IEEE Information Theory Society Newsletter

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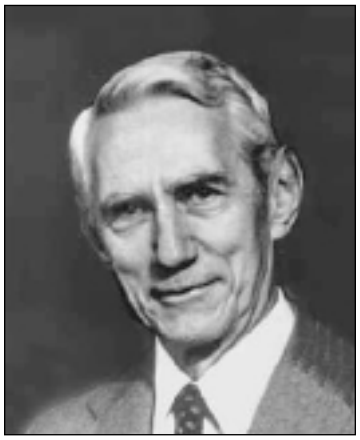
Memorial Tribute to Dr. Claude Shannon

Mr. President, I rise today in memory of Dr. Claude Shannon, a pioneer in the field of modern communications technology. His work provided a major part of the theoretical foundation leading to applications as diverse as digital cell phones, deep space communications and the compact disc.



Dr. Shannon died on February 24 after suffering from Alzheimer's disease. He was not widely known by the general public, but he should have been. His work predated the establishment of the World Wide Web, but in 1948 he published a seminal paper entitled "A Mathematical Theory of Communication." This paper was the first to provide a mathematical model of the communication process. He was able to define "information" in a way that was unrelated to its semantic meaning by explaining the power of encoding information in a simple language of 1's and 0's . Communication then became the process of transferring information from a "source", modified by an "encoder", through a "channel", to a "decoder" at the output of a channel. This theory underlies the modern communications revolution.

Dr. Shannon's work showed that every kind of information source — text, images, video, data – has associated with it a quantifiable information content that mandates how efficiently it can be *represented* — the basis for "data compression". For instance, he showed that, no matter how clever you are, you can't represent English text with less than about 1.5 bits per letter. Dr. Shannon also established fundamental limits to how efficiently one can *transmit* information over imperfect communication channels; his work on reliable transmission formed the theoretical basis for the modems, satellite links and computer memories that are pervasive today. These aspects of Shannon's work became the foundation of what we now call "Information Theory."

As important as Dr. Shannon's 1948 masterwork was, it was not his sole contribution to the emerging information age. As a graduate student at MIT, Shannon made a profound and fundamental contribution to the field of computer design when he showed that a then-obscure branch of mathematics called "Boolean algebra" — the algebra of 1's and 0's — could be used to design circuits for computation and switching. The result was what some have called "the most influential master's thesis in history." Shannon's work on cryptography during World War II also formed the modern theoretical framework for secure communication systems.

The Washington Post pointed out in Dr. Shannon's obituary that his achievements are at the core of the technology that delivers the Internet and its various applications, from music to video to e-mail. His work has had applications in fields as diverse as computer science, genetic engineering and neuroanatomy. Some have called his 1948 paper "the Magna Carta of the information age."

Dr. Shannon was also renowned by his friends and colleagues for his eclectic interests and capabilities. He rode down the halls of Bell Labs on a unicycle while juggling; he invented a rocket-powered Frisbee; and he developed "THROBAC-I," a computer that computed in Roman numerals.

There are only a few authentic geniuses in this world. Dr. Shannon was one and today we remember him for his accomplishments.

Editor's Note: The above memorial was read into Volume 147 of Congressional Record S2068, Daily Edition March 8, 2001 at the request of Senator John D. Rockefeller (D-WV).

From the Editor

Lance C. Pérez

This issue of the *IEEE Information Theory Society Newsletter* contains information on the arXiv (http://arXiv.org) preprint server which provides a convenient means for the distribution of articles prior to journal publication. IT Society members are encouraged to monitor this site for the appearance of an information theory section.

Please help make the Newsletter as interesting and informative as possible by offering suggestions and contributing news. The deadlines for the next few issues are as follows:

Issue	Deadline
September 2001	July 15, 2001
December 2001	October 15, 2001
March 2002	January 15, 2002

Electronic submission, especially in ASCII and Word formats, is encouraged.

This is the first issue of the newsletter under my editorship and I would like to thank Kimberly Wasserman for her valuable assistance.

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IEEE

Information Theory Society Newsletter

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The Historian's Column

A. Ephremides

We are all accustomed nowadays to the powerpoint presentation formats that are becoming ubiquitous in technical (and non-technical) presentations. This new technology has been embraced with such enthusiasm that in the race to be the first to anticipate the future, many agencies and conference organizers are doing away completely with the more traditional presentation tools (like overhead and slide projectors or, god forbid, the good-old blackboard). It used to be said that if someone used an overhead projector he/she must have been an engineer. If it was the blackboard, then the person must have been a mathematician. If the person did not use any aids, he/she must have been a lawyer or a politician. If he/she read from a book, it must have been a preacher. And if the writing (on whatever medium) was illegible, it must have been a doctor. No more, however; now there has been fusion, or convergence, to use the popular terms of the day, into the magical powerpoint technology.

A. Ephremides

These observations caused me to ruminate about the use of gadgets in our profession and (what else?) to look back and attempt to make some historical sense out of the choice and use of technology tools. To make sure that I am not thought of as a counterrevolutionary, let me say that I have nothing against the powerpoint technology. Some of my best friends use powerpoint routinely. I must confess, however, that I do have a slight problem with some attitudes that I will refer to as powerpoint terrorism or gadget extremism.

