IEEE Information Theory Society Newsletter

President's Column

David L. Neuhoff

David L. Neuhoff

I would like to begin this column with a summary of the highlights of the September Board of Governors meeting at the Allerton Conference on Communication, Control and Computing in Monticello, Illinois, USA. As typically happens, recent and forthcoming conferences and workshops were reviewed. A proposal from Bill Ryan and Krishna Narayanan to hold an IT Workshop in Lake Tahoe, California, USA, Sept. 2-6, 2007 was approved. This joins the June ISIT in Nice, France, and the July IT Workshop in Bergen, Norway, as the principal IT sponsored meetings for 2007. One of the new features of ISIT 2007, approved by the Board, is a Best Student Paper Award. If successful, this is likely to become a regular feature of future ISIT's. Prior to the September BoG meeting, the Board approved technical cosponsorship of the June 2007 Canadian Workshop on Information Theory to be held in Edmonton, Alberta.

The Board discussed and approved a proposal from the Ad Hoc Committee on Conferences, constituted at the July BoG meeting and chaired by Bruce Hajek, to form a standing Conference Committee. This new committee will recommend sponsorship of various conferences and workshops, provide oversight thereof, maintain guidelines for such, monitor the conference pipeline, recommend policies for conferences, and provide advice and assistance to meeting organizers.

Prompted by a call from IEEE, the Board discussed a number of small Constitution and Bylaw changes, such as the definition of a quorum at BoG meetings and the makeup of the Nominations Committee. A couple of changes were approved at this meeting; further changes will be considered in 2007.

Andrea Goldsmith reported on the activities of the Student Committee which in the past year or so has held a number of well attended events at conferences and workshops. The Board is quite enthusiastic about these activities, and the Committee budget for the 2007 was increased to $10,000 US.

Finally, two areas of concern to information theorists were discussed. First, the apparently declining funding for information theory research in the US was discussed. It was decided to form an ad hoc committee to examine the situation. Second, Sandeep Pradhan described the difficulty of obtaining classic information theory books that are now out of print. The Board shares this concern and asked Sandeep to look for and propose possible solutions.

By the time you read this, you should have seen the IEEE membership renewal brochure for 2007, and I hope, renewed your IT membership. I also hope that you noticed the "IT Conference Digital Library" in the "What's New for 2007", as well as the IT section of the brochure. This indicates that online access to IT sponsored conference workshop proceedings will be available through IEEE *Xplore* as a basic component of membership in the IT Society. As I mentioned in the September Newsletter, we received permission to offer this for 2007 as a promotional trial. However, at this writing, I have just returned from an October IEEE meeting in Morristown, NJ, USA, in which permission was granted to extend this trial through 2009. The IT BoG views the inclusion of such online access as a way to increase the value of IT membership, as well as to stimulate the information theory field and to promote the *Information Theory Transactions* by making the early announcements of new results, which first appear in IT conference and workshop proceedings and are published later in the *Transactions*, widely available in a timely fashion to all IT members. While we view this as a very positive step, it must be said that for IEEE central administration, this is an experiment with potentially negative, as well as positive, outcomes.. Both IEEE and the IT Society receive considerable revenue from conference proceedings, principally through IEEE *Xplore* and sales to large organizations such as universities and corporations. For example the IT Society receives approximately $200K US annually. There is considerable concern that if many IEEE societies include online access to conference proceedings, this may decrease the appetites of large organizations for purchasing access to conference proceedings, and substantially reduce current rev-

IEEE

From the Editor

Daniela Tuninetti

Dear IT society members,

The fall semester is almost over, as well as this calendar year, which also means that I have been serving as Editor for this newsletter for nearly a year … time really flies! It has been an extremely interesting and enriching year. I would like to thank my predecessor Lance Perez, who still gives me precious advice on how to handle newsletter-related matters, and our President Dave Neuhoff, who has always been available.

For this first year, I am proud of having two new columns on a regular basis: the guest column for NSF program manager Sirin Tekinai and the report on the initiatives of the IT Society Student Committee.

For next year, I would like to have at least one technical article in each issue. In this respect, I will keep on soliciting reflections from the winners of the IT Paper award and of the Joint ComSoc/IT Paper award. However, everybody is invited to contact me to discuss whether his/her idea is suitable for the newsletter. I would especially encouraged plenary speakers at conferences of general interest for the IT community, to submit a summary of their lecture. I believe our society member will greatly appreciate this.

Nick Laneman, the online editor, and myself are also trying to set up an online version of the newsletter. We envision each article to be individually accessible from the table of content. Nick has done a wonderful job of atomizing the submission of reports for the BoG meetings. I would like to leverage this automated tool to encourage authors to submit their articles to the newsletter. For example, chairmen of IT Society-sponsored conferences could submit both their report to the BoG and a summary for publication in the Newsletter through the web site. We are open to suggestions, so please write to us with your ideas.

Back to this last issue of 2006: I hope you will enjoy the column of our President David L. Neuhoff, as well as Anthony Ephremides' Historian's column, and Sol Golomb's puzzle. You will also find the announcement of the winners of the IT Society Awards, by our first vice president Bixio Rimoldi, interesting reflections on Network Coding by the winners of the 2005 IT Paper Award Ning Cai, Robert Li, and Raymond Yeung. In addition, there are reports on the activities of the Hong Kong Chapter, on the recent workshop in honor of Robert Gallager's 75th birthday, on the workshop in honor of Rolf Johannesson's 60th birthday, and on the many initiatives on the IT Society Student Chapter. Don't miss the report on the first ITA workshop in San Diego, and the interesting "Call for Problems" for the second ITA workshop to be held in January 2007 in San Diego. Last but not the least, enjoy the minutes from the BoG meeting in Seattle by Mehul Motani. I would also like to thank Mehul for his service to the society, and extend a warm welcome to the new society secretary Joao Barros. Finally, you will find interesting insider news from program manager Sirin Tekinay at the National Science Foundation, the calls for nominations for the 2007 society awards, and the list of the this year new book by Raymond Yeung.

Finally, in the September 2006 article "Bin Yu Wins Guggenheim Fellowship" we mistakenly wrote "He was selected from ..." when we should have written "She was selected from

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enue streams. As a result, the IEEE approval is for the limited period of three years, and comes with the stipulation that in early 2009, we report on the impact of including online access on our membership, field and transactions.

This column marks the end of my year as President of the Information Theory Society. I am grateful for the opportunity to have served as president and hope that I have executed its duties well. The Society appears to be in good health. Interest in our transactions, conferences and workshops is increasing. Valuable contributions continue to be made in new and old topics. Our financial health is sound with our annual budget only slightly larger than our reserves. Declining membership is the one concern, though the August figures, which are considered the most reliable, show less decline than reported in the previous Newsletter (6.5% rather than 8%). The future of the Society is now in the excellent hands of the new officers: Bixio Rimoldi, President; Marc Fossorier, First Vice President; and Andrea Goldsmith, Second Vice President. Finally, we should all extend our gratitude and best wishes to Hideki Imai who has just completed five years of service and leadership, from Second Vice President to Senior Past President.

Best wishes to all for the New Year.

From the Editor continued from page 2

...". We would like to apologize to Bin Yu for the typing mistake.

Please help to make the Newsletter as interesting and informative as possible by offering suggestions and contributing news. The deadlines for the next few issues of the Newsletter are as follows (please notice that the deadlines have been moved forward by about a week with respect to the past):

Issue	Deadline
March 2007	January 10, 2007
June 2007	April 10, 2007
September 2007	July 10, 2007

Electronic submission, especially in Ascii, LaTeX and Word formats, is encouraged. Please keep in mind that any electronic photographs should be high resolution.

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Best Wishes for the New Year,
Daniela Tuninetti

The Historian's Column

Anthony Ephremides

Funding for our research has been, and remains, a dominant concern in our professional lives. In fact, it is the major pre-occupation of most members of our Society who are in academia. It plays a key role in promotions, status, prestige, attracting students, traveling to conferences, and, indeed, it shapes our careers. It is interesting to see how the funding sources, methods, and patterns have evolved over the years, both in the United States and abroad.

When I started my career around 1971 the main source of research support was the National Science Foundation (NSF). Proposals were unsolicited and did not need to comply with specific themes and objectives. "Blue-sky" thinking and innovative ideas were encouraged across the board and each proposal was handled the same way we handle journal articles today. It was sent out to individual reviewers and the Program Directors at NSF acted like journal Editors (except there was no opportunity for rebuttals or revision). One of the "mainstays" in our field was Elias Shutzman who held the post charged with funding Communications and Information Theory research as a career Program Director. He was present at all our symposia and workshops and was simultaneously revered and feared. He would sit in individual sessions and listen to papers and one was never sure whether he was choosing to hear a presentation to assess progress or to learn about new results. One time, I recall, I was walking in the streets of Washington, DC, and I felt a tap on my shoulder. It was Elias Shulzman who wanted to know how my research was progressing on a grant that I had from him that was coming up for renewal. I was headed for a restaurant that evening and I remember that the encounter resulted in indigestion and a miserable evening.

There was, to be sure, some Industry research money in those days and some support from the Department of Defense. But in relative terms those were rather minor compared to the size and scope of NSF support.

As the numbers of researchers grew and as the technology of our field progressed, the handling of the proposals in the traditional way was unsustainable. Thus, the system of rotating directors (on leave from academia for a few years) and the formation of panels started being the dominant mode. But still there were no explicit programs, solicitations, and deadlines. However, change was in the air and everyone had this strange feeling that research money was getting increasingly

difficult to get. The real moment of change came when Erich Bloch came to the helm of NSF in the early eighties. He started the revolutionary concept of major group efforts, research Centers, and the like. He also spearheaded the concept of program objectives and research agendas. In response to increasing congressional pressure under the Reagan administration to show the "bang for the buck", he emphasized the need to set priorities and scrutinize the impact of the research that NSF was funding.

At the same time deregulation of the Phone Industry was taking place (which meant increased competition and diminished research support from Industry) and the role of the Department of Defense was looming bigger as ARPA (DARPA's predecessor) was funding major projects like the ARPANET and Radio Networks.

It is interesting that the reaction of the community to the changed research funding methodology was mixed. Some applauded the change and others lamented it. As expected, these who were funded under the new system thought it was a great idea while those who weren't thought it was a lousy one. Still, to this day, controversy continues regarding the small, single-investigator projects versus the mega projects that are shaped by research initiatives.

It is also interesting that whatever one thinks of the changed system, it was emulated widely around the world. First, the European Union and then Japan started creating similar large-scale initiatives, forming major research centers, and suppressing the unguided research by individuals.

By now the process has evolved further in the direction of, more-or-less, managed research. Support from Industry has all but dried up almost entirely. The NSF is sliding more and more into structured initiatives. And the DoD is actually funding more basic research than NSF in our field. The comparison to other systems of funding around the world leads to mixed conclusions. Some programs in the European Union are so bureaucratically managed that they have deteriorated essentially to simple, almost equitable, division of resources among all eligible players. Brussels is sensitive to this criticism and it is trying to change it somewhat. For the first time this year there will be individual researcher grants in European programs in our field.

Our Society has always felt the need to promote our ideals of fundamental research within NSF. Several of our members have served tours of duty at the Agency trying to safeguard the principles of basic research. Lew Franks, Aubrey Bush, Tom Fuja, Venu Veeravalli, Sirin Tekinay, David Goodman, and others have been recent and not so recent examples. Gene Wong has served at a much higher level. The pressure, however, for more guided research remains strong. Albert Einstein is credited with many profound pronouncements. Among them is the one that says that "the more research is managed, the more science suffers".

It is not clear what the future holds. It is not clear what is the best way to use public funds to support the efforts of the best minds in the world. It is an ongoing experiment that unfolds as the system struggles to cope with the challenges and the sheer increasing numbers of applicants, programs, needs, and ideas. Sometimes one wishes that there could be research money gurus who, like King Ludwig of Bavaria, would smartly choose the Richard Wagners of our Field and shower them with resources. The trouble is there are no more such kings and there may not be any more Wagners. I would like to be the first to challenge the second part of this assertion. But the question of finding the best means of research support remains unanswered and vitally important.

IT Society Announces 2006 Paper Award Winners

B. Rimoldi

2006 Joint IT/ComSoc Paper Award

At ISIT 2006 in Seattle it was announced that the 2006 Joint IT/ComSoc Paper Award goes to

T. Weissman, E. Ordentlich, G. Seroussi, S. Verdu and M. Weinberger, "Universal Discrete Denoising: Known Channel," IEEE Trans. Inform. Theory, vol. 51, no. 1, pp. 5-28, Jan. 2005.

