edu/allerton>

COORDINATED SCIENCE LABORATORY AND
THE DEPARTMENT OF ELECTRICAL AND
COMPUTER ENGINEERING

University of Illinois at Urbana-Champaign

CALL FOR PAPERS

SITA2000

2000 Symposium on Information Theory and its Applications

October 10 - 13, 2000

Aso, Kumamoto, Japan

Sponsored by the Society of Information Theory and Its Applications, Japan Co-sponsored by the IEEE Information Theory Society, Japan Chapter and the IEICE Technical Group on Information Society, Japan

The Twenty-third Symposium on Information Theory and its Applications (SITA2000) will be held on October 10 - 13, 2000 in Aso, Kumamoto, Japan. General sessions of this symposium solicits paper submission from people who will present new theoretical developments and techniques in information theory and its applications to real world.

Topics of interests include, but are not limited to, the following areas:

Shannon Theory	Coding Theory
Source Coding	Channel Coding
Compression	Coded Modulation
Applications of Information Theory	Cryptography
Information Security	Sequence Design and Analysis
Stochastic Process	Image and Speech Processing
Communication Theory	Signal Processing
Computer Network	Optical Communications
Spread Spectrum Systems	Neural Network
Signal Processing and Coding for Storage	

Submission Guidelines:

Working Language: Japanese or English, English sessions are provided.

Abstract: 200-word abstract with 5 keywords to be submitted. The title page must include the author's name, affiliation, complete return address, telephone, facsimile, and e-mail address.

Submission Address:

Prof. Yasutada Oohama
Graduate School of Information Science and
Electrical Engineering
Kyushu University
6-10-1 Hakozaki, Higshi-ku, Fukuoka 812-8581, Japan
Tel: +81-92-642-4044,
Fax: +81-92-632-5204,
E-mail: oohama@csce.kyushu-u.ac.jp

Schedules:

Submission of Abstract: August 4, 2000
Notification of Acceptance: August 15, 2000
Submission of Final Manuscript: September 4, 2000

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Refelctions on 1999. . .

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information across the two paths, and by appropriate signal processing at the receiver, we see, in effect a single channel that is better than either path. This advantage, over a single path from base station to mobile, is called diversity.

The simplest form of transmit diversity is the delay diversity scheme proposed by Wittneben [W], where a signal is transmitted from the second antenna, then delayed one time slot, and transmitted from the first antenna. Figure 3 shows an 8-state trellis representation of delay diversity for the 8-PSK constellation next to an 8-state space-time code 8-PSK. Both schemes provide diversity gain, but with the space-time code

there is an additional coding gain of 1.8 dB. Correlation of signals across transmit antennas is a fundamental difference between space-time codes and the Lucent BLAST architecture pioneered by Foschini et al. [F1]. Decoding complexity is similar to trellis codes for the Gaussian channel if we assume that the path gains from the base station to the mobile are known to the receiver. The advantage of space-time coding over simple delay diversity persists in a practical IS-136 modem, where path gains are estimated through pilot tones, and there is significant Doppler spread (see Naguib et al. [N]).

To tease apart *diversity gain* and *coding gain* we consider the squared distance between two codewords c and \tilde{c} at the output of the wireless channel. We introduce a matrix B with

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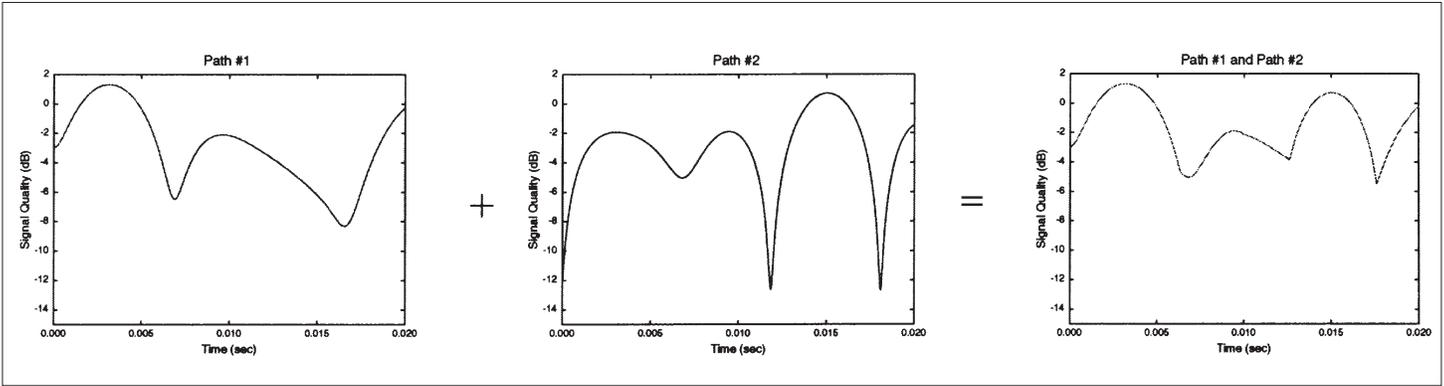