Let us try to be objective. Using a powerpoint format does have distinct advantages. Not only does the availability of soft copies make it easier to store, transmit, and modify presentations easily (after all, the use of view graphs does provide that capability as well, provided the view graphs have been electronically composed), but it also permits the use of aggressive, bold, and entertaining graphics to presumably enhance a presentation. The counterpoint to powerpoint is that the medium threatens to become the message. Increasingly, we see mediocre presentations conceal their weaknesses under the sheen of dazzling displays. This is not unlike the case of commercial television in which content takes second place to form. In fact, if powerpoint users were more imaginative they might create a new form of artistic expression rather than merely display graphs, curves, and bullets. Consider how naked a powerpoint speaker must feel if the laptop is disabled or taken away. Wouldn't it be useful to have versions of one's presentations whereby only the "ether" separates him/her from the audience! I remember that one of the most effective presentations I heard was the one by Tom Cover in the 1983 NATO Advanced Study Institute in which he gave a 2-hour talk based on a few view graphs on which he had scribbled by hand the most essential props for his talk. That has remained for me an unsurpassed challenge all these years.

So the question is "Will we all be using powerpoint in the near future?" Although I do not consider by any means this to be a burning question, I cannot help remembering the impact of the introduction of the...lowly calculator. For some readers talking about the calculator must be tantamount to talking about the wheel or some other gadget from the remote past. And yet, in the early seventies, its introduction was a sensation. Many of my colleagues at the time embraced it with such a vengeance that they wouldn't be caught dead without having one on their belt, hooked in a holster like a handgun. And it was so funny to see how they would grab any opportunity to pull it out of the holster and fire away by calculating the 5% tax charged on a purchase of a $17.95 book.

I hardly see any calculators carried around today, but I take pride in assuring you that I have never used one even when it was de rigueur to carry one around. I felt that the agility of my mind was being compromised if I relied on it excessively. In a sense, even though the analogy can only go so far, doing the mental calisthenics of multiplying and dividing, and, yes, even taking square roots, without the help of a calculator, is similar to bypassing the use of an elevator and, instead, using stairs to go up to the third floor, so that our heart and muscles receive some exercise.

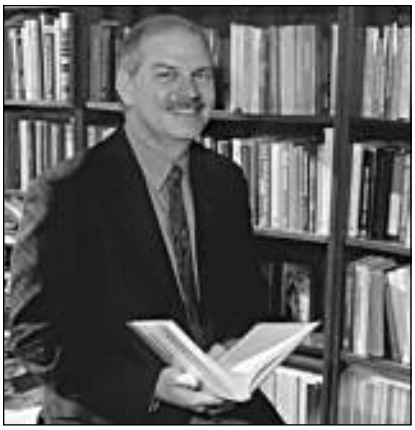
But today's avalanche of gadgets and technologies is bombarding us with so many powerful products that it's becoming almost hopeless to resist. Consider, for example, the marvelous world wide web. Who hasn't found real utility in this world-transforming and overwhelming, versatile tool? And regardless of who invented it, it is here to stay and to be used. But, please, not to be overused! The enthusiasm with which everyone has adopted the use of the web has resulted in an insidious and subtle transfer of labor to those who use it. It used to be that information was sent to you and placed on your lap. Now it is only available on the web. Everyone asks us to visit their website to find the information we seek. I could easily spend my whole day looking up websites if I took every admonition to do so seriously. Unfortunately, it's not fun anymore. It looks like we will be condemned to look at a screen while we are awake.

At a recent meeting, where by the way all presentations were in powerpoint, the quality of the talks was quite poor. I

looked around to see that half the audience was staring at their laptops, open in front of them, doing either browsing, or editing, or e-mail, or games. And it dawned on me! The information era (that we all have a part in bringing about) has arrived. And staring at a screen qualifies as a new form of virtual sleep. Let us hope that like the social protocol that is emerging regarding the proper use of cell phones, there will be similar bounds and limits to the use of the gadgets we help invent. And let us occasionally test the status of our mental abilities by trying to make, from time to time, a good presentation without the use of powerpoint.

H. Vincent Poor Awarded the 2001 IEEE Graduate Teaching Award

Thomas Fuja



H. Vincent Poor

Prof. H. Vincent Poor, a longtime member and former president of the IEEE Information Society, was awarded the 2001 IEEE Graduate Teaching Award at the 2001 International Symposium on Information Theory, held June 24-29 in Washington D.C. Prof. Poor was cited "For exemplary teaching, inspired guidance of graduate students, and contributions to graduate education in statistical signal processing."

Prof. Poor is a professor of electrical engineering at Princeton University, a position he has held since 1990; prior to joining Princeton he was a faculty member at the University of Illinois, beginning in 1977.

During Poor's 25-year career at Princeton and Illinois he has supervised 15 PhD theses and 20 MS theses. His graduate students have gone on to take faculty positions at some of the finest universities in the world, including Rice, Princeton, USC, Illinois, Texas A&M, and Cornell. Other students have taken research positions at such leading firms as Qualcomm, Intel, and NEC. Moreover, he has authored a well-regarded graduate text ("An Introduction to Signal Detection and Estimation") and has received a number of awards for teaching excellence.

Asked to comment on his success as a graduate advisor, Prof. Poor said, "I think the most important thing in working with graduate students is to give them the freedom to be creative... My experience has been that students are more productive in the long run if given enough time and freedom to find their own way through research issues." Poor went on to credit his own advisor, Prof. John Thomas of Princeton University, for inspiring his approach.

Poor also observed that "...the process of educating graduate students is not so much one of imparting knowledge to another person as it is one of learning alongside another person. I've learned a great deal from my students."

Joel Snyder, president of the Institute of Electrical and Electronics Engineers (IEEE), was present at the ISIT Awards Luncheon to make the award. However, Prof. Poor was unable to attend the luncheon due to unexpected circumstances; as a result, he was presented the award by IT Society president Joachim Hagenauer at the ISIT banquet later in the week.