This award recognizes an outstanding contribution to communications and information theory in 2005. A summary of the nomination statement follows.

The paper has opened the new area of discrete universal denoising. Previously, the work on discrete denoising had been either ad-hoc or of purely theoretical interest. This paper makes a fundamental contribution by introducing a new algorithm, called DUDE, that has the following properties: (i) it is universal yet optimal in the sense that it suffers no performance penalty relative to the best Bayesian denoiser which knows the statistics of the clean data; (ii) it allows stationary ergodic sources; (iii) it has linear complexity in the size of the data. These properties remind the Lempel-Ziv algorithm for source compression which also has similar hallmarks. The proof of optimality of DUDE is quite novel. It deals both with stochastic and with individual sequence settings and it pinpoints the best rate of context growth with the data that leads to both optimality and linear complexity. This is a paper with deep roots in the statistical literature. It is likely that it will prove to be quite influential not only in engineering and computer science but also in statistics.

Recipients of the Joint IT/ComSoc Paper Award.

2006 Information Theory Society Paper Award

At ISIT 2006 in Seattle it was announced that the 2006 Information Theory Society Paper Award goes to

A. Orlitsky, N. P. Santhanam, J. Zhang, "Universal Compression of Memoryless Sources Over Unknown Alphabets" IEEE Transactions on Information Theory, vol. 50, No. 7, pp 1469-1481, July 2004.

This award recognizes an exceptional publication in information theory, appearing in the period January 1, 2004 through December 31, 2005. The following description of the paper derives from a nomination statement.

This paper develops a theory and an algorithm for the compression of patterns seen as a steppingstone to compress i.i.d. sources when the alphabet size is large (even unknown) compared to the length of the sequence. To appreciate the practical importance of the problem is suffices to point out that for a mega-pixel image the alphabet size is 16 million and the sequence length is 1 million. The paper establishes several connections between patterns and celebrated results, namely the Bell number, the Stirling number, and results from Hardy and Ramanujan on the number of integer partitions. The authors go much further by developing efficient algorithms (both block and sequential) for universal pattern compression, including an algorithm that compresses i.i.d. patterns in linear time with diminishing redundancy. These algorithms are intimately connected to classical probability estimation for unknown alphabets (such as those derived by Good and Turing during World War II). In a separate paper (which appeared in Science, Oct. 2003, p427-431), the authors use the insight from this paper to construct efficient probability estimation algorithms that can prov-

Recipients of the Information Theory Society Paper Award.

ably outperform Good-Turing estimators. Therefore the paper has an impact not only on questions of data compression but also questions related to probability estimation. The paper is refreshingly original, solves an important engineering problem, and is beautifully written.

The award will be presented at ISIT 2007 in Nice, France.

Reflection on Linear Network Coding

Shuo-Yen Robert Li, The Chinese University of Hong Kong
Raymond W. Yeung, The Chinese University of Hong Kong
Ning Cai, Xidian University

Ning Cai, Robert Li, and Raymond Yeung.

Network coding enhances the data transmission rate in many ways. During the last few years, network coding has grown into an active research field with wide applications. So, exactly what is network coding? Does it always mean linear network

coding? How and when were the key concepts formed? We shed some lights on these questions through individual reflection on the early work leading to the paper "Linear Network Coding."[1]

During the last few years, network coding has grown into an active area of research and applications. It is a technique to enhance the data transmission rate in the multicasting from a source to multiple destinations and also in multiple concurrent transmissions. The idea of network coding is readily illustrated by the example over the butterfly network in Figure 1, where each arrow represents a channel for transmitting one bit of data. The source node S intends to deliver to both receivers T_1 and T_2 a message represented by the two bits a and b. Upon receiving the two bits, node W sends their binary sum downstream and eventually both receivers T_1 and T_2 get the message through simple decoding. The performance of any kind of addition before transmission is a form of coding, which differs fundamentally from the store-and-forward mechanism used in Internet. According to store-and-forward, node W would forward either the bit *a* or *b* downstream and the mission would fail.
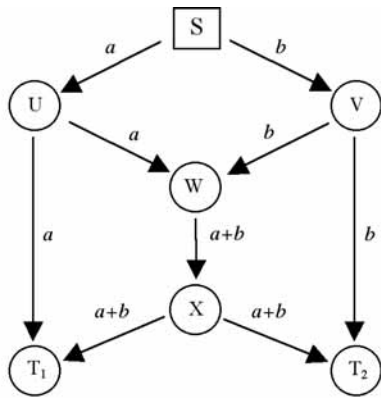
Figure 1. An example of linear network coding over the *butterfly* network.

The butterfly network example has been instrumental in popularizing network coding into an interdisciplinary area among coding theory, information theory, linear algebra, operations research, peer-to-peer content delivery, and wireless communications. The perception of exactly what is network coding depends on how each individual generalizes the concept conveyed by the butterfly network example. In particular, most people automatically assume linear coding mechanism in network coding because it is so in the butterfly network example as well as in all applications of network coding so far.

It is a straightforward concept to enhance transmission rate through coding when there are multiple paths or channels between a source and a receiver. Figure 2 illustrates an example for the source to send two symbols to three receivers. Every symbol transmitted by the source is mathematically derived from raw data symbols. Let this technique be called *multi-path source coding*. For decades it has appeared sporadically in the literature aiming at specific applications. Examples include multi-channel access protocols,[2-4] redundant array of independent disks,[5] and satellite networks.[6]
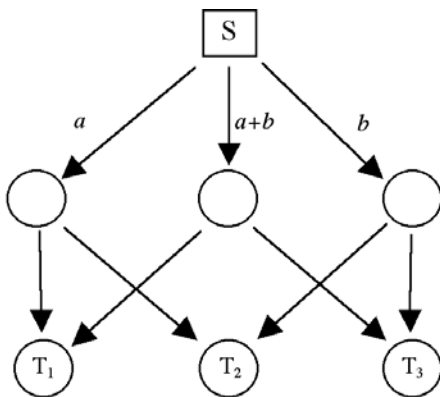

Figure 2. An example of *multi-path source coding*.

In contrast to multi-path source coding, network coding started out as a generic concept with abstract formulation and allows the performance of coding at intermediate nodes as well as the source. Initially there were different and incompatible formulations of network coding from different approaches. Below the

three of us offer individual reflection on the early stage of development, including the endeavor leading to the paper Linear Network Coding.[1]

1. Reflection by Bob Li

Since 1979 I had been wishing to establish switching theory as a new branch of applied algebra. By 1997 I had accrued some original findings and started to organize them into a book.[7] The book project demanded intensive effort. One day in late September, Raymond Yeung came and showed me the 3-receiver example in Figure 2, which sufficed to demonstrate that coding could do better than store-and-forward. His inspiration had come from satellite networks.[6] In retrospect, multi-path source coding was quite related to my previous work on multi-channel protocols.[2-4] Although I was unable to make the connection to my own work, the resonance to the 3-receiver example was vibrant at the back of my mind. From time to time I could not help exploring its theoretic underpinning despite my need to concentrate in the book project.

Soon afterwards Raymond brought a draft manuscript generalizing that example from an information theoretic approach. I read part of it and spotted an obviously wrong result. Subsequently I constructed a counterexample (Figure 1), which was later known as the butterfly network. It became immediately apparent to us that the butterfly network example would make an ideal introduction to whatever theory that might turn out. To me, this example must also represent some general principle of the linear algebraic nature. This thought kept haunting me and finally immobilize my book project. To get over with it as quickly as possible, I pursued the problem day and night and finally came up with a mathematical draft in November. After handing it over to Raymond, I tried to forget it immediately and resume my concentration in algebraic switching theory.

There was a problem though. The information theoretic approach of Raymond and my linear algebraic approach did not blend well. For instance, it could look odd to an information theorist if the definition a *code* of some sort started with the association of a vector space with each node in a network. Lacking the time and energy to reconcile the incompatibility, the basic concepts from the two approaches were separately published in the proceedings of conferences in mathematics, information theory, and operations research[8-10] in 1998. The information theoretic approach eventually led to the first journal paper on network coding,[11] while the linear algebraic approach led to the paper "Linear Network Coding." The latter incurred extra delay because of bouncing around journals in "wrong" fields initially. In retrospect, this fact reflected the lack of identity of an emerging interdisciplinary field. Eventually, Raymond successfully completed the paper submission while writing a book of his own.[12]

"Linear Network Coding" left some quantification issues open, including the required size of the base field and the computational complexity in construction. Meanwhile, a notable incompleteness of the paper was that it vaguely started the concept of convolutional network coding but did not elaborate enough further.

I must say that, during 1997-2003, I have done little to promote network coding as a new field of study. Work by other authors,

for example, Ralf Koetter and Muriel Medard,[13] has helped popularizing this new field. In early 2004, I resumed active research on network coding. The aforementioned incompatibility between two different approaches was finally resolved a year later.[14,15]

When I ran into Elwyn Berlekamp at the 2005 International Symposium on Information Theory, I was able to tell him that, after three decades, this former PhD student finally published on something related to algebraic coding theory.

While writing a newsletter for SPIE in mid 2006,[16] I had to search for the old literature pertaining to multi-path source coding. I ended up finding three papers,[4-6] including one of my own. Even then, my memory still left out two of my older and relevant papers.[2,3] It would not surprise me if other people have also deployed similar techniques to multi-path source coding. Whether they can readily recall the work is a different matter.

2. Reflection by Raymond Yeung

In summer 1997, I visited Rudi Ahlswede at Bielefeld right before ISIT 1997 at Ulm. There I first met Ning Cai and we started working on the problem of single-source network coding on a general network, which was a continuation of the problem of multi-source network coding in a satellite network that Zhen Zhang (USC) and I had previously studied. A few weeks after I came back to Hong Kong, Ning and I already had worked out the proof of the so-called max-flow min-cut theorem for network coding. In the manuscript that I was responsible for writing up, we had a lemma saying that if there are only two sink nodes, store-and-forward is just sufficient.

Since Bob is an expert on switching theory, and network coding generalizes the paradigm of switching, I presented our work to Bob and gave him a preprint of our manuscript. A few weeks later, I ran into Bob again in the corridor. Bob said, "Raymond, I have not got the chance to read the proofs in your paper yet, but excuse me if I am blunt. I think one of the lemmas in the paper is wrong." You probably could guess which lemma Bob was referring to. We went to his office and he went on to tell me that if the partial orders of two maximum flows cannot reconcile, our lemma could not be correct. He then thought in front of the white board for a little while, and to my amaze, he showed me what is now widely known as the butterfly network!

That was the beginning of Bob's contribution to network coding. During the next few discussions, Bob kept telling me that linear coding should work trivially, but I kept telling him that it was not as simple as he thought. Then we stopped our discussion after a while.

Something actually was happening during this time. Out of his fascination about network coding, Bob put away his project on switching theory and worked on the linear network coding problem for two whole months. Finally, he came up with a set of notes consisting of ten pages. At the beginning, he wrote, "This problem actually is not as trivial as I thought during the first one hundred rounds." Nevertheless, in his notes, he had come up with the vector space approach to linear network coding which is now known as the global description of a network code. An explicit construction of a linear network code that achieves the max-flow bound was also provided.

The road to publication of this work was not smooth. In order to draw the attention of the network flow community, we submitted the paper to a journal in operations research. To our disappointment, the paper was rejected after one year, with the report of only one reviewer saying that the work does not fit their journal. The paper was eventually submitted to the IT Transactions. Venkat Anantharam, being the Associate Editor, read the paper very carefully and identified a gap in our proof of the main result. During that time, Ning Cai was visiting me from Bielefeld, and we brought it up to Bob. Unfortunately, after working on network coding intensively for two months, Bob again dived into his switching theory and totally forgot about his own proof for linear network coding. So the chore of fixing the proof was left to Ning and me.

Another part of the story went all the way back to the 1998 Information Theory Workshop held in Metsovo, Greece, where I presented our linear network coding result. After the talk, Ralf Koetter and Alex Vardy talked to me and they were very interested in the problem. As many of you may know, Ralf Koetter and Muriel Medard (both at UIUC then) subsequently worked out a matrix approach to linear network coding which is now known as the local description of a network code. Though an explicit code construction is not provided, this approach has the unique advantage that the proofs are considerably more transparent than ours, and it contains other very interesting results such as the static network code. In fact, this important paper has served as the vehicle for popularizing the subject, in particular beyond the information theory community.