Figure 2. Diversity means that two paths are better than one!

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rows indexed by transmit antennas and columns indexed by time slots, where the it^{th} entry is the difference $c_{it} - \tilde{c}_{it}$. Squared distance turns out to be proportional to

$$\sum_{j=1}^M h_j B B^* h_j^*$$

where h_j is the vector of path gains from the different transmit antennas to the j^{th} receive antenna. When the vector h_j finds the null space of the matrix $B B^*$ the j th receive antenna experiences a deep fade. Diversity gain is then just the minimum rank of the matrix B , where the minimization is over all pairs of codewords. Coding gain depends on the product of the nonzero eigenvalues of B , and again there is a minimization over all pairs of codewords. This analysis leads to two design criteria for space-time codes, and when the number of antennas is small, the codes presented in our paper come within 2.5 dB of the outage capacity.

We would like to thank our friends for their efforts to incorporate block space-time codes in 3rd generation wireless standards. These codes were introduced to minimize decoding complexity in papers involving our colleagues Siavash Alamouti and Hamid Jafarkhani. Wideband Code Division Multiple Access or W-CDMA is a spread spectrum technology that has been selected by European and Japanese standards bodies as the physical layer for 3rd generation wireless infrastructure known as Universal Mobile Telecommunications Systems or UMTS. Diversity makes it possible to support services with different data rates within W-CDMA by varying the length of the spreading sequence. The difficulty in the past was that services associated with short spreading sequences were not sufficiently reliable. The new W-CDMA transmitter uses space-time coding across two or more transmit antennas, and the receiver exploits this transmit diversity together with the temporal structure of the spreading code. Alan Gatherer and colleagues from Texas Instruments championed the space-time coding technology within W-CDMA. Subsequently Bert Hochwald, Tom Marzetta and Constantinos

Papadias from Lucent Technologies persuaded CDMA 2000 to also adopt space-time coding. In the TDMA world, SBC and BellSouth have shown that IS-136 voice capacity can be doubled by combining half rate speech coding with space-time channel codes.

There have been many developments since our paper appeared; algorithms for differential detection; a theory of equalization for space-time codes, specifically for the EDGE evolution of GSM; algorithms for interference suppression that make data rates of 0.75 Mb/s possible at 26 dB on a 30 kHz channel with 8 transmit and 4 receive antennas; and space-time codes for wireless OFDM that provide 1.5 bits/sec/Hz and require only 5.5-7 dB (depending on delay spread) to achieve a frame error rate of 10%. Now that the Gaussian channel has yielded its secrets, we hope that more members of the Information Theory community will be tempted into exploring wireless channels equipped with multiple antennas.

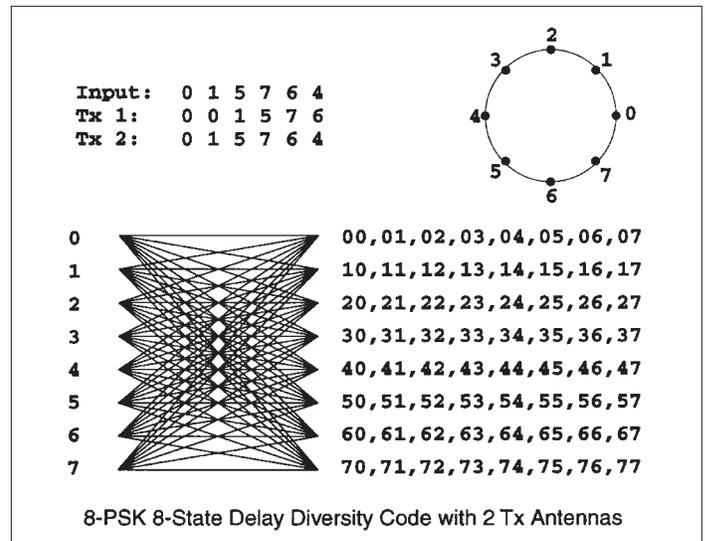


Figure 3a. Delay diversity. The edge label xy means that symbol x is transmitted from the first antenna and symbol y from the second antenna. Labels on edges leaving a given state disagree in the second position. Labels on edges entering a given state disagree in the first position. Hence the diversity gain is 2.