The Graduate Teaching Award was established in 1990. It is supported by the IEEE Foundation and it consists of a bronze medal, a certificate, and a cash honorarium.

Poor was president of the IEEE Information Theory Society in 1990; he was also program co-chair of the 1998 International Symposium on Information Theory and is currently a member of the IT Society Board of Governors.

H. Vincent Poor Elected to the National Academy of Engineering

Professor H. Vincent Poor of Princeton University has been elected to the National Academy of Engineering of the United States "For contributions to signal detection and estimation and their applications in digital communications and signal processing."

Prof. Poor is a a longtime member and former president of the IEEE Information Theory Society

ArXiv Preprint Server Available

Joachim Hagenauer

ArXiv (http://arXiv.org) is a preprint server run on a voluntary basis by the physics community, independent of any publisher, but supported by the NSF and others. It has now been expanded to cover large areas of mathematics and some areas of computer science, control theory, etc. The Information Theory Society will ask ArXiv to establish a subcategory for Information Theory.

Any author may post a paper on this server, as he or she might do on his or her own Web site. In the communities that use ArXiv, it is absolutely standard to do this in parallel with submitting a paper to a journal, or when a paper is mature enough to be posted on a personal Web site. The paper may be updated as time goes on. There is no peer review or other screen.

ArXiv has several features: (a)It is easy to search; (b) One can subscribe to the areas one is interested in and be alerted immediately to all new papers in that area; (c) It contains various easy-to-use facilities such as format conversion; (d) The infrastructure is well developed and maintained by somebody else!

People submitting articles to ArXiv should be aware that as soon as a paper is accepted by the IT Transactions or any other IEEE publication and the copyright form is signed, the copyright for the paper or electronic publication resides with IEEE and the preprint version should be removed from servers to avoid confusion. The paper will then become available electronically through IEEE Explore and the IT digital library.

IEEE Information Theory Society Board of Governors Meeting

Johns Hopkins University, Baltimore, MD
March 23, 2001, 11:00 AM

Attendees: Ezio Biglieri, Michelle Effros, Anthony Ephremides, Thomas E. Fuja, Aaron Gulliver, Joachim Hagenauer, Bruce Hajek, Michael Honig, Johannes Huber, Torleiv Kløve, Ryuji Kohno, Han Vinck.

1. The meeting was called to order at 11:00 AM by Society President Joachim Hagenauer. A moment of silence was observed in memory of Claude Shannon.
2. The new and returning members of the Board were welcomed. It was announced that the Annual Meeting of the Society will be held on Sunday, June 24 before ISIT in Washington, beginning at 12:00 PM. The remaining Board meeting for 2001 will be held on Wednesday, September 5 during the Cairns IT Workshop, beginning at 9:00 AM.
3. The Agenda was approved as distributed with the following changes:

   9.3 Galley Proofs was deleted
   15.10 ITG Conference [Huber] was added
4. The minutes of the previous meeting in Honolulu, HI on November 5, 2000, were approved as distributed.
5. Society President Joachim Hagenauer read a copy of the letter of condolence he sent to Mrs. Shannon on behalf of the Society. A number of condolence letters were sent to the IT Society, in particular one was received from the Popov Society. A memorial to Shannon was read into the Congressional Record. Framed copies will be given to Mrs. Shannon and the Society. The Society copy will be displayed at ISIT 2001. A number of events are being planned to honour Claude Shannon. A brief memorial session will be held during ISIT before the opening reception. A memorial paper being written by Robert Gallager will be published in the Transactions. A Commemorative issue of the newsletter is planned for July. Tony Ephremides will contact the Newletter Editor to coordinate this issue.

   
   Aaron Gulliver

   The President reported on the TAB meeting he attended in Tampa, FL. He informed the board that IEEE will use approximately 12% or $180,000 of our long term reserves to cover their operating costs deficit. This figure is quite significant and will have a significant effect on the Society. It was stated that there should be more feedback from Division Directors to the societies about major financial decisions. After some discussion, it was suggested that the IEEE consider cutbacks in expenses and staff in order to reduce their costs, or adopt other measures to balance there budget such as increasing membership fees.

   The ad hoc Committees and their chairs are as follows:

   Electronic Publications . . . . . Steven McLaughlin
   Symposium Review . . . . . Thomas Fuja
   Workshops and Symposia . . . . . Steven Wicker
   Joint ComSoc/IT Award . . . . . Thomas Fuja
   Revenues . . . . . Marc Fossorier

   The ad hoc Committee on Revenues is composed of Marc Fossorier, Steven Wicker, Joachim Hagenauer and Han Vinck. The committee mandate is to look at means of increasing revenues such as raising member and non-member fees.
6. The Treasurer's Report prepared by Marc Fossorier was presented. A five page update on the financial status of

the Society was distributed and discussed. It was noted that the cash available is very low, and that money will have to be transferred from long term investments immediately. Concern was raised about the substantial increase in reimbursed expenses of the Transactions Editors in recent years.

For the April budget, the board authorized the Society Treasurer to transfer up to $300,000 from long term investments to cash reserves, in consultation with the Society President.

The Society President thanked Marc Fossorier for his excellent job in handling the Society finances and preparation of the Treasurer's Report.

The following motion was passed unanimously:

> The Board of Governors of the Information Theory Society expresses its surprise and concern regarding the expropriation by the IEEE Board of Directors of a substantial amount of the Society's reserves to cover the General Fund deficit. The Board of Governors requests a full explanation of the reasons and rationale for this alarming development, and authorizes the President to take whatever measures necessary to obtain information to enable the board to plan subsequent actions.