3. Reflection by Ning Cai

I was visiting Raymond at CUHK in 2000-01. During that time, I contributed to fixing the proof that a *generic linear network code* achieves the max-flow upper bound. This was a continuation of my previous work with Raymond and Bob on network coding.

Network coding has brought about a paradigm shift in network communication. Its mathematical elegance and depth as well as its tremendous application potential have attracted a large number of excellent researchers in both theory and practice. In the past, we applied what we knew about point-to-point communications to networks. By doing this, we fragmented the network into a collection of individual communication channels. An important area of applications of network coding is wireless communications because of the multicast nature. Meanwhile, randomization of linear network coding[17,18] facilitates the use in peer-to-peer content delivery. Looking forward, network coding will eventually evolve into a modern theory for network communications, both in terms of data transmission (including error correction) and information security.[19,20]

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Bob Gallager's 75th Birthday Workshop

Shan-Yuan Ho

On the special occasion of Bob Gallager's birthday, a workshop was held at the American Academy of Arts and Sciences on July 17th, 2006. There were 63 participants at the day long workshop. Anyone who has worked with Bob recognizes the deep insight and understanding he brings to fundamental science, as well as the profound impact and benefit on the current technology. The talks focused on Bob's contributions and how they influenced and notably changed the landscape of information theory, coding theory, data networks, and communication systems.

The morning talks focused on the earlier works of Gallager. These included:

Tom Richardson : "LDPC Codes Come of Age"

It took more than 30 years for the world to catch up to the ideas inherent in Bob Gallager's Ph.D. Thesis. This talk reviewed the legacy of his work and the current state of affairs in theory and in practice.

Elwyn Berlekamp (Bob's 2nd PhD student): **"History of Block Coding with Noiseless Feedback for the Binary Symmetric Channel"**

This talk focused on some results in Elwyn's thesis, which relate to Stan Ulam's celebrated problem of 20-bit messages, where one wishes to determine "n" yes-no questions against an adversarial opponent constrained to lie at at most "e" times.

Abbas El Gamal: "On Gallager's Converse for the Degraded Broadcast Channel"

Gallager's insightful identification of the auxiliary random variable in the proof of the converse for the capacity of the degraded broadcast channel has had an enormous impact on the development of multiple user information theory. This talk gave a brief history of this development, discussed related results, and a recent outer bound to the capacity of the discrete-memoryless broadcast channel.

Bob and Marie with Bob's Ph.D. students.

Bob Gallager holding his 75th birthday gift from his Ph.D. students.

Marcelo Weinberger: "Variations on Some Themes by Gallager"

This talk focused on some of Bob Gallager's contributions to lossless source coding during the seventies, and the impact of these contributions in the following decades. Discussed in particular are his work on Huffman codes and optimal prefix codes for geometric distributions and its relation to the JPEG-LS standard for lossless image compression, and his characterization of the min-max redundancy of universal codes in terms of channel capacity.

The afternoon talks included:

Dimitri Bertsekas : "A Journey Through Data Networks"

This talk, loaded with entertaining anecdotes and stories, charted some of the highlights of Data Networks research at MIT and elsewhere, as personally experienced by Dimitri, between 1977 (when he first got into the field and started working with Bob) and 1992 (when they finished the 2nd edition of their Data Networks book).

Bruce Hajek: "What was Gallager thinking when he spent all that time on networking?"

An overview of Gallager's contributions to diverse areas in the theory of data networks, this talk traced the impact on the past and possible impact on the future. Topics included distributed algorithms for spanning trees and dynamic routing, broadcast, random multiple access, protocol overheads, deterministic constraints, and fairness. A theme discerned in Gallager's work is key results for simple models.

Abhay Parekh (Bob's 26th PhD student)**: "Why is the Internet still a "Best Effort" network?"**

This talk discussed why the internet, which carries increasing amounts of video and voice, still remains largely a "best effort" network. Abhay provided an explanation, which draws heavily from the insights developed at MIT under the strong intellectual leadership of Bob Gallager.

Jim Massey: "The Essential Gallager"

Jim gave a very interesting and captivating talk on Bob's techniques of doing research and explored the state of his mind as possible answers to the following question. Why is that no matter what Bob Gallager touches he comes out smelling like a rose?

A banquet was held in the evening at the Academy. The banquet speaker, **Sanjoy Mitter**, gave a philosophical treatise about understanding – a word that characterizes Bob Gallager. Sanjoy gave an entertaining talk about the process of understanding, reduction to essentials, and the universality of understanding. The evening ended with a special presentation by **Shan-Yuan Ho**, who gave a tribute and presented Bob with a gift from his 44 PhD students (his first in 1962 to his last in 2005) in his 44 years of advising.

This birthday workshop was to commemorate and honor a truly special person, his illustrious career as a fundamental researcher, celebrated mentor, and a rare individual. The event was delightfully enjoyed by all the participants.

On the celebration of the 75th birthday of

ROBERT GALLAGER

Bob, our deepest gratitude to you for your generously shared wisdom, kindness, humility, and integrity. Your insightful creativity, passion for research, and profound thinking inspire us all.

Operation Polar Bear: Workshop Held on the Occasion of Rolf Johannesson's 60th Birthday, July 2-4, 2006, Lund, Sweden

Maja Lončar and Jossy Sayir

On the unusually warm evening of Sunday, July 2, 2006, about 30 colleagues, friends and family gathered in the reception hall of the cosy hotel Concordia in Lund, Sweden, to greet and surprise Rolf Johannesson on the occasion of his 60th birthday. Rolf Johannesson, professor in the Information Technology Department of Lund University in Sweden, co-author of the book "Fundamentals of Convolutional Coding", has devoted most of his career to research in convolutional codes, and has contributed many new concepts and fundamental results in this field.

Rolf walked into the hotel unawares, accompanied by his close family, who brought him under false pretences, with the promise of a quiet family dinner. Instead, he suddenly found himself in front of a crowd shouting "Surprise"! The cocktail party quickly developed into a relaxed and warm reunion of old friends and close colleagues. In the course of the evening, Rolf learned about the workshop that would take place during the following two days, devoted to topics of coding and information theory. The event was organized under the code name *Operation Polar Bear* by three conspirators: his PhD student Maja Lončar, Jossy Sayir, and Jim Massey.

On Monday, July 3, the actual birthday, the workshop started with an entertaining talk by Jim Massey, who presented the "Seven Kinds of Greatness" that characterize Rolf. There followed excellent presentations by Han Vinck, Göran Einarsson, Tom Høholdt, and Thomas Johansson in sessions chaired by Lars Zetterberg and Dan Costello. Each talk was not only a technical presentation, but also a personal reflection on Rolf's life, work, and on the memories each of the speakers shares of Rolf. The afternoon session was opened by another highlight of the workshop – Dan Costello and Kamil Zigangirov's talk "To Be Block or to Be Convolutional –

That is the Question". The talk featured interesting historical facts and comparisons of convolutional, block and LDPC codes, told by the speakers through the prism of Rolf's life, supported by many funny photos of Rolf, provided by his wife Regina. Unsurprisingly given the speakers, the question was eventually answered in favour of convolutional codes. The talks that followed, given by Martin Bossert, Andy Loeliger and Ralf Koetter, and chaired by Boris Kudryashov and Ingemar Ingemarsson, continued in a similar manner – each of them connected to Rolf in an original way, giving the workshop a special touch.

The banquet dinner was held on the evening of July 3, with Ben Smeets acting as the toastmaster. The delicious dinner was often interrupted by toasts to Rolf, starting with Lars Zetterberg, Rolf's doctoral "grandfather". Rolf, visibly touched by the whole event, engaged in funny recollections too, most notably from the period of 1973-74, which he spent with Jim Massey at the University of Notre Dame, when he not only broadened his knowledge on sequential decoding, but also developed a taste for fine whiskies.

Tuesday, July 4, featured a half day workshop with talks by Irina Bocharova, Tomas Ericson and Ben Smeets. As finale, the participants were shown a film directed by Boris Kudryashov and Irina Bocharova, consisting of 12 short birthday messages by Rolf's colleagues and former PhD students. An excellent guitar performance by Vladimir Sidorenko and a comic sketch by Kamil Zigangirov were just a few of the highlights. The friends parted their ways after a farewell lunch, carrying away pleasant impressions of three sunny days in Lund.

The film, the photos and the proceedings are available upon request from Maja Lončar, maja@it.lth.se.
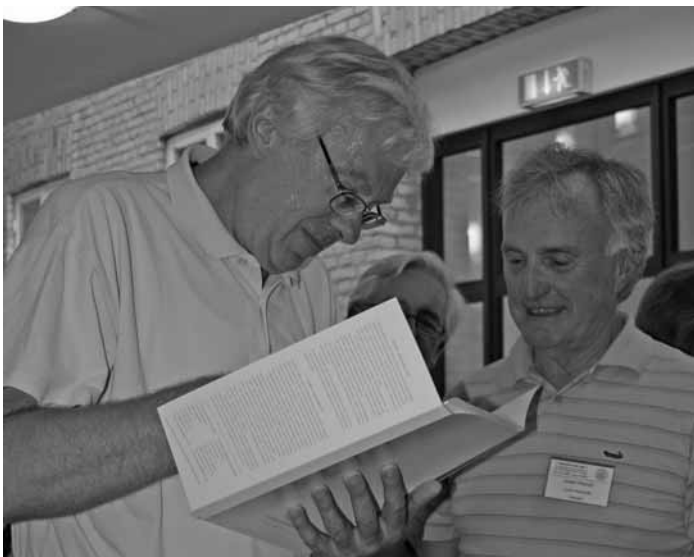
Rolf and Jim examining the workshop program.

Arf Uncle Rolf !

I sure wish I could be with you today to wish you a happy 60th birthday. I asked Dad to bring you a strong proof that I personally selected for you as a small token of my affection and admiration. (Mom wanted me to give you some three-year-old stuff, but I prevailed.)

Arf, Arf,

Oliver

p.s. I'm really sorry that I pee'd in your shoe and I promise not to do it again.

Oliver's letter to Rolf.

Hong Kong Chapter at a Glance

The Hong Kong Information Theory Chapter is a relatively young chapter. It was incarnated in 2000. At that time, Vijay Bhargava was on leave from University of Victoria and was a visiting professor at the Hong Kong University of Science and Technology (HKUST). With the encouragement of Vijay, a group of people started to work on the formation of a new chapter. Enough signatures were eventually collected. An information theory colloquium was then held on Oct. 28 to signal the birth of the chapter. Raymond Yeung, one of the co-authors of the 2005 IEEE Information Theory Society Best Paper entitled "Linear Network Coding", was the first chair.

The Hong Kong chapter is still a small chapter. Currently, the chapter has about 30 members spreading mainly over the 7 terrestrial institutions. There are also quite a few student members mainly from the Chinese University of Hong Kong, HKUST, and the City University of Hong Kong. The chapter's first attempt to organize an information theory workshop occurred in 2003. About 250 paper submissions were received. The workshop was subsequently canceled due to the SARS scare. Over the years, the chapter has invited prominent figures in the information theory field to Hong Kong for short visits, short courses and seminar talks. Recently, the chapter has also witnessed some new faces – Daniel Palomer and Sidharth Jaggi are now members of our little happy family.

The chapter has close ties with neighboring chapters. An annual joint workshop with the Taiwan Chapter, alternatively held in Hong Kong and Taiwan, has provided opportunities to exchange ideas across the strait. Chapter members also actively participate in the organization of information theory and communications conferences in mainland China, for example, the IT Workshop held in Chengdu in October 2006.

The chapter tries to wet the appetite of young people on information theory. Since 2003, the chapter has organized an annual "post-graduate day" (PG-day). The PG-day is a one-day event where graduate students report their research activities and results. More often than not, the results are just preliminary. The event, however, brings young and not-so-young people together to share views and ideas.

The chapter is honored to receive the 2006 Best Chapter Award and will continue to strive for excellence.