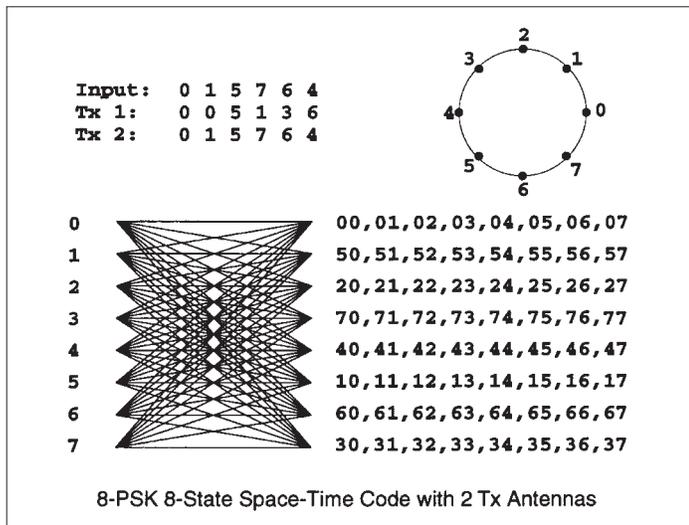


Figure 3b. Space-time code. Labeling of even numbered states is identical to delay diversity. The difference in labeling of odd numbered states is that the symbol transmitted from the first antenna is negated.

References

[F] G. J. Foschini, Jr., Layered Space-Time Architecture for Wireless Communications in a Fading Environment when using Multi-Element Antennas, Bell Labs Technical Journal, Autumn 1996.

[Fl] G. J. Foschini, Jr. and M. J. Gans, On limits of wireless communication in a fading environment using multiple antennas, Wireless Personal Communication, March 1998.

[N] A. Naguib, V. Taxokh, N. Seshadri, and A. R. Calderbank, A Space-Time Coded Modem for High Data Rate Wireless Communication, IEEE J. Select. Areas Commun., vol. 16, pp. 1459-1478, 1998.

[T] E. Telatar, Capacity of multi-antenna Gaussian channels, AT&T Bell Labs Internal Technical Memorandum, June 1995.

[W] A. Wittneben, Base station modulation diversity for digital SIMULCAST, in Proc. IEEE VTC, May 1993, pp. 505-511.

GOLOMB'S PUZZLE COLUMN™ PUZZLE NO. 49:

Solutions to "Student Contest Problems"

1. We are given $\log_2 x = \log_4(x+1)$. Since $\log_2 x = 2\log_4 x = \log_4 x^2$, we have $x^2 = x+1$, whose positive root is $x = \frac{\sqrt{5}+1}{2} = 1.61803399\dots$, the "golden mean." (For negative x , $\log_2 x$ would not be defined.)
2. The equation $4x^2 - 36\lfloor x \rfloor + 45 = 0$ can be rewritten $x^2 = 9\lfloor x \rfloor - 11.25$, from which $x = \sqrt{9\lfloor x \rfloor - 11.25}$, where $\lfloor x \rfloor$ is an integer, and x must satisfy $\lfloor x \rfloor \leq x < \lfloor x \rfloor + 1$. Since the roots of $4x^2 - 36x + 45 = 0$ are $4\frac{1}{2} \pm 3$, we can anticipate solutions near 1.5 and 7.5. Testing integer values of $\lfloor x \rfloor$ from 0 to 12, we find exactly six roots:

$$x = \frac{3}{2}\sqrt{4a-1} \text{ for } a = 1, 2, 3, 4, 5, 6.$$

3. To find the roots of $x^5 - 55x^4 + 330x^3 - 462x^2 + 165x - 11 = 0$, which has five real roots by Descartes' Law of Signs, we let $a = \cos \theta$, $b = \sin \theta$, so that $a + bi = e^{i\theta}$. Setting $\theta = \frac{k\pi}{11}$ for odd values of k (specifically for $k = 1, 3, 5, 7, 9$), we have $(a + bi)^{11} = e^{11i\theta} = e^{ik\pi} = -1$ (for each odd k). Expanding and equating the imaginary parts,

$$\binom{11}{1}a^{10}b - \binom{11}{3}a^8b^2 + \binom{11}{5}a^6b^5 - \binom{11}{7}a^2b^9 - \binom{11}{11}b^{11} = 0.$$