7. Aaron Gulliver presented the report on the IT Society website. Statistics show that the number of file transfers from the website is up 16% since the November board meeting in Hawaii, and up 50% from one year ago. Total volume is now at 18.4 Mbytes/day, which is a 75% increase from a year ago. Conference information and the newsletters continue to be the most popular items. Now that the digital library is available to members via the web, usage of this resource has increased significantly. The Shannon obituary was posted soon after his death. It has been accessed almost 700 times to date.

   A new section for Chapters has been created on the website. This was done in coordination with Membership Committee Chair, Han Vinck. Each Chapter now has a separate page for links and chapter information. The membership information pages have also been updated.

8. The President presented the Newsletter Editors Report. He stated that the delay in publication of the December newsletter is due partly to IEEE staff problems and partly to the recent move by the Newsletter Editor. The Editor has expressed a desire to step down from this position, but will continue until a replacement is found. The President asked the board members to forward names of people who would be suitable for the position.

   There was some discussion on expanding the newsletter to a magazine, and including material such as tutorial articles on a regular basis. The President will consult the Treasurer on the financial implications of such a change, and also ask the IEEE about the associated costs.

9.1. The report from the Editor-in-Chief Alexander Vardy was distributed. The question of Editor expenses was again raised. Delays and anomalies in the review process were also discussed. This is a chronic problem, as it is impossible to force people to provide timely reviews. Since the EIC position is changing hands, the board requested that incoming EIC Paul Siegel inquire about how other societies, such as the Signal Processing Society, handle papers and delinquent reviewers.

Two new Associate Editors were nominated, David Tse (new position) in the Communications area, and Emre Telatar to replace Imre Csiszar in the Shannon Theory area. The appointments were approved unanimously.

Concern was raised about the regional distribution of the Editorial Board. Ryuji Kohno stated that he will forward the names of four people from Region 10 who can be considered for new Associate Editor positions. The President will also write a letter to the new EIC asking that Associate Editors from Region 10 be appointed.

9.2. There was no Publications Editors Report.

10. There was no report from the Electronic Publications ad hoc Committee. The LANL ArXiv preprint server was discussed. It was noted that IEEE IT Society involvement will be a problem because of copyright and other issues. Following a suggestion by Dave Forney, the President will write a paragraph on this archive to be published in the Newsletter to make members aware of this resource. The Society will advertise the archive but not endorse it.

11. There was nothing to report from the ad hoc Committee on Education. Ezio Biglieri stated there will be a meeting of the IEEE Education Committee in Alexandria on April 21-22, 2001, which he will attend. A report will be presented at the next board meeting.

12. Han Vinck presented the report from the ad hoc Committee on IT Book Translations. The book by Kasami et al. has been translated form Japanese to Russian and is now being translated from Russian to English. This task is almost finished and Kasami will check the translation when it is done. The ad hoc Committee on Membership Issues considered the problem of potential members in countries where membership is not affordable, such as many African countries.

    The proposed solution is to provide free Affiliate Memberships. The following wording was approved by the Board:

    > Information Theory Society Affiliate Memberships for Residents of Developing Countries
    >
    > The IEEE Information Theory Society would like to bring the benefits of Society Membership to as many individual engineers and scientists as possible. These benefits include reduced conference fees, publications and other services offered by the IT Society.
    >
    > The "Affiliate Society Membership" program of the IT Society is intended to support science in countries

where paying normal IEEE dues creates significant financial hardship.

The Board of Governors encourages requests for free affiliate memberships. These requests should clearly indicate the reasons for wanting to be an affiliate member and not a regular IT Society member.

Note that Affiliate members have the same privileges as regular members, such as Newsletters, Transactions on Information Theory, reduced conference fees etc. (see http://www.itsoc.org/membership/frmem.html).

Affiliate IT Society members will not be members of the IEEE. This program has limited funds and therefore the decision of the Membership Committee in supporting any request will be final.

13. The frequency of the IT Symposia were discussed. The major concern is the short deadline for submissions after the previous Symposium. The Board felt that not enough time has passed since the change to yearly ISIT to assess the impact, and decided to leave this issue until the 2002 meeting in Lausanne. A decision will then be made and any changes will become effective in 2005 or 2006.

14. The Distinguished Lecturer Program was discussed. The board decided that no changes are needed to the list of IT Society Distinguished Lecturers.

15.1. Ezio Biglieri presented a report on ISIT 2000. The audit is now in progress and the books will be closed soon.

15.2. There was no report on ICPWC 2000.

15.3. A report from the organizers of the 2001 Canadian Workshop on Information Theory was circulated. The event is progressing as scheduled.

15.4. Prakash Narayan joined the meeting and presented a report on ISIT 2001, which will be held in Washington, DC. The preparations are on schedule. A detailed overview of the activities was given, including a brief Shannon memorial event before the opening reception. Travel grants and the basis for allocation were discussed.

15.5. A report on the 2001 Information Theory Workshop to be held in Cairns, Australia, was circulated. It was noted that the BOG meeting will be held on Wednesday morning.

15.6. The website for ISIT 2002 in Lausanne, Switzerland is now active.

15.7. There was no report on the Information Theory Workshop to be held in Pokhra, Nepal.

15.8. Ryuji Kohno reported that the organization of ISIT 2003 was progressing well. The Call for Papers is being prepared. Prof. Shojiro Sakata has been added as a Co-Chair of the Program Committee.