GOLOMB'S PUZZLE COLUMN™

The 3X + 1 Problem

Solomon W. Golomb

The notorious "3X + 1 problem" is usually described as a mapping T from Z^+ (the positive integers) into Z^+, where $T(n) = 3n + 1$ if n is odd while $T(n) = n/2$ if n is even. The most important conjecture is that no matter what positive integer m you start with, if you perform the mapping T repeatedly you will ultimately arrive at the number 1. (The logical alternatives are that you may end up in a "limit cycle" of some period $c > 1$, or that from some starting integer m, all elements of the sequence $\{m, T(m), T^2(m), T^3(m), \ldots\}$ are distinct and therefore tend toward infinity. Extensive computation has failed to discover either the limit cycle $c > 1$ case or the "tending toward infinity" case, but these have not been theoretically ruled out.)

I would like to propose a trivial modification to speed up the process. Let M be the mapping from U^+ (the positive odd integers) into U^+ given by $M(n) =$ the largest odd divisor of $3n + 1$, for each n in U^+. (Thus, $M(n) = (3n + 1)/2^k$, where the denominator is the highest power of 2 that divides $3n + 1$.)

For example, if we start with $n = 9$, the sequence $\{n, M(n), M^2(n), \ldots\}$ becomes $\{9, 7, 11, 17, 13, 5, 1\}$.

All questions in this column can be answered fairly easily, and most of them involve the inverse mapping $M^{-1}(n)$ concerning the *predecessors* of n with respect to the mapping M.
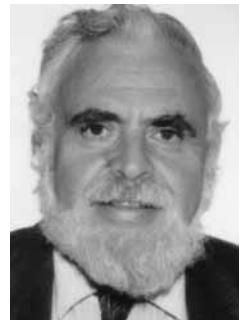
1. Starting with $n = 27$, calculate the sequence $\{n, M(n), M^2(n), M^3(n), \ldots\}$ until you end up at "1".

2. Determine the set Q of positive odd integers with no predecessors with respect to M. (That is, for n in Q there is no m with $M(m) = n$.)

3. For what positive odd integers t is $M(t) = 1$?

4. Show that any positive odd integer n *not* in the set Q has infinitely many distinct predecessors with respect to M.

5. Are there any positive odd integers that have "parents" (i.e. predecessors) but no "grandparents" with respect to M?

6. Prove that there are no non-trivial two-cycles, i.e. values of $n > 1$ with $M(M(n)) = n$.

The Information Theory and Applications Center and Workshop

Andrew Viterbi, Irwin Jacobs, Alon Orlitsky, Ramesh Rao, and Larry Smarr at the 2006 ITA inaugural workshop.

This past February, UC San Diego founded the Information Theory and Applications (ITA) Center, a "research and resource" center intended to conduct and promote the study of information theory and its applications to communications, computer- and life-sciences, finance, statistics, and related disciplines.

ITA was inaugurated during a week-long workshop attended by over 400 researchers from 84 universities and 25 companies. The workshop comprised 200 talks, a lively panel discussion on the past and future of information theory, a keynote talk and several tutorials on bioinformatics, and an open-problems session.

In the eight months since its inception, ITA has sponsored a variety of activities and initiatives. These included active seminar and colloquium series, focused workshops, short courses, and an open-problems venue. The center also has several postdoc positions available starting in 2007.

One activity that may benefit many of us is the short courses. These typically span nine to twelve hours and their videos and notes are posted on ITA's website. In past courses, David Tse covered Fundamentals of Wireless Communication, Ralf Koetter and Muriel Medard talked about Network Coding, Ezio Biglieri presented Coding for Wireless Channels, and Ruediger Urbanke out-

lined Modern Coding Theory. Future courses will include Space-Time Codes by Hamid Jafarkhani, and A Systems Approach to Bioinformatics by Edward Doughherty.

Plans are also being finalized for the Second ITA Workshop to be held Monday-Friday 1/29-2/2 2007. As with ITA 2006, Monday and Tuesday will involve information theory and communications while Thursday and Friday will concern applications to networking, signal processing, machine learning, statistics, bioinformatics, and control. This time, the applications focus will be on machine learning, with keynote presentation, four tutorials, and many talks on the topic.

Several special sessions and events are planned:
Sunday: Reception
Monday: Open problems (suggestions solicited)
Tuesday: Panel discussion on publications issues
Wednesday: Overviews by graduating students and postdocs
            Keynote on Machine Learning by Michael Jordan
            Tour and picnic at Torry Pines State Park
            Banquet and ... surprise
Thursday, Friday: Four machine-learning tutorials

More information about ITA can be found at http://ita.ucsd.edu.

ITA poster showing Claude Shannon.

Call For Problems

Do you have a favorite open problem? A problem that you believe is key to further advance in your field or research? Or, perhaps, a conjecture that, if proved, would make your results so much stronger? Well, now you have a chance to tell the world about it.

The Information Theory and Applications Center at the University of California San Diego is planning to have a session on "Open Problems in Information Theory and Its Applications" as part of the Second ITA Workshop, to be held January 29 through February 2, 2007 on the UCSD campus (see the previous article). The organizers of the Workshop are hereby soliciting submissions of open problems to be presented at this session.

Each submission should adhere to the content and format guidelines described in what follows. The content of the submission must include the following components.

Description: Please describe the problem clearly and completely, using succinct mathematical notation. Do *not* assume any prior background --- the description should be accessible to a broad audience of researchers in information theory and its applications. Preference will be given to binary problems, whose solution consists of a single bit of information (is it true that ...?).

Motivation: Please tell us why the problem is important. Describe the history of the problem. In which *general* context does it arise? What would be the ramifications of a solution to this problem?

Prior work: Please provide a brief summary of all relevant prior work, citing the appropriate references. If you have insights/intu-iition/ideas as to how the problem could be solved, please be generous and describe these as well.

All submissions should consist of a brief cover letter and a PDF file, sent by e-mail to <open.problems@ita.ucsd.edu>. The PDF file should be formatted either as an article of at most 2-3 pages, or as a potential workshop presentation, not to exceed 10-15 slides.

All submissions received by December 15 will be considered. Notifications of acceptance will be sent by e-mail not later than January 8. Authors of accepted problems will be expected to present them at the Workshop, and to contribute an article (one to three pages) to be posted on the Workshop website. ITA may choose to assign monetary awards for the solution of some of the open problems that are accepted for presentation.

Sanjoy Dasgupta, Alon Orlitsky, Alexander Vardy
General Chairs, Second ITA Workshop

Massimo Franceschetti, Tara Javidi, Paul Siegel
Technical Chairs, Second ITA Workshop

Call for Nominations

2007 Information Theory Society Paper Award

The Information Theory Society Paper Award is 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 a certificate and an honorarium of US$1,000 for a paper with a single author, or US$2,000 equally split among multiple authors. The 2006 award will be given for a paper published in 2005 and 2006.

NOMINATION PROCEDURE: By March 1, 2007, please email the name of the paper you wish to nominate, along with a supporting statement explaining its contributions, to the IT Transactions Editor-in-Chief, Vincent Poor, at poor@princeton.edu, with a cc to Lynn Stetson at lstetson@princeton.edu.

2007 Joint ComSoc/IT Paper Award

The Joint Information Theory/Communications Society Paper Award recognizes one or two outstanding papers that address both communications and information theory. Any paper appearing in a ComSoc or IT Society publication during the year 2006 is eligible for the 2007 award. A Joint Award Committee will make the selection.

NOMINATION PROCEDURE: By February 1, 2007, please email the name of the paper you wish to nominate, along with a supporting statement explaining its contributions, to IT Society First Vice President, Marc Fossorier at marc@aravis.eng.hawaii.edu

2007 Information Theory Society Aaron D. Wyner Distinguished Service Award

The IT Society Aaron D. Wyner Award honors individuals who have shown outstanding leadership in, and provided long standing exceptional service to, the Information Theory community. This award was formerly known as the IT Society Distinguished Service Award.

Nominations for the Award can be submitted by anyone and are made by sending a letter of nomination to the President of the IT Society by April 15, 2007. The individual or individuals making the nomination have the primary responsibility for justifying why the nominee should receive this award.

NOMINATION PROCEDURE: Letters of nomination should: (i) identify the nominee's areas of leadership and exceptional service, detailing the activities for which the nominee is believed to deserve this award; (ii) include the nominee's current vita; and (iii) include two letters of endorsement. Current officers and members of the IT Society Board of Governors are ineligible.

Please send all nominations by April 15, 2007 to IT Society President, Bixio Rimoldi, at bixio.rimoldi@epfl.ch.

IEEE Awards

The IEEE Awards program pays tribute to technical professionals whose exceptional achievements and outstanding contributions have made a lasting impact on technology, society and the engineering profession.

Institute Awards presented by the IEEE Board of Directors fall into several categories (from http://www.ieee.org/web/aboutus/home/index.html, follow "Awards" and the the specific award for which you would like to more information):

Medal of Honor   (Deadline: July 1)
Medals   (Deadline: July 1)
Technical Field Awards   (Deadline: January 31)
Corporate Recognitions   (Deadline: July 1)
Service Awards   (Deadline: July 1)
Prize Papers   (Deadline: July 1)

Of particular interest in the IEEE Technical Field Awards are:
IEEE Leon K. Kirchmayer Graduate Teaching Award
http://www.ieee.org/awards/sums/gradtch.xml, and
IEEE Undergraduate Teaching Award
http://www.ieee.org/awards/sums/ungrad.xml

The Awards program honors achievements in education, industry, research and service. Each award has a unique mission and criteria, and offers the opportunity to honor distinguished colleagues, inspiring teachers and corporate leaders. The annual IEEE Awards Booklet, distributed at the Honors Ceremony, highlights the accomplishments of each year's IEEE Award and Medal recipients.

The IEEE establishes Joint Awards with National Societies in other countries to recognize individuals who have made significant technical, educational or service contributions to the engineering profession or to society in general. See http://www.ieee.org/portal/pages/about/awards/JANS/jans.html.

The IEEE also recognizes outstanding individuals through special membership categories:

IEEE Fellow (deadline: March 1, 2007, see http://www.ieee.org/web/aboutus/fellows/fellows.html), and IEEE Honorary Member (deadline: July 1, 2007, see http://www.ieee.org/portal/pages/about/awards/noms/honrnom.html).

Nominations are initiated by members and the public, then reviewed by a panel of peers and professionals who are especially knowledgeable in a particular field. Their recommendations are submitted to the IEEE Awards Board prior to ultimate approval by the IEEE Board of Directors.

Other IEEE organizations also recognize specific technical and professional achievement through other awards programs, please refer to http://www.ieee.org/portal/pages/about/awards/othawd.html.

Forward questions/comments/suggestions related to the IEEE Awards nomination process to: awards@ieee.org.

Recent Activities of the Information Theory Society Student Committee

Andrea Goldsmith, Ivana Maric, Brooke Shrader, and Lalitha Sankaranarayanan

From a t-shirt contest to panel events to proposing a student paper award, the student committee has been pushing ahead in its efforts to increase interest and participation among student members in the Information Theory Society.

The committee held a t-shirt design contest in the spring of 2006. Four original designs were submitted by student members Chris Ng, Amin Mobasher, Kostis Xenoulis, and Ivana Maric. Our thanks go to the student judges Onur Ozan Koyluoglu, Mayank Bakshi, Hossein Bagheri, Ruoheng Liu, John Papandriopoulos, and Edward Kwok Shum, who in a vote of 4-2 chose the design submitted by Ivana Maric as the winner. We congratulate Ivana and thank all of the students who submitted designs and judged the contest! Free t-shirts with the winning design were given out at the ISIT and Allerton conferences and will be made available at future meetings of the student committee. We plan to conduct a similar t-shirt design contest next year and encourage our members to get an early start on their creative designs!

At the ISIT 2006 conference, the committee hosted a research round table discussion on Monday July 10. The enthusiastic attendance

and participation of nearly 80 students had the student volunteers scrambling to ensure that there were sufficient boxed lunches and chairs to allow for the discussions to continue without a lull! The tables were organized by topics with each table led by a student leader. Hanan Weingarten (The Technion) and Jinsong Wu (Queen's University) led the discussion on MIMO broadcast capacity and space-time coding, Haim Permuter (Stanford University) led the one on the capacity of feedback channels, Chris Ng (Stanford University) moderated the discussion on cooperation and relaying, Niranjan Ratnakar (UIUC) headed the one on network coding, and the discussion on secrecy system capacity was moderated by Yingbin Liang (Princeton University). The overwhelmingly positive feedback from the student participants certainly simplified the committee's decision to continue hosting a similar event every year.