Since $b \neq 0$, we divide by $-b$ to get

$$b^{10} - 55b^8a^2 + 330b^6a^4 - 462b^4a^6 + 165b^2a^8 - 11a^{10} = 0.$$

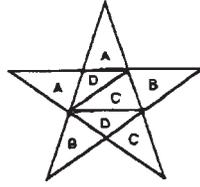
Since $a \neq 0$, we divide by a^{10} to obtain

$$\tan^{10} \theta - 55 \tan^8 \theta + 330 \tan^6 \theta - 462 \tan^4 \theta - 165 \tan^2 \theta - 11 = 0.$$

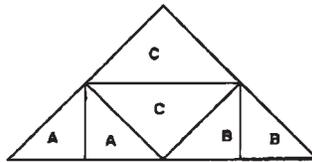
Thus, $x = \tan^2\left(\frac{k\pi}{11}\right)$ is a root of the original polynomial equation for each $k = 1, 3, 5, 7, 9$.

(Did you recognize the 11th row of Pascal's Triangle showing up as the coefficients of the polynomial?)

4. The region between the two horizontal lines has exactly half the total area of the pentagram. The figure shows a pairing of congruent regions to demonstrate this.



5. The inscribed rectangle contains half the area of the isosceles triangle. The figure shows a pairing of congruent regions to demonstrate this.



6. From $x + y + \sqrt{xy} = 57$ we have $xy = 57^2 + x^2 + y^2 + 2xy - 114x - 114y$. Given also that $x^2 + y^2 + xy = 2451$, we have $0 = 57^2 + 2451 - 114x - 114y$, $x + y = 50$. In the first equation, $\sqrt{xy} = 7$, and $xy = 49$. Then $(z - x)(z - y) = z^2 - 50z + 49 = (z - 1)(z - 49)$, so that $\{x, y\} = \{1, 49\}$. (Which of x and y is 1 and which is 49 is not specified from the given conditions.)

7. Given $(u + \frac{1}{u})^2 = 3$, we have $u^3 + \frac{1}{u^3} = (u + \frac{1}{u})(u^2 - 1 + \frac{1}{u^2}) = \pm\sqrt{3}((u + \frac{1}{u})^2 - 2) = \pm\sqrt{3}$

Extra credit. For real u , $(u + \frac{1}{u})^2 \geq 4$, so we must look for the complex roots of $u + \frac{1}{u} = \pm\sqrt{3}$, $u^2 \pm \sqrt{3}u + 1 = 0$,

$u = \frac{\pm\sqrt{3} - \sqrt{-1}}{2} = \frac{1}{2}(\pm\sqrt{3} \pm i)$. Since $\frac{1}{\frac{1}{2}(\sqrt{3} + i)} = \frac{1}{2}(\sqrt{3} - i)$, we can take $\{u, \frac{1}{u}\} = \{\frac{\sqrt{3}+i}{2}, \frac{\sqrt{3}-i}{2}\}$. The four primitive twelfth roots of unity are the possible values of u .

8. The positive integers fall into equivalence classes with respect to the relation “ ab is a perfect square,” which is reflexive, symmetric, and transitive. Each square-free positive integer is in a separate class, and the other members of that class consist of the square-free “leader” times any perfect square. Since the product of two integers is a perfect square if and only if they are in the same equivalence class under this relation, the maximum sized subset of $\{1, 2, 3, \dots, 25\}$ for which the product of two distinct members is never a perfect square equals the number of square-free integers from 1 to 25. These numbers are $\{1, 2, 3, 5, 6, 7, 10, 11, 13, 14, 15, 17, 19, 21, 22, 23\}$, a set of 16 elements.

Extra Credit: Since we can pick any representative from each of these 16 equivalence classes, we see that these classes are:

1 2 3 5 6 7 10 11 13 14 15 17 19 21 22 23
 4 8 12 20 24
 9 18
 16
 25

Hence, the number of different subsets meeting the required conditions is $5 \times 3 \times 2^3 \times 1^{11} = 120$.