15.9. Bruce Hajek proposed that the 2004 Symposium be held in Chicago. The dates will be June 27 - July 2, and he has obtained quotes form several hotels. Dan Costello and Bruce Hajek will be the General Co-Chairs.

A motion to approve the Chicago proposal was passed unanimously, with the condition that a detailed proposal be presented at the June board meeting.

15.10. Johannes Huber presented a report on the ITG Conference on Source and Channel Coding to be held in Berlin. Technical co-sponsorship with the Society has already been obtained.

15.11. Ezio Biglieri announced that ComCon 8 will be held in Crete in June 2001. Technical co-sponsorship was approved for this conference.

16. The Membership and Chapters Committee report was presented by Han Vinck. He provided a detailed overview of membership and a membership development plan. He noted that the number of chapters is low, but that two new chapters have been created this year. A proposal for a "Best Chapter of the Year Award" was approved unanimously.

17. The Awards Subcommittee report was presented by Tom Fuja. The joint IT/ComSoc Paper Award Committee has now been established, so it is expected that progress will be made in the near future. The Best Paper Award Committee has now been created and is now requesting nominations from Society members.

18.1. Bruce Hajek represented the Society in the planning of the new Mobile Computing Journal. He consulted Society members in the area and determined that there was not a lot of interest in the Society being a key player. The Board approved technical co-sponsorship but no future involvement is expected.

18.2. The board discussed changes to the Bylaws concerning the Best Paper Award. These changes will be considered at the Annual Meeting in June, 2001. The wording of the proposed changes to the last 2 paragraphs of **Article VIII. Paper Award, Section 2.** are as follows:

The Awards Subcommittee shall submit to the Board a list of up to three selected nominations for the Information Theory Society Paper Award at least 3 weeks in advance of the first Board meeting following June 1st 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 ballot, conducted by the Society President or designee at the Annual Meeting. The paper receiving the highest total number of votes in the balloting shall be declared the winner of the Information Theory Society Paper Award.

18.3. Joachim Hagenauer announced that the IEEE review of the Information Theory Society report will be required at the end of May. It will be considered at the June 20, 2001 TAB meeting. An ad hoc Committee consisting of Aaron Gulliver, Thomas Ericson, Anthony Ephremides, Alexander Vardy and Kimberly Wasserman will assist the President with this review.

19. Joachim Hagenauer thanked John Goutsias for hosting the board meeting.

The meeting was adjourned at 4:10 PM.

The Seventh Canadian Workshop on Information Theory

Vancouver, British Columbia
June 3 – 6, 2001

Cyril Leung (University of British Columbia)
Ivan Fair (University of Alberta)

The Seventh Canadian Workshop on Information Theory was held June 3 – 6, 2001, at the University of British Columbia in Vancouver, British Columbia. The workshop was sponsored by The Canadian Society for Information Theory and was made possible through generous financial support from Agilent Technologies Inc., the New Media Innovation Centre, Sierra Wireless Inc., and TR*Labs*. The IEEE Information Theory Society was a Technical Co-Sponsor of the workshop, and support was also received from the Department of Electrical and Computer Engineering at UBC and the Alberta Informatics Circle of Research Excellence (iCORE).The Canadian Workshop on Information Theory is held biennially. The Seventh workshop marked the first return to the west coast of Canada since the workshop was held at Dunsmir Lodge on Vancouver Island in 1989. The 2003 CWIT will be held in Waterloo, Ontario.

The workshop was organized in a single-track format with presentations over two and a half days. The technical program included presentations from three invited speakers as well as 35 presentations from researchers representing 13 different countries. The list of attendees included 76 registrants from 15 different countries. The workshop commenced with Prof. J. Hagenauer paying tribute to Claude Shannon, after which a minute of silence was observed. Prof. Hagenauer then presented his invited talk, "From Analog to Digital and Back Again." Subsequent days of the workshop began with invited talks from Prof. V. Tarokh, who spoke on "Transmit Diversity when the Receiver does not know the number of Transmit Antennas," and Prof. S. Verdú who presented his research on "Efficient Use of Bandwidth in the Wideband Regime."

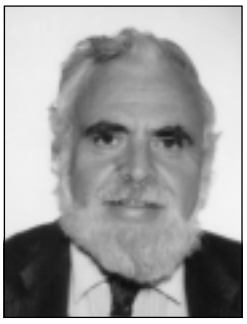
Seven technical sessions were held:

- *Turbo Codes* (Chair: C. Schlegel, University of Utah)
- *Source Coding* (Chair: F. Kschischang, University of Toronto)
- *Source Coding, Cryptography, and Shannon Theory* (Chair: P. Fortier, Laval University)
- *Wireless Systems* (Chair: H. Vinck, Essen University)
- *Wireless Systems and Signal Processing* (Chair: J.-Y. Chouinard, University of Ottawa)

GOLOMB 'S PUZZLE COLUMN ™

SUMS AND PRODUCTS OF DIGITS

Solomon W.Golomb



For every positive integer n, let S(n) be the sum of the decimal digits of n, let P(n) be the product of the decimal digits of n,and let R(n)= n/S(n), the ratio of n to the sum of the digits of n.

1. The equation $S(n)\cdot P(n) = n$ can also be written $P(n) = R(n)$. One solution is $n = 1$, where $S(n) = P(n) = R(n) = n = 1$. There are larger solutions, but only finitely many. Which ones can you find?