The committee also hosted a panel discussion on Thursday July 13 on the topic of How to Choose, Formulate and Solve an Information Theory Problem. Prof. Andrea Goldsmith of Stanford University served as the panel moderator and the panelists includ-

Lively discussions at the research round table and lunch at ISIT 2006.

Students enjoy their box lunches at the panel discussion on "How to choose, formulate, and solve an Information Theory problem."

ed Prof. Rob Calderbank of Princeton University, Prof. Tom Cover of Stanford University, Prof. Michelle Effros of Caltech, Prof. Tony Ephremides of the University of Maryland, Prof. Ralf Koetter of the University of Illinois, Urbana-Champaign, and Prof. Alon Orlitsky of the University of California, San Diego. Nearly 350 people attended the panel discussion, enjoyed a box lunch, were treated to excellent tips on research methodologies, as well as a free t-shirt. It is worth noting that the panel discussion was the most highly-attended event at ISIT 2006 aside from the Shannon and plenary lectures. Thanks to the round table moderators and panelists for making the student events at ISIT hugely successful!

In response to the interest and enthusiasm displayed at the research discussion lunch, our webmaster Amin has created a Yahoo! Groups for students to continue the discussions started at ISIT. The page can be found at http://groups.yahoo.com/group/itsoc. We welcome all interested and intrepid students to join in the discussion!

The IT Student Committee hosted its 4th panel discussion, "Frying Pan or Fire: To Postdoc or Not" on Wednesday, Sept 27 at the Allerton Conference. We had five panelists, all current or former postdocs: Atilla Eryilmaz (1st year MIT postdoc), Desmond Lun (1st year UIUC postdoc), Yingbin Liang (2nd year Princeton postdoc), Todd Coleman (UIUC professor, former postdoc at MIT), and Tsachy Weissman (Stanford professor, former Stanford/HP Labs postdoc). The panel was moderated by Ivana Maric. Unanimously, the panelists viewed their postdoc experience as a rewarding period of uninterrupted, independent research, with the flexibility to explore totally new research areas, as some of our panelists did. It was pointed out, though, that the benefits of a postdoc position are less obvious for students interested in industry jobs, as postdoc years may be viewed as unnecessary by an employer. About 40 students attended the panel, there were many questions and too little time. Our thanks to students Amin Mobasher, Haim Permuter, Ruoheng Liu, Masoud Ebrahimi and Anand Sarwate for taking the photos and organizing the room for the panel. The panel recording and the photos will be posted on the IT Student Committee website.

Finally, the committee initiated a recommendation for a student paper award to be conferred at the ISIT conference. The Technical Program Committee (TPC) of ISIT 2007 subsequently presented a formal proposal for the award, and the BoG approved the proposal in September. We think this award is an excellent means of honoring student contributions to Information Theory!

We were delighted by the level of student participation in the recent events hosted by the committee. We are always looking for new participants and new volunteers to help us in organizing events and maintaining the committee website. If you'd like to suggest a new event or to help in planning, you can contact Lalitha, our volunteer coordinator at lalitha@winlab.rutgers.edu. For input and suggestions regarding the website, please contact our webmaster Amin amin@cst.uwaterloo.ca. Meanwhile, you can find more information on our events (including pictures, summaries of meetings, audio files from panel discussions, and research and job-seeking resources) at our website.http://itsoc-students.ece.cornell.edu

Panel moderator Andrea Goldsmith with panelists: Rob Calderbank, Tony Ephremides, Tom Cover, Ralf Koetter, Michelle Effros, and Alon Orlitsky.

IEEE Information Theory Society Board of Governors Meeting

The Westin Seattle, Seattle, WA, USA, July 8, 2006

Mehul Motani

Attendees: John Anderson, Alexei Ashikhmin, Guisseppe Caire, Daniel Costello, Thomas Cover, Richard Cox, Anthony Ephremides, Dave Forney, Marc Fossorier, Andrea Goldsmith, Alex Grant, Hideki Imai, Torleiv Kløve, Ralf Koetter, Frank Kschischang, J. Nicholas Laneman, Steven W. McLaughlin, Muriel Médard, Urbashi Mitra, Mehul Motani, David L. Neuhoff, Vincent Poor, Bixio Rimoldi, Nela Rybowicz, Anant Sahai, Shlomo Shamai, Ulrich Speidel, Joseph A. O'Sullivan, Desmond Taylor, Alexander Vardy, Venugopal V. Veeravalli, Adriann J. van Wijngaarden, Ken Zeger.

The meeting was called to order at 13:50 by Society President David Neuhoff. The members of the Board were welcomed and introduced themselves.

1. The agenda was approved and distributed. Board members were also encouraged to look at the agenda and other materials online at the new Society development server.

2. The Board unanimously approved the minutes of the previous meeting.

3. The President introduced Richard Cox, the IEEE Division 9 Director.

   Mr. Cox reviewed the structure of IEEE, and briefly mentioned membership and public imperatives, periodicals, conferences, and standards.

   Division 9 includes Aerospace/electronics, geoscience/remote sensing, intelligent transportation, information theory, oceanic engineering, signal processing, and vehicular technology. It was noted that there is still no clear understanding of the impact of being in one division versus another.

4. The President presented his report and miscellaneous announcements.

   The President reported on the state of the Society, including the IT Transactions, conferences and workshops, awards, finances, and membership.

   The President reported on recent IEEE Technical Activities Board (TAB) news and activities.

5. The President put forth two new appointments for the positions of Secretary and Treasurer respectively. João Barros was nominated as Secretary. Anant Sahai was nominated as Treasurer.

   The Board unanimously approved the appointment of João Barros as Secretary.

   The Board unanimously approved the appointment of Anant Sahai as Treasurer.

6. Muriel Médard presented the Treasurer's report.

   The Society's finances were reviewed. The Treasurer reported that the surplus was going up for three years running. It was noted that this left some funding for new initiatives of the Society.

   The financial activities of the Society conferences and workshops was reported in the Treasurer's report online.

7. Matters related to Symposia and Workshops were then discussed.

   (a) ISIT 2009 Seoul: Vince Poor summarized the progress of the organization. There was some discussion of the dates of the conference with respect to ICC. Vince Poor requested formal Board approval, with the freedom to adjust the dates is needed.

      The Board unanimously approved the proposal, with the freedom to the organizers to change the dates if needed.

   (b) ITW 2008 Portugal: Steve McLaughlin put forth a proposal for a ITW Workshop in 2008.

      The Board unanimously voted to approve the proposal.

   (c) ISIT 2008 Toronto: Frank Kschischang reported briefly on the progress.

   (d) ITW 2007 Norway: Torleiv Kløve reported briefly on the progress.

   (e) ISIT 2007 France: Guisseppe Caire reported briefly on the progress of the organization of the annual Symposium.

   (f) ITW 2006 China: Dan Costello reported briefly on the progress including finances.

      Things are on track.

   (g) ISIT 2006 Seattle: Jody O'Sullivan reported on the state of matters of the symposium, including the venue and the finances.

   (h) ITW 2006 Uruguay: There was nothing to report except that the workshop ran successfully.

   (i) ITW 2005 Japan: Hideki Imai reported briefly on the workshop.

   (j) ISIT 2005 Australia: Alex Grant reported briefly that the Symposium is pending an audit and aiming to close the books shortly.

(k) ITW 2005 New Zealand: Ulrich Speidel reported briefly on the workshop. He requested that the New Zealand chapter be allowed to keep a portion of the surplus to fund local students and young researchers. The Treasurer replied that this might be a problem because the surplus goes straight to IEEE.

There was discussion on whether and how the Society (or the Sympoisum/Workshop) should provide travel grants to students.

The ad-hoc conference committee will consider this matter and report to the Board at a subsequent Board meeting.

(l) Ralf Koetter raised the issue of encouraging authors to submit papers to ArXiv.

He requested official board approval.

The Board unanimously approved the proposal and endorsed the notion that Conference organizers should encourage authors to submit their papers to ArXiv.

(m) Technical Co-Sponsorship of WiOpt: Tony Ephremides briefly described WiOpt and requested the Board to technically co-sponsor the workshop. There was a motion for the Board to technically co-sponsor the workshop permanently.

The Board unanimously approved the motion.

There was a motion for the Workshop to place their proceedings on IEEEXplore, without any fee paid by the Society.

The Board unanimously approved the motion.

(n) Technical Co-Sponsorship of NetCod 2007: Ken Zeger described the 1-day Net-Cod workshop. There was a motion to technically co-sponsor the NetCod 2007 workshop and to include the proceedings in IEEEXplore, without any fee paid by the Society.

The Board unanimously approved the motion.

(o) Technical Co-Sponsorship of Allerton 2006: There was a motion for the Society to technically co-sponsor the Allerton 2006 workshop.

The Board unanimously approved the motion.

8. Mark Fossorier discussed several conference related issues.

The first is the differential in registration fees for IEEE members and IEEE Society members.

The second issue concerned On-site membership promotions, namely giving non-IEEE member delegates who register on-site a discount if they join IEEE and the Society at the time of registration.

This matter was handed off to the ad-hoc Conference Committee for further discussion.

9. The President raised the matter of online access to conference proceedings.

The Society would like to include online access to all past and present Conference proceedings to all Society members. There was a discussion about whether if the Society should charge for this access (as requested by IEEE) or not.

There was a motion to include online access as part of the basic membership fee to all past and present conference proceedings to all Society members and discuss this with IEEE.

The Board unanimously approved the motion.

10. The Society Online Editor, Nick Laneman, gave an update on the IT Society website.

There is a general desire to make the website more useful to the members by incorporating dynamic content and allowing users to contribute content.

There was a suggestion that the Society should purchase a dedicated server.

It was decided that the matter be discussed offline.

11. Andrea Goldsmith reported on the activities of the Society Student Committee.

At ISIT 2006, there will be a panel discussion and a research round table.

There was a motion to charge the TPC of ISIT 2007 to work out a detailed plan of how to award the Best Student Paper Award at the main Conference of the Society and present this to the Board at its September 2006 meeting.

The Board unanimously approved the motion.

12. Bixio Rimoldi presented the Awards Committee report.

The Awards Committee recommends that the Best Paper Award be given to the following paper:

Universal compression of memoryless sources over unknown alphabets, A. Orlitsky, N.P. Santhanam, and J. Zhang, IEEE Transactions on Information Theory, IT-50:7 (July 2004), pp. 1469-1481.

The Board unanimously accepts the recommendation of the Awards Committee.

The Awards Committee recommends that the IT Society Chapter of the Year Award be given to the Hong Kong Chapter.

13. Marc Fossorier raised the issue of a proposed change to the Society By-Laws with respect to the Chapter of the Year Award. There was a brief discussion.

There was a motion raised to change the eligibility criteria so that any chapter is eligible.

The Board unanimously approved this motion.

There was a motion to increase the prize from $1000 to $2000.

The Board unanimously approved this motion.

There was a motion to change the procedure so that the winner for year XX is recognized at ISIT in year XX and to recognize the Chapter Chairs at a lunch at ISIT XX.

The Board unanimously approved this motion.

14. The IT Transactions Editor-in-Chief gave an update on the Society Transactions. The EIC reviewed the mail dates, page counts, and page budgets of the Transactions.

The EIC noted two special issues with deadlines later in 2006, one on Relaying and Cooperation and another on Information Theoretic Security.

The EIC submitted five new associate editor appointments for Board approval:

- Andi Loeliger (ETH) in Coding Techniques, effective September 1, 2006.

- Ludo Tolhuizen (Phillips Research) Coding Theory, effective September 1, 2006.

- Andrea Goldsmith (Stanford) in Communications, effective October 1, 2006.

- Alex Grant (South Australia) in Communications, effective November 1, 2006.

- John Anderson (Lund) for Book Reviews editorial position, effective January 1, 2007.

The Board unanimously approved all five AE appointments.

15. Alexander Vardy reported on the activities of the Ad-Hoc Committee on the Growth of the Transactions. The Committee has compiled comprehensive data that reflects the growth of the Transactions in the past 18 years. Of note is the fact that the acceptance rate has remained roughly constant since 1989 but the number of published pages has been growing exponentially. The consequences of this growth and possible responses by the Society were discussed. The committee made the following recommendations:

- First recommendation: transition to all-electronic publication, with hard copies provided to libraries only;

members should receive monthly push email with ToC/hyperlinks.

- Second recommendation: hierarchical organization of the table of contents and of the Editorial Board.