9. If there are 5 pairs of socks in the drawer, and three socks are extracted, there are $10 \times 9 \times 8$ ordered ways in which this can be done. In $10 \times 1 \times 8 = 80$ cases, the first and second socks match. In $10 \times 8 \times 2 = 160$ cases, the third matches one of the first two. Thus the probability, as the ratio of favorable cases to total cases, is $(80 + 160)/720 = \frac{1}{3}$ (There are many other ways to obtain this answer.)
10. If six cards bear the respective numbers 1, 2, 7, 8, 9, 9, and two are selected at random, there are $\binom{6}{2} = 15$ possible pairs (ignoring the order of selection). The cases in which the sum of the two selected cards is a multiple of 3 are: (1, 2), (1, 8), (2, 7), (7, 8), and (9, 9). Hence, the probability that the sum will be a multiple of 3 is $\frac{5}{15} = \frac{1}{3}$.

Note: Several of these problems were taken, with or without modifications, from the November, 1999, issue of the Canadian publication CRUX MATHEMATICORUM, which included the problem sets of recent Mathematics Olympiads from seven countries, as well as from other high school competitions.

Conference Calendar

DATE	CONFERENCE	LOCATION	CONTACT/INFORMATION	DUE DATE
June 5-9, 2000	IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2000)	Istanbul, Turkey	Conference Management Services 3109 Westchester Ave. College Station, TX, USA 77845-7919 Email: mercer@conf-mgmt.com Web: http://icassp2000.sdsu.edu	
June 18-24, 2000	7th International Workshop on Algebraic and Combinatorial Coding Theory	Blagoevgrad, Bulgaria	S. M. Dodunekov Institute of Mathematics and Informatics Bulgarian Academy of Sciences 8 G. Bonchev Str. 1113 Sofia, Bulgaria Email: stedo@moi.math.bas.bg	
June 25-30, 2000	ISIT 2000	Sorrento, Italy	Professor Ezio Biglieri Dipartimento di Elettronica Politecnico di Torino Corso Duca Degli Abruzzi, 24 I-10129, Torino, Italy email: biglieri@polito.it Tel: +39 011 5644030 Fax: +39 011 5644099 Web: http://www.unisa.it/isit2000	
July 4-7, 2000	Information Theoretic Methods in Mathematics	Balatonlelle, Hungary	Imre Csiszár A. Renyi Institute of Mathematics Hungarian Academy of Sciences H 1364 Budapest, PÖB127, Hungary Email: csiszar@math-inst.hu Web: http://www.renyi.hu/~infmath/	
October 4-6, 2000	38th Annual Allerton Conference on Communication, Control, and Computing	Monticello, Illinois, USA	38th Annual Allerton Conference Coordinated Science Laboratory University of Illinois 1308 W. Main Street Urbana, Illinois 61801-2307 USA Email: allerton@csl.uiuc.edu Web: http://www.comm.csl.uiuc.edu/allerton	July 7, 2000
October 10-13, 2000	2000 Symposium on Information Theory and its Applications (SITA2000)	Aso, Kumamoto, Japan	SITA2000 Secretariat c/o Imamura Laboratory Department of Computer Science and Electronics Kyushu Institute of Technology Izuka, Fukuoka 820-8502, Japan Tel: +81-948-29-7662 Fax: +81-948-29-7651 Email: sita2000@capricorn.cse.kyutech.ac.jp Web: http://www.capricorn.cse.kyutech.ac.jp/sita2000	August 4, 2000
November 5-8, 2000	International Symposium on Information Theory and Its Applications (ISITA 2000)	Honolulu, Hawaii	Prof. Eiji Okamoto Center for Cryptography, Computer and Network Security University of Wisconsin, Milwaukee Milwaukee, WI 53201 Tel: +1-414-229-5731 Fax: +1-414-229-6958 Email: okamoto@cs.uwm.edu Web: http://isita2000.soft.iwate-pu.ac.jp/	March 15, 1999
June 24-29, 2001	IEEE International Symposium on Information Theory (ISIT 2001)	Washington, D.C., USA	Prof. Tom Fuja Department of Electrical Engineering 272 Fitzpatrick Hall University of Notre Dame Notre Dame, IN 46556 USA Tel: (219) 631-7244 Fax: (219) 631-4393 Email: tfuja@nd.edu Web: http://www.seas.smu.edu/isit2001/	October 1, 2000

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