2. The ratio $R(n) = n/S(n)$ is sometimes an integer (e.g.when $n = 12$, $R(n) = 12/(1 + 2) = 4$) and sometimes not (e.g. when $n = 15$, $R(n) = 15/(1+5) = 2.5$). Does every positive integer m occur as $R(n)$ for some positive integer n? If "yes ", give a proof; if "no", find the smallest positive m which is never of the form $R(n)$.

3. For each positive integer k, determine which k-digit number n gives the minimum value (integer or not) of $R(n)$. (While this is a separate problem for each positive integer k, there is an interesting pattern to the solutions.)

4. For how many of the $9\cdot 10^{k-1}$ k-digit integers is $R(n)$ an integer? (This value has been tabulated for $1 \le k \le 7$, but no closed form expression, or even a good asymptotic approximation, has yet been found.)

5. For each positive integer k, which k-digit number gives the smallest *integer* value of $R(n)$, and what are these values? (This behavior is far less regular than in Problem 3, and the explicit answer has only been found, by exhaustive search, for $1 \le k \le 7$.)

Note. Except for Problem 2, due to John H. Conway, the remaining problems are based on an unpublished paper of David Singmaster.

- *Error Control Coding* (Chair: F. Alajaji, Queen's University)
- *Detection* (Chair: S. Kallel, University of British Columbia)

We were very fortunate that Prof. Ian Blake kindly agreed to be the banquet speaker at the workshop. During his interesting and entertaining talk, he demonstrated how research published in the *IEEE Transactions on Information Theory* touches us all in our daily lives, citing works by Diffie and Hellman, Reed and Solomon, Lempel and Ziv, and looking to the future, the recently published work by Tarokh, Sheshadri and Calderbank. The banquet concluded with a chorus of "Happy Birthday" to Ian Blake, in honour of his 60th birthday.

Further information about CWIT 2001, as well as PDF versions of all papers presented at the workshop, can be found at the workshop web site www.cce.com/cwit.

5th International Symposium on Power-Line Communications and Its Applications (ISPLC 2001)

April 3-6, 2001, Malmö, Sweden

A. J. Han Vinck

ISPLC 2001 focuses on the general problem of communications over power lines. The objective of the symposium is to stimulate research and contribute to the formulation and solution of new problems encountered by scientists and engineers working in this field. The Symposium covers a range of communication topics from a practical as well as a theoretical point of view. ISPLC 2001 was hosted by the Department of Information Technology, Lund University (Göran Lindell, chairman) and EnerSearch Industrial Research Consortium (Hans Ottosson, chairman), Malmö, Sweden. The General Secretary Yvonne Hoekansson, took special care of all participants and the local arrangements. The Symposium attracted over 190 registered participants from 29 countries.

The Program for the 2001 Symposium contained three extremely stimulating days filled with the very frontline of scientific and technical achievements in the area of Power-Line Communications and Its Applications. The Symposium is arranged as two main activities. One activity is the keynote and invited presentations together with the Technical Program. The Scientific and Technical Program was composed of 59 scientific papers of which six were invited keynote presentations.

Two keynote presentations were related to Critical Infrastructures and the fact that PLC can support the sustainability of the power networks and help in the operation of the grid through communication and distributed intelligence. These talks were *Power Line Communication for the Defense against Catastrophic Failures of Complex Interactive Power Networks*, by Professor Arun Phadke, Virginia Tech, USA and*Power Line Communication as a Means for Electronic Power Markets*, by Dr. Fredrik Ygge, EnerSearch AB, Sweden.

Broad band technology over the power line is moving fast and the following keynote talks pointed at the interesting problems: *Broad Band PLT Access Solutions - Assessing Developments*, by Professor Paul Brown, White Box Solutions Ltd, UK and *Regulatory and Consumer Acceptance of Power Line Products*, by Mr. Peter Strong, nSine Limited, UK.

Two keynote presentations dealt with the extremely important issues of Regulations and Security. These were *Regulatory*

ISPLC 2001 participants enjoy the banquet in the Old "Crowning Hall" of Malmö.

ISPLC 2001 participants during a presentation.

Issues in Power Line Communication, by Professor John Newbury, Open University Manchester, UK and *Security Issues and Power Line Communication*, by Professor Rune Gustavsson, Blekinge Institute of Technology, Sweden.

Invited Session Organizers were: Klaus Dostert, University of Karlsruhe, Germany; Frank Kschischang, University of Toronto, Canada; Gen Marubayashi, SOKA University, Tokyo, Japan; John Newbury, Open University, Manchester, UK; Hermann Rohling, Technical University of Hamburg-Harburg, Germany. Han Vinck closed the Symposium with concluding remarks.

The conference support personnel, Yvonne Hoekansson and Vivian Ottosson.

bition and Workshop program collected seven Company presentations in the PLC forum, workshops spanning over all three days, as well as the European Commission IST Project PALAS (Power-Line as an Alternative Local AccesS).

The Symposium Banquet Was Hosted By Sydkraft And Malmö City In The Town Hall, With Entertainment By Local Artists. This Part Of The Program Was Impressive Due To The Unique Atmosphere In The Crowning Hall That Dates Back To The Year 1500. At The Banquet, It Was Announced That Next Year's Symposium Will Take Place In The Last Week Of March 2002 In Athens.

The second activity holds the workshops and an exhibition, new for ISPLC. With this structure, the intention is to present both research related contributions as well as contributions with a look at broad applications of PLC technology, vital to the performance and economy of the energy sector. The Exhibition and Workshop program collected seven Company presentations in the PLC forum, workshops spanning over all three days, as well as the European Commission IST Project PALAS (Power-Line as an Alternative Local AccesS).