- Third recommendation: a page limit of five pages for orrespondence items.

There was a motion to approve the recommendation to impose a page limit of 5 pages for correspondence items. The Board unanimously approved the motion.

There was a motion to implement the monthly push email with table of contents and hyperlinks. The Board unanimously approved the motion.

There was a motion to implement a hierarchical structure of the table of contents. The Board unanimously approved the motion.

16. Availability of Classic Information Theory Books

It was decided that this item would be discussed at a subsequent Board meeting.

17. The Nominations committee presented its report.

It was reported that 12 nominations had been received for the Board.

3 nominations were introduced and endorsed from the floor: Alon Orlitsky, Muriel Medard, Emina Soljanin.

The Board unanimously approved the list of 15 nominations.

18. It was reported that the following nominations had been received for Society officers.

- Bixio Rimoldi for President

- Marc Fossorier for 1st Vice President

- Venu Veeravalli for 2nd Vice President

- Andrea Goldsmith for 2nd Vice President

The Board unanimously closed and approved all the nominations.

19. There was no new business.

20. The next Board meeting will be held at the Allerton Conference on September 27, 2006 at approximately 7pm.

21. The meeting was adjourned at 19:30.

2006 Kailath Lecture and Colloquia

Tsachy Weissman and Sergio Verdu

On the occasion of Thomas Kailath's 70th birthday, a group of his former students and associates joined to honor his influence and contributions by endowing a fund to support an annual lecture, as well as colloquia, workshops and other research-enhancing activities. The aim of this fund is to foster greater awareness of the power of the mathematics-based disciplines of information theory, communications, computation, control and signal processing to address challenging problems in engineering and the physical, biological and social sciences.

The first of these events - the Kailath Lecture and Colloquium - was held at Stanford during June 2005, and culminated in Robert Gallager's Kailath Lecture, entitled "*The Golden Years of Information Theory*". The June 2006 issue of the IT newsletter contained a report on that event.

The Second Kailath Lecture and Colloquium, which was chaired by Abbas El Gamal, was held at Stanford during July 6-7, 2006. The Colloquium began with a morning session on July 6, with a talk by Freddy Bruckstein of the Technion, entitled "*Digital Geometry for Image Analysis Tasks*", a talk by Ali Sayed of UCLA, entitled "*Distributed Processing over Adaptive Networks*", and a talk by George Verghese of MIT, entitled "*Integrating Data, Models and Reasoning for Patient Monitoring in Critical Care*".

The morning session was followed by a Q&A session with Thomas Kailath, which focused on the decade '56-'66 at MIT, JPL and the Schalkwijk-Kailath Algorithm.

The main event of the day was Jacob Ziv's Kailath Lecture, entitled "*On Universal Modelling: How to Learn the Most from an Individual Sequence*".

Following the day's events, a reception and dinner were held at the Stanford Faculty Club in honor of Jacob Ziv. Several of Jacob's former students and colleagues, including Freddy Bruckstein, Meir Feder, Abraham Lempel, and Tsachy Weissman, took the podium to recount Jacob's diverse influences on their careers.

On the following day, a colloquium on feedback communication was held, organized by Tsachy Weissman. This colloquium featured the following talks:

- "*Achieving the Empirical Capacity of Individual Noise Channels Using Feedback*", by Meir Feder of Tel Aviv University,

- "*Dependence-Balance Bounds and Capacity Results for the Gaussian MAC with Feedback*", by Michael Gastpar of Berkeley,

- "*Gaussian Feedback Capacity*", by Young-Han Kim of UC San Diego,

- "*A Coding Scheme for Additive White Noise Channels with Feedback Corrupted by Quantization or Bounded Noise*", by Nuno Martins of the University of Maryland,

- "*Interactive Communication: The Role of Feedback in Source Coding*", by Alon Orlitsky of UC San Diego,

- "*The Capacity of the Trapdoor Channel with Feedback*", by Haim Permuter of Stanford,

- "I*ncreasing Reliability Using Only Noisy Feedback*", by Anant Sahai of Berkeley,

- "*Decentralized Processing: The Impact of a Common Finite Capacity Feedback Link*", by Shlomo Shamai of the Technion,

- "*An MDP Approach to Computing Feedback Capacity*", by Sekhar Tatikonda of Yale,

- "*Noisy Channels with Feedback: The First Fifty Years*", by Sergio Verdu of Princeton,

- "*Robustness and Sensitivity of the Schalkwijk-Kailath Scheme*", by Tsachy Weissman of Stanford,

- "*Noisy Feedback Is Strictly Better Than No Feedback on the Gaussian MAC*", by Michele Wigger of ETH Zurich.

Commensurate with the colloquium's subtitle "*Celebrating the 40th anniversary of the Schalkwijk-Kailath Algorithm*", many of the talks featured recent extensions of and variations on the celebrated Schalkwijk-Kailath scheme.

Not unexpectedly, the Second Kailath Lecture and Colloquium proved to be a resounding success. The speakers provided much material for thought about current and future directions of information theory and related fields.

Videos of the lectures from both the 2005 and 2006 events, as well as some preliminary details on the Third Kailath Lecture and Colloquia are on the Lecture website. (http://isl.stanford.edu/kailathlecture/)

Workshop Report: Europe Meets Australia

Jossy Sayir

The European Network of Excellence in Wireless Communications (NEWCOM) and the Australian ARC Communication Research Network (ACoRN) held a joint workshop in Vienna, Austria on September 20-22, 2006. The workshop was organized locally by the Telecommunications Research Center in Vienna (ftw.) in collaboration with Vienna University of Technology.

The workshop brought together more than 120 researchers for three memorable days of scientific and social interaction. Forty-one peer-reviewed papers were presented, summarizing the scientific output of the two research networks. Two very well attended full-day tutorials were held on the first day: "Information Theory for Relaying and Cooperation" by Gerhard Kramer (Bell Laboratories, USA); and "Measurement and Modeling of Wireless Propagation Channels for MIMO and UWB" by Andreas Molisch (Lund University, Sweden) and Ernst Bonek (formerly Vienna University of Technology). Each of the following days began with an insightful keynote plenary talk: "Feedback and Control under Data Rate Constraints" by Girish Nair (University of Melbourne, Australia) and "10GBit/s Ethernet over Copper" by Gottfried Ungerboeck (Broadcom Corporation, USA/Switzerland). Finally, on the last day, a panel discussion on "Grand Challenges in Wireless Communications", headed by Ernst Bonek, brought together Jim Massey (formerly ETH Zurich, Switzerland), Heinrich Meyr (RWTH Aachen, Germany) , Lars Rasmussen (University of South Australia) and Marek Bialkowski (University of Queensland, Australia). The thought-provoking debate on the future of the field attracted the attention of the local press, which covered the event with full-page articles, so that the debaters, well-known within our research community, have now become celebrities among readers of scientific supplements in Austrian newspapers.

The workshop was blessed with excellent weather and Vienna showed its friendliest face under a cloudless blue sky with trees and foliage dressed in bright autumnal colours. The participants were treated to a cocktail reception at Vienna's neo-gothic city hall, where a representative of the mayor gave a remarkably concise speech relating wireless communications to Viennese wine. On the second evening, a banquet was held in a typical rustic Austrian "Heurigen" (wine tavern) on a hill overlooking Vienna. On this occasion, the NEWCOM Best Paper Award for the best paper within the past 2 years by NEWCOM researchers was presented to Nele Noels, Vincenzo Lottici, Antoine Dejonghe, Heidi Steendam, Marc Moeneclay, Marco Luise, and Luc Vandendorpe for their paper "A Theoretical Framework for Soft-Information-Based Synchronization in Iterative (Turbo) Receivers". The NEWCOM Young Investigator Award was awarded to Nele Noels from the University of Ghent, Belgium. The Award Committee for these awards consisted of three members of NEWCOM's scientific advisory board: Henry Bertoni, Jim Massey and Rob Calderbank. Finally, Sergio Benedetto, Director of NEWCOM, and Lars Rasmussen, Convenor of ACoRN, presented Alex Grant (University of South Australia) and Jossy Sayir (ftw.) with an award and a bottle of wine each for having served as Technical Program Chair and Local Organizing Chair of the workshop, respectively. The wines were of such excellent quality that the two organizers are now volunteering to organize more workshops.

The workshop website http://www.newcom-acorn.org gives further information about the event. The proceedings are available in CD-form from ftw. (office@ftw.at) and will be made available on EURASIP's online library shortly.

Panel Discussion "Grand Challenges in Wireless Communications".

Marco Luise receives the NEWCOM Best Paper award from Jim Massey.

Alex Grant recognized as chair of the Technical Program Committee by Sergio Benedetto and Lars Rasmussen.

Jossy Sayir recognized as Chair of the Local Organizing Committee, accompanied by his baby daughter Mia.

GOLOMB'S PUZZLE COLUMN™

Some Quadratic Matrix Equations Solutions

Solomon W. Golomb

We have the four matrix equations

(A) $M^2 = M$,   (B) $M^2 = -M$,   (C) $M^2 = I$,   (D) $M^2 = -I$.

Some useful facts are:

If M is $n \times n$ with elements in F, then $|M|$, the determinant of M, is in F. $|M^2| = |M|^2$, and $|I| = 1$. Also $|-M| = (-1)^n |M|$, and in particular $|-I| = (-1)^n$.

If $M = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ then $|M| = ad - bc$, $Tr(M) = a + d$, and $M^2 = \begin{pmatrix} a & b \\ c & d \end{pmatrix}^2 = \begin{pmatrix} a^2+bc & b(a+d) \\ c(a+d) & d^2+bc \end{pmatrix}$.

1. The possible values of $|M|$ in the four cases are:

    (A) $|M| = 0$ or 1, (B) $|M| = 0$ or -1, (C) $|M| = 1$ or -1, (D) $|M| = 1$ or -1 if n is even but j or $-j$ if n is odd, where M is $n \times n$, and $j^2 = -1$, with $j = \pm i = \pm \sqrt{-1}$ if F is R or C; $j \in F$ if $F = Z_p$ with $p = 4k+1$, and $j \in F^2$ but $j \notin F$ if $F = Z_p$ with $p = 4k-1$.

2. With $M = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, so $Tr(M) = a + d$, the possible values of $Tr(M)$ for the four matrix equations are:

    (A) $Tr(M) \in \{2, 1, 0\}$

    (B) $Tr(M) \in \{-2, -1, 0\}$

    (C) $Tr(M) \in \{2, 0, -2\}$

    (D) $Tr(M) \in \{2j, 0, -2j\}$, with j as in the previous solution.

    To derive these, with $Tr(M) = a + d = \tau$, we see that $M^2 = \begin{pmatrix} a^2+bc & b\tau \\ c\tau & d^2+bc \end{pmatrix}$, which we substitute into each of the four equations.

3. For the characteristic polynomials and eigenvalues of M, we use the Cayley-Hamilton Theorem, from which M must satisfy, respectively: (A) $M^2 - M = \mathbf{O}$, (B) $M^2 + M = \mathbf{O}$, (C) $M^2 - I = \mathbf{O}$, and (D) $M^2 + I = \mathbf{O}$, where $\mathbf{O} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$. The eigenvalues must be consistent with these matrix equations. Thus, the possible pairs of eigenvalues are:

    (A) $\{1, 1\}$, or $\{1, 0\}$, or $\{0, 0\}$,

    (B) $\{-1, -1\}$, or $\{-1, 0\}$, or $\{0, 0\}$,

    (C) $\{1, 1\}$, or $\{1, -1\}$, or $\{-1, -1\}$,

    (D) $\{j, j\}$, or $\{j, -j\}$, or $\{-j, -j\}$,

    where j is as in the previous solutions. If we solve this problem before problem 2, then we can use $Tr(M) = \lambda_1 + \lambda_2$, the sum of the eigenvalues, to answer problem 2.

4. Here is where we find the general solutions.

    (A) Since $M^2 = M$ means $\begin{pmatrix} a^2+bc & b(a+d) \\ c(a+d) & d^2+bc \end{pmatrix} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, either (i) $a + d = 1$, or (ii) $b = c = 0$. If (ii) $b = c = 0$, we have

    $a^2 = a, d^2 = d$, so $a \in \{1, 0\}$ and $d \in \{1, 0\}$ with the four solutions for M: $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$. If (i)

$a + d = 1$, $bc = a - a^2 = a(1 - a)$ and $bc = d - d^2 = d(1 - d)$, where $a = 1 - d$ and $d = 1 - a$, so $bc = ad = a(1 - a) = d(1 - d)$. Since $|M| = ad - bc$, this case requires $|M| = 0$. Any a may be chosen, $a \in F$, with $d = 1 - a \in F$. Then, since $bc = a(1 - a)$, if $b \neq 0$ then $c = a(1 - a)/b$, and if $c \neq 0$ then $b = a(1 - a)/c$. Thus, in case (i),

$M = \left(\begin{smallmatrix} a & b \\ \frac{a(1-a)}{b} & 1-a \end{smallmatrix} \right)$ for $b \neq 0$, and $M = \left(\begin{smallmatrix} a & \frac{a(1-a)}{c} \\ c & 1-a \end{smallmatrix} \right)$ for $c \neq 0$. (The case $b = c = 0$ is (ii).) Examples in case (i) include

$\left(\begin{smallmatrix} 1/2 & 1/2 \\ 1/2 & 1/2 \end{smallmatrix} \right)$ and more generally $\left(\begin{smallmatrix} a & a \\ 1-a & 1-a \end{smallmatrix} \right)$, as well as $\left(\begin{smallmatrix} 1 & b \\ 0 & 0 \end{smallmatrix} \right)$ and $\left(\begin{smallmatrix} 1 & 0 \\ c & 0 \end{smallmatrix} \right)$.

(B) Since $M^2 = -M$ means $\left(\begin{smallmatrix} a^2+bc & b(a+d) \\ c(a+d) & d^2+bc \end{smallmatrix} \right) = \left(\begin{smallmatrix} -a & -b \\ -c & -d \end{smallmatrix} \right)$, the two cases are (i) $a + d = -1$, and (ii) $b = c = 0$. In case (ii),

$a^2 = -a$, $d^2 = -d$, so $a \in \{0, -1\}$, $d \in \{0, -1\}$, and the only solutions are $\left(\begin{smallmatrix} -1 & 0 \\ 0 & -1 \end{smallmatrix} \right)$, $\left(\begin{smallmatrix} -1 & 0 \\ 0 & 0 \end{smallmatrix} \right)$, $\left(\begin{smallmatrix} 0 & 0 \\ 0 & -1 \end{smallmatrix} \right)$, $\left(\begin{smallmatrix} 0 & 0 \\ 0 & 0 \end{smallmatrix} \right)$ the negatives of the solutions in (A).

In case (i), $a + d = -1$, $d = -(1 + a)$, $d^2 + d = a^2 + a = -ad = -bc$. If $b \neq 0$, $c = \frac{a^2+a}{-b}$ $M = \left(\begin{smallmatrix} a & b \\ \frac{a^2+a}{-b} & -1-a \end{smallmatrix} \right)$. If $c \neq 0$,

$M = \left(\begin{smallmatrix} a & \frac{a^2+a}{-c} \\ c & -1-a \end{smallmatrix} \right)$. Examples in case (i) include $\left(\begin{smallmatrix} 1 & 1 \\ -2 & -2 \end{smallmatrix} \right)$ and $\left(\begin{smallmatrix} 1 & 2 \\ -1 & -2 \end{smallmatrix} \right)$.

(C) Since $M^2 = I$ means $\left(\begin{smallmatrix} a^2+bc & b(a+d) \\ c(a+d) & d^2+bc \end{smallmatrix} \right) = \left(\begin{smallmatrix} 1 & 0 \\ 0 & 1 \end{smallmatrix} \right)$, the two cases are (i) $a + d = 0$ and (ii) $b = c = 0$.

In case (ii), $a^2 = d^2 = 1$, and the four matrices are $\left(\begin{smallmatrix} 1 & 0 \\ 0 & 1 \end{smallmatrix} \right)$, $\left(\begin{smallmatrix} 1 & 0 \\ 0 & -1 \end{smallmatrix} \right)$, $\left(\begin{smallmatrix} -1 & 0 \\ 0 & 1 \end{smallmatrix} \right)$, and $\left(\begin{smallmatrix} -1 & 0 \\ 0 & -1 \end{smallmatrix} \right)$.

In case (i), since $a + d = 0$, $d = -a$, and $bc = 1 - a^2 = 1 - d^2$. If $b \neq 0$, then $c = \frac{(1-a^2)}{b}$, giving $M = \left(\begin{smallmatrix} a & b \\ \frac{1-a^2}{b} & -a \end{smallmatrix} \right)$ If $c \neq 0$,

then $b = \frac{(1-a^2)}{c}$, giving $M = \left(\begin{smallmatrix} a & \frac{1-a^2}{c} \\ c & -a \end{smallmatrix} \right)$. Examples in case (ii) include $\left(\begin{smallmatrix} 1 & 1 \\ 0 & -1 \end{smallmatrix} \right)$ and $\left(\begin{smallmatrix} \sqrt{2} & \sqrt{2} \\ -\sqrt{2}/2 & -\sqrt{2} \end{smallmatrix} \right)$.

(D) Since $M^2 = -I$ means $\left(\begin{smallmatrix} a^2+bc & b(a+d) \\ c(a+d) & d^2+bc \end{smallmatrix} \right) = \left(\begin{smallmatrix} -1 & 0 \\ 0 & -1 \end{smallmatrix} \right)$, in case (i) $a + d = 0$ and in case (ii) $b = c = 0$. In case (ii), $a^2 = d^2 = -1$,

so $a = \pm j$, $d = \pm j$ (where $j^2 = -1$ as previously), so the four possible matrices are $\left(\begin{smallmatrix} j & 0 \\ 0 & j \end{smallmatrix} \right)$, $\left(\begin{smallmatrix} j & 0 \\ 0 & -j \end{smallmatrix} \right)$, $\left(\begin{smallmatrix} -j & 0 \\ 0 & j \end{smallmatrix} \right)$, and $\left(\begin{smallmatrix} -j & 0 \\ 0 & -j \end{smallmatrix} \right)$.

In case (i), with $a + d = 0$, $d = -a$, and $bc = -1 - a^2 = -1 - d^2$. If $b \neq 0$ then $c = \frac{(-1-a^2)}{b}$. If $c \neq 0$, $b = \frac{(-1-a^2)}{c}$. Thus,

either $M = \left(\begin{smallmatrix} a & b \\ \frac{-1-a^2}{b} & -a \end{smallmatrix} \right)$ or $M = \left(\begin{smallmatrix} a & \frac{-1-a^2}{c} \\ c & -a \end{smallmatrix} \right)$. Examples of this case include $\left(\begin{smallmatrix} 1 & 1 \\ -2 & -1 \end{smallmatrix} \right)$ and $\left(\begin{smallmatrix} 2 & 2 \\ -\frac{5}{2} & -2 \end{smallmatrix} \right)$

Note that for all four equations, "case ii" has $b = c = 0$ with only four solutions for M; but "case i", where $Tr(M) = a + b$ has a special value, has many solutions (in fact infinitely many if $F = R$ or $F = C$).

New Books

Raymong Yeung

Elements of Information Theory, 2nd Edition, by Thomas M. Cover and Joy A. Thomas. Wiley, 2006, 776 pp., $84.95, ISBN 0-471-24195-4.

Contents:

Introduction and Preview; Entropy, Relative Entropy, and Mutual Information; Asymptotic Equipartition Property; Entropy Rates of a Stochastic Process; Data Compression; Gambling and Data Compression; Channel Capacity; Differential Entropy; Gaussian Channel; Rate Distortion Theory; Information Theory and Statistics; Maximum Entropy; Universal Source Coding; Kolmogorov Complexity; Network Information Theory; Information Theory and Portfolio Theory; Inequalities in Information Theory.

Statistical and Inductive Inference by Minimum Message Length, by C.S. Wallace. Information Science and Statistics, 2005, 432 pp., $79.95, ISBN 0-3872-3795-X.

Contents:

Inductive Inference; Information; Strict Minimum Message Length (SMML); Approximations to SMML; MML - Quadratic Approximations to SMML; MML Details in Some Interesting Cases; Structural Models; The Feathers on the Arrow of Time; MML as a Descriptive Theory; Related Work

Uncertainty and Information: Foundations of Generalized Information Theory, by George J. Klir. Wiley, 2006, 520 pp., $94.95 £55.95, ISBN 0-471-74867-6.

Contents:
Introduction; Classical Possibility-Based Uncertainty Theory; Classical Probability-Based Uncertainty Theory; Generalized Measures and Imprecise Probabilities; Special Theories of Imprecise Probabilities; Measures of Uncertainty and Information; Fuzzy Set Theory; Fuzzification of Uncertainty Theories; Methodological Issues; Conclusions

High-Fidelity Multichannel Audio Coding, 2nd Edition, by Dai Tracy Yang, Chris Kyriakakis, and C.-C. Jay Kuo. EURASIP, 2006, 234 pp., $119.95, ISBN 977-5945-24-0.
Contents:
Introduction to digital audio; Quantization; Entropy coding; Introduction to psychoacoustics; Subjective evaluation of audio codecs; MPEG-4 audio coding tools; MPEG advanced audio coding; Introduction to new audio coding tools; Interchannel redundancy removal and channel-scalable decoding; Adaptive Karhunen-Loève transform and its quantization efficiency; Progressive syntax-rich multichannel audio codec; Error-resilient scalable audio codec design.

An Introduction to Digital and Analog Communications, 2nd Edition, by Simon Haykin and Michael Moher. Wiley, 2007, 528 pp., $97.95 £56.50, ISBN 0-471-43222-9.
Contents:
Introduction; Fourier Representation of Signals and Systems; Amplitude Modulation; Angle Modulation; Pulse Modulation - Transition from Analog to Digital Communications; Baseband Data Transmission; Digital Band-Pass Modulation Techniques; Random Signals and Noise; Noise in Analog Communications; Noise in Digital Communications; System and Noise Calculations.

Mobile Wireless Communications, by Mischa Schwartz. Cambridge University Press, 2005, 470 pp., £40.00, ISBN 0-521-84347-2.
Contents:
Introduction and overview; Characteristics of the mobile radio environment-propagation phenomena; Cellular concept and channel allocation; Dynamic channel allocation and power control; Modulation techniques; Multiple access techniques - FDMA, TDMA, CDMA - system capacity comparisons; Coding for error detection and correction; Second-generation, digital, wireless systems; Performance analysis - admission control and handoffs; 2.5G/3G Mobile wireless systems - packet-switched data; Access and scheduling techniques in cellular systems; Wireless LANs and personal-area networks

Introduction to Ultra Wideband Communication Systems, by Jeffrey H. Reed. Prentice Hall, 2005, 672 pp., $106.00, ISBN 0131481037.

Wireless Communications, by Andreas Molisch. Wiley-IEEE Press, 2006, 668 pp., $75.00 £45.00, ISBN 0-470-84888-X.

Advanced Wireless Networks: 4G Technologies, by Sava G. Glisic. Wiley, 2006, 864 pp., $165.00 £90.00, ISBN 0-470-01593-4.

Theory and Applications of OFDM and CDMA: Wideband Wireless Communications, by Henrik Schulze and Christian Lueders. Wiley, 2005, 420 pp., $84.95 £45.00, ISBN 0-470-85069-8.

Turbo Receiver Design: From Theory to Practice, by Mark Reed. Wiley, 2006, 384 pp., $120.00 £65.00, ISBN 0-470-01060-6.

The Art of Error Correcting Coding, 2nd Edition, by Robert H. Morelos-Zaragoza. Wiley, 2006, 384 pp., $90.00 £50.00, ISBN 0-470-01558-6.

Error Correction Coding: Mathematical Methods and Algorithms, by Todd K. Moon. Wiley, 2005, 800 pp., $130.00 £74.50, ISBN 0-471-64800-0.

Channel Adaptive Technologies and Cross Layer Designs for Wireless Systems with Multiple Antennas: Theory and Applications, by Vincent K. N. Lau, Yu-Kwong, and Ricky Kwok. Wiley, 2006, 544 pp., $99.95 £57.50, ISBN 0-471-64865-5.

Mobile, Wireless and Sensor Networks: Technology, Applications and Future Directions, by Rajeev Shorey and Chan Mun Choon. Wiley, 2006, 432 pp., $89.95 £51.50, ISBN 0-471-71816-5.

Ad Hoc Wireless Networks: A communication-Theoretic Perspective, by Ozan Tonguz and Gianluigi Ferrari. Wiley, 2005, 360 pp., $108.00 £60.00, ISBN 0-470-09110-X.

Wireless and Mobile Data Networks, by Aftab Ahmad. Wiley, 2005, 346 pp., $84.95 £48.95, ISBN 0-471-72922-1.

History of Wireless, by Tapan K. Sarkar, Robert Mailloux, Arthur A. Oliner, Magdalena Salazar-Palma, and Dipak L. Sengupta. Wiley, 2006, 680 pp., $59.95 £34.50, ISBN 0-471-71814-9.

Pseudo Random Signal Processing: Theory and Application, by THans-Jurgen Zepernick and Adolf Finger. Wiley, 2005, 436 pp., $120.00 £65.00, ISBN 0-470-86657-8.

Advanced Digital Signal Processing and Noise Reduction, Third Edition, by Saeed V. Vaseghi. Wiley, 2005, 480 pp., $125.00 £70.00, ISBN 0-470-09494-X.

Probability and Random Processes for Electrical and Computer Engineers, by John A. Gubner. Cambridge University Press, 2006, 640 pp., £40.00, ISBN 0-521-86470-1.

Contemporary Cryptography, by Rolf Oppliger. Artech House Publishers, 2005, 510 pp., £61.00, ISBN 1-58053-642-5.

User's Guide to Cryptography and Standards, by Alex W. Dent and Chris J. Mitchell. Artech House Publishers, 2005, 402 pp., £56.00, ISBN 1-58053-530-5.

Digital Modulation Techniques, 2nd Edition, by Fuqin Xiong. Artech House Publishers, 2006, 853 pp., £85.00, ISBN 1-58053-863-0.

Handbook of Sensor Networks: Algorithms and Architectures, edited by Ivan Stojmenovic. Wiley, 2005, 531 pp., $115.00 £65.95, ISBN 0-471-68472-4.

Ultra-Wideband Wireless Communications and Networks, edited by Xuemin Shen, Mohsen Guizani, Robert Caiming Qiu, and Tho Le-Ngoc. Wiley, 2006, 320 pp., $120.00 £65.00, ISBN 0-470-01144-0.

Workshop Report: 5th Asia-Europe (AEW5) Workshop on "Concepts in Information Theory"

October 25-27, 2006, Jeju, South Korea

Han Vink

The 5th Asia-Europe workshop on "Concepts in Information Theory" took place on the beautiful Jeju Island, in the south of South-Korea. The workshop is based on a longstanding cooperation between Asian and European scientists. Presenters are encouraged to pay special attention to the educational aspects of their presentation and concentrate on the main ideas and concepts in Information theory. In the workshop the 30 scientist from Japan, South-Korea, China, Taiwan and Germany enjoyed the 22 excellent presentations that were prepared according to the workshop goals. The main lecture, an overview on the capacity of interference channels, was given by Prof. Kingo Kobayashi and Prof. Te Sun Han. The workshop also paid a tribute to a well respected and special scientist that is extremely inspiring and/or always very clear in his/her presentations. In the past tributes were paid to Jim Massey and Jack Wolf. For this workshop Te Sun Han accepted the invitation to be the guest of honour. The workshop was chaired by: Yuan Luo, China; Hsiao-Hwa Chen, Taiwan; Hiroyoshi Morita, Japan; Han Vinck, Germany. Prof. Jong-Seon No, South Korea, acted as a national advisor. The workshop included a banquet and a half-day excursion to some of the highlights of the island. Workshop proceedings can be ordered at: Rieth@exp-math.uni-essen.de.

Presented lectures:
- Te Sun Han and Kingo Kobayashi: A Recent Research on the Capacity Problem for Interference Channels
- Han Vinck: Biometrics and Coding Techniques for Authentication
- Hiroyoshi Morita: On Signal Constellation of Single Cross Error Correcting Integer Codes
- Jun Muramatsu: Some Results on Secret Key Agreement from Correlated Sources
- Hidetoshi Yokoo: Lossless Data Compression and Lossless Data Embedding
- Hirosuke Yamamoto: FV Code Trees with no Synchronizing Strings
- Hiroki Suyari: Tsallis Entropy Uniquely Derived from a Fundamental Nonlinear Differential Equation
- Yen-Yi Lee: Characterizations of Best Huffman Trees
- Mitsugu Iwamoto: A Remark on Visual Secret Sharing Schemes Allowing the Rotation of Shares
- Yuan Luo: Three Versions of Depths of Vectors over $GF(2)$ and Linear Complexity
- Tomohiro Ogawa: On Asymptotic Reversibility of Quantum Operations
- Katsuhiro Nakamura: Some Results on Efficient Multi-Dimensional Codes over Z_q Based on the Lee Metric
- Jun-Ichi Takeuchi: Tree Source and Stochastic Complexity
- Shih-Chun Lin: Lattice-based Vector Dirty Paper Coding for MIMO Gaussian Broadcast Channels
- Chen Sun: Achieving Diversity by Generating Channel Pertubation with Random Beamforming in
- Block Fading Environment
- Pin-Hsun Lin: Extending the Linear Range of Power Amplifiers with Dirty Paper Coding
- Ying Li: Recursive Enumeration of Golay Sequences
- Tadashi Wadayama: An Upper Bound on Block Error Probability of Optimal Codes for Partial Response Channel
- Chen Yanling: On Wiretap Channel with Side Information
- Chia-Che Yang: A Path Finding Avatar in Hybrid Method of a Virtual Environment
- Wen-Thong Chang: Improvement of Spread Spectrum Image Steganography with Iterative Decoding Feedback

The chairmen: Yuan Luo, Han Vinck, TeSun Han (guest of Honour), Hiro Morita.

The participants at the excursion dinner.

Guest Column: From the National Science Foundation

News From the Communications Program at NSF

Sirin Tekinay, Program Director

Dear reader,

This is the fifth column in this series- I can't believe it's been more than a year since I joined the NSF. I'm glad to see that this space has been serving its purpose of fueling our interaction on ideas, visions, and issues that impact us all as professionals in the communications community as it provides insight to relevant NSF activities and news.

I am grateful that I continue to enjoy our close interaction, which helps me do my job as your program officer in Washington.

New and Upcoming Solicitations

In the last two issues, I described the process of formulation of a solicitation and what happens after it is posted. At the time of writing, our Theoretical Foundations 2007 Program is in the administrative review process, about to be posted. We targeted the late January to early February timeframe for the deadline of our call for proposals. This means we will be running panels through the spring.

Other recent postings that are relevant to our communities are:

- The foundation- wide Major Research Instrumentation (MRI) Program [1] Solicitation was posted recently, with a deadline of January 25, 2007. The Major Research Instrumentation Program (MRI) is designed to increase access to scientific and engineering equipment for research and research training in our Nation's organizations of higher education, research museums and non-profit research organizations. This program seeks to improve the quality and expand the scope of research and research training in science and engineering, and to foster the integration of research and education by providing instrumentation for research-intensive learning environments. The MRI program encourages the development and acquisition of research instrumentation for shared inter- and/or intra-organizational use and in concert with private sector partners.

  The MRI program assists in the acquisition or development of major research instrumentation by organizations that is, in general, too costly for support through other NSF programs.

- The CISE Directorate-wide new solicitation [2] was announced with two deadlines: October 25 for letters of intent and December 15 for full proposals. I had reported

on Global Environment for Networking Innovations (GENI) in previous issues. In order to support the GENI design and development process, the Directorate for Computer and Information Science and Engineering (CISE) will support the work of a GENI Project Office (GPO). Working closely with the computing research community, the GPO will assume responsibility for completion of all GENI preconstruction planning requirements as described in NSF's Guidelines for Planning and Managing the Major Research Equipment and Facilities Construction Account. Upon successful completion of the multiple stages comprising GENI design, and contingent upon support from NSF management, the National Science Board, the Administration and the Congress, GENI will proceed to the construction phase with funding provided from the agency's Major Research Equipment and Facilities Construction (MREFC) account. It is anticipated that the GPO will then have full responsibility for overseeing the construction of the facility, ensuring that GENI is delivered on time and within budget. Upon successful GENI construction and commissioning, the GPO may subsequently operate the facility in service to the computing research community. To ensure that all GENI activities are driven by fundamental research opportunities in networking and distributed systems, the GPO will work closely with the computing research community in all aspects of the design, development, construction and operation of GENI. The community's research interests in GENI will be represented by a GENI Science Council (GSC) comprised of research leaders in networking and distributed systems; the GSC will be chartered and supported by the NSF-funded Computing Community Consortium. The GPO will work in partnership with the GSC in all aspects of GENI design, development, construction and operation. The GSC will also develop a GENI Science Plan, a "living document" that will evolve over time as new scientific opportunities and challenges are identified.

- The annual Networking Technology and Systems Program [3] Solicitation was posted recently, calling for proposals by January 22, 2007. The preparation of this solicitation involved careful coordination with the theoretical foundations program solicitation to maintain the healthy dose of overlap between our programs. NSF's Networking Technology and Systems (NeTS) program solicits proposals from the networking research and education community, encouraging investigators to make bold assumptions about the future of networking.

The scope of the program covers all properties of information networks including network architecture, protocols, algorithms, and proof of concept implementation of hardware and software. Research activities include creation of new network architectures, modeling of phenomena, network design, analysis, measurement, and performance evaluation. The research scope of the program spans many types of networks that include end-to-end complex wide-area networks and sub-networks including local area networks, ad hoc networks, sensor networks, vehicular networks, and optical networks. It also includes research on heterogeneous networks that are hybrids of two or more types of sub-networks. NeTS proposals may be submitted in one of the four programmatic areas: Future INternet Design (FIND); Networking of Sensor Systems (NOSS); Wireless Networks (WN); and Networking Broadly Defined (NBD).

News on Communications Research

The reason for our delayed deadline (May 25, 2006) of TF06 [4] was that we wanted to be able to have access to 2007 funds that would become available on September 30; i.e., within the six-month "proposal dwell time" we aim to make decisions. This mechanism was set up as a means to even out the success rate in our program from year to year.   At the time of writing, some declination and some award decisions have been made, but half of the proposals are still under consideration.

While the TF06 competition has not yet been finalized, I am proud to have made this year's (2007) CAREER awards. I have made sure the success rate of this program (the apple of our eye; where NSF makes a most tangible mark in researchers' careers, and in turn, research) was not compromised by the ambiguity of our budget. The five awards that I am thrilled to have made are on proud display on our website.

The most frustrating part of the job, however, is to decline good proposals because of budget limitations. I'm tirelessly working on not only getting co-funding from other agencies, NSF directorates and divisions, but I'm also hoping to raise awareness of the relevance and application of our research in other sciences and engineering. As I reported in previous issues, the Science of Interaction initiative has taken hold, especially tightening the bond between information and biology areas.

I am excited by your enthused support of the Science of Interaction, and I look forward to our increased interaction to enable more resources into our areas.

On a Personal Note

One of the best rewards of my job is the chance to meet researchers face to face. Having settled in a relatively comfortable rhythm between my home institution and NSF, I have been able to increase the frequency of my planned visits out to universities. NSF encourages and sponsors these visits in a manner that will avoid any potential conflicts of interest. I have had the pleasure and privilege of meeting with researchers and administrators at Texas A&M, Rice University, Stevens Institute of Technology, Brooklyn Poly, Penn State, to name a few. These are not basic site visits where I review the ongoing programs at these institutions, rather, I fully take the opportunity to get firsthand input on how to improve our program, how to better serve our community. Teleconferencing is an excellent way of making up for the travel time I don't get often enough. The optimization of teleconferencing versus traveling is given in [5].

NSF People

In every column, I introduce some of the people I work with; who embody the culture and spirit of NSF. This time I would like to present two members of the GENI Team; in keeping with NSF tradition, a leader who is approaching the end of his sabbatical with NSF, and fresh blood who joined our front office recently.

Dr. Wei Zhao served as a Senior Associate Vice President for Research and a Professor of Computer Science at Texas A&M University. Since January 2005, he is the Director for the Division of Computer and Network Systems (CNS) at NSF, housing much of the communications networking and, more recently, management of GENI, in his team. Wei has been an enthusiastic supporter and co-funder of our SING program inspired by GENI. Wei is leaving us soon to join the academia as a dean. Wei's stellar research career is shadowed by his administrative successes in research management. His quick wit, smiley face, and general even keeled positive, constructive energy are all extremely