Information about the 2001 proceedings can be obtained from Stefan Host, Lund University, (stefan.host@it.lth.se). Information about ISPLC2001 can be found at http://www.enersearch.se/isplc2001/.

NSF Award Recognizes Wireless Pioneer

MIT engineer to receive Waterman Award

From the NSF Web Page

Vahid Tarokh, a 34-year-old associate professor at the Massachusetts Institute of Technology (MIT) and a recognized leader in the research field of wireless communications, will receive the National Science Foundation's (NSF) highest honor for young scientists and engineers. The Alan T. Waterman Award, named after NSF's first director, will be presented at a National Science Board (NSB) dinner May 23.

Tarokh is the primary inventor of "space time coding," a new technique that significantly improves the speed and reliability of wireless data transmission. These innovations helped form international standards for the latest cell phones, personal digital assistants and other wireless devices. By some estimates, more than one billion handsets might be employing the space-time codes within five years.

One challenge that Tarokh faced was to design codes that could dramatically enhance performance, yet still work with existing wireless transmitters and receivers. His solution was to build on highly complex mathematical models to develop protocols that may be transmitted via multiple antennas and received by sites that may or may not use multiple antennas.

"Dr. Tarokh richly deserves the Waterman Award," said Ruzena Bajcsy, NSF assistant director for computer and information science and engineering. "As a

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GOLOMB 'S PUZZLE COLUMN™ AN INGENUITY TEST SOLUTIONS

1. To solve the simultaneous equations for x and y in terms of a and b,

$$x^2+xy+x=a$$
$$y^2+xy+y=b,$$

where a and b are positive real numbers, take the sum and the difference of the two equations:

$$(x^2+2xy+y^2)+(x+y)=a+b;\ (x^2-y^2)+(x-y)=a-b$$
$$(x+y)^2+(x+y)-(a+b)=0;\ (x-y)(x+y+1)=(a-b).$$

$$(x+y)=\frac{-1\pm\sqrt{1+4(a+b)}}{2};\ (x-y)=$$

$$\frac{a-b}{(x+y)+1}=\frac{2(a-b)}{1\pm\sqrt{1+4(a+b)}}=\left(\frac{a-b}{a+b}\right)\left(\frac{-1\pm\sqrt{1+4(a+b)}}{2}\right).$$

Then

$$2x=(x+y)+(x-y)=\left(\frac{a-b}{a+b}+1\right)\left(\frac{-1\pm\sqrt{1+4(a+b)}}{2}\right),$$

and

$$x=\left(\frac{a}{a+b}\right)\left(\frac{-1\pm\sqrt{1+4(a+b)}}{2}\right),$$

$$y=\left(\frac{b}{a+b}\right)\left(\frac{-1\pm\sqrt{1+4(a+b)}}{2}\right).$$

For example, if a=4, b =2, the two solutions are (x,y)= (–2, –1) and $(x,y)=\left(\frac{4}{3},\frac{2}{3}\right)$.

2. When $n(n+1)/2$ points are arranged to form an equilateral triangle with n points on a side,the number $f(n)$of three-point subsets (of any size, in any orientation) which form the vertices of an equilateral triangle *is* $\binom{n+2}{4}$ for all $n\geq 1$. The shortest proof I've seen so far (from Joe Buhler) is longer than I'd like. I'm still hoping that some reader will find a simple, clever proof.

3. Given an $m\times n$ "square array"of dots, a continuous path P is drawn from the upper left to the lower right corner, where P consists entirely of straight line segments, goes through all mn dots, changes direction only at dots, stays inside the $m\times n$ rectangle, and never intersects itself. The interior of the rectangle can then be two-colored from the way this region is partitioned by P, where adjacent regions separated by P have opposite colors. The problem was to show that within the rectangle, the two colors cover equal areas.

   This result is a direct corollary of *Pick's Theorem* [1], [2], which asserts: "Suppose a 'lattice polygon' P has all its vertices at points of a square lattice L . Then the area of (the interior of) P is $i+\frac{b}{2}-1$, where i is the number of lattice points in the interior of P, and b is the number of lattice points on the boundary of P". In our application, all mn points of the lattice are "on the boundary", so the areas of the two colors are equal.

4. On an $m\times n$ "square array" of dots, a continuous path P consisting entirely of straight line segments goes through all mn dots. In this problem the path P may go outside the $m\times n$ rectangle, turn at arbitrary locations, and intersect itself. You were asked for the smallest number of segments that P can contain, in terms of m and n. The answer is $\min(2m-1, 2n-1, m+n-2)$. For a detailed treatment, see [3].

5. "Given a cubic polynomial $g(x)$ with non-zero roots r_1, r_2, r_3 such that $\frac{g(\alpha)+g(-\alpha)}{g(0)}=K$, where α and K are real, $\alpha\neq 0$ and $K\neq 2$, find the value of $\frac{1}{r_1r_2}+\frac{1}{r_2r_3}+\frac{1}{r_3r_1}$ in terms of α and K."

   This value is $\frac{K-2}{2\alpha^2}$, as follows: Let $g(x)=ax^3+bx^2+cx+d$. Then $g(\alpha)+g(-\alpha)=2b\alpha^2+2d$, and $g(0)=d$, so $K=\frac{2b\alpha^2}{d}+2$. Now also, $g(x)=a(x-r_1)(x-r_2)(x-r_3)=ax^3-a(r_1+r_2+r_3)x^2+a(r_1r_2+r_2r_3+r_3r_1)x-ar_1r_2r_3=ax^3+bx^2+cx+d$. Next, $\frac{b}{d}=\frac{r_1+r_2+r_3}{r_1r_2r_3}=\frac{1}{r_1r_2}+\frac{1}{r_2r_3}+\frac{1}{r_3r_1}$, but $\frac{b}{d}=\frac{K-2}{2\alpha^2}$.

6. "If A, B, C are positive integers with $A+\frac{1}{B+\frac{1}{C+1}}=\frac{115}{36}$, find $A^2+B^2+C^2$."

   Clearly, A is the integer part of $\frac{115}{36}=3\frac{7}{36}$, so A=3. Subtracting 3 from both sides, $B+\frac{1}{C+1}=\frac{36}{7}=5\frac{1}{7}$, so B=5, and then C+1=7 so C=6. Therefore, $A^2+B^2+C^2=3^2+5^2+6^2=70$.

References

[1] H. Steinhaus, *Mathematical Snapshots*, Oxford Univ. Press, New York, 1969.

[2] B.Grünbaum and G.C. Shephard, "Pick 's Theorem", *American Math. Monthly*, vol. 100, no. 2, February, 1993, 150-161.

[3] S.W. Golomb and J.L. Selfridge, "Unicursal Polygonal Paths and Other Graphs on Point Lattices", *Pi Mu Epsilon Journal*, vol. 6, no. 3, Fall, 1970, 107-117.

Conference Calendar

DATE	CONFERENCE	LOCATION	CONTACT/INFORMATION	DUE DATE
June 3-6, 2001	**2001 Canadian Workshop on Information Theory**	British Columbia Vancouver	Dr. C. S. Leung Department of Electrical & Computer Engineering University of British Columbia 2356 Main Mall Vancouver, B.C., V6T 1Z4 Tel: +1-604-822-2866 Fax: +1-604-822-5949 Email: cleung@ece.ubc.edu Web: http://datacom.ece.ubc.ca/cwit	January 8, 2001
June 10-16, 2001	**3rd International Workshop on Optimal Codes and Related Topics**	Sunny Beach, Bulgaria	Dr. Ivan Landjev Institute of Mathematics and Informatics 8 Acad G. Bonchev Str. 1113 Sofia, BULGARIA Tel: +359-2-979-2821 Fax: +359-2-971-3649 Email: oc2001@moi.math.bas.bg Web: http://www.moi.math.bas.bg/oc2001/oc2001.html	January 31, 2001
June 24-29, 2001	**IEEE International Symposium on Information Theory — ISIT 2001**	Washington, D.C., USA	Prof. Prakash Narayan Department of Electrical and Computer Engineering University of Maryland College Park, MD 20742 USA Tel: (301) 405-3661 Fax: (301) 314-9281 Email: prakash@eng.umd.edu Web: http://www.seas.smu.edu/isit2001/	October 1, 2000
September 2-7, 2001	**2001 IEEE Information Theory Workshop**	Cairns, Australia	Dr Lei Wei School of Elec., Comp. & Telecommun. Eng University of Wollongong NSW 2522, Australia L.Wei@elec.uow.edu.au Phone: +61 2 4221 3407 Fax: +61 2 4221 3236	March 31, 2001
October 3-5, 2001	**Mini-Workshop on Convolutional Codes**	Essen, Germany	Han Vinck IEM Ellernstrasse 29 45326 Essen, Germany Fax: +49 201 183 7663 E-mail: vinck@exp-math.uni-essen.de	August 7, 2001
June 30- July 5, 2002	**2002 IEEE International Symposium on Information Theory**	Palais de Beaulieu, Lausanne, Switerland	Prof. Bixio Rimoldi Communication Systems Department Swiss Federal Institute of Technology CH-1015 Lausanne, Switzerland E-mail: isit02chair@epfl.ch Phone: +41 21 693 76 62 Fax: +41 21 693 43 12	
March 17-21, 2002	**2002 IEEE Wireless Communications and Networking Conference (WCNC 2002)**	Orlando, Florida, USA	Dick Lynch Verizon Wireless, USA www.wcnc.org/2002	August 15, 2001
April 28- May 2, 2002	**2002 IEEE International Conference on Communications (ICC 2002)**	New York, New York, USA	Mark Karol Avaya Inc., USA mk@avaya.com www.icc2002.com	August 15, 2001

NSF Award Recognizes Wireless Pioneer

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computer scientist and engineer myself, I would like to add that his colleagues are especially proud on his behalf, for the recognition this award brings to the importance of basic research in information theory and technology."

As a measure of Tarokh's influence, most academic conferences on wireless communications and information theory now have multiple sessions on space-time codes, reflecting that many researchers are now building on his ideas. "Given all these activities," he said, "I forecast a day when space-time codes will be used to push very high rates of wireless data to laptops and other handheld devices."

Tarokh joined MIT's department of electrical engineering and computer science in September 2000 after rising rapidly within AT&T Labs, where he was department head for wireless communications and signal processing. Tarokh's current research interests also include video indexing and multimedia signal processing.

According to Tarokh, he became interested in wireless at AT&T, where his supervisor — A. Rob Calderbank — "is in the level of classical mathematicians including the great Claude Shannon himself." Shannon was the legendary AT&T and MIT researcher whose 1948 paper, A Mathematical Theory of Communication, laid the foundation for modern information technology.

The Alan T. Waterman Award honors an outstanding young U.S. scientist or engineer who is at the forefront of his or her research field. The honoree receives a medal, as well as a $500,000 grant over three years for scientific research or advanced study in any field of science or engineering.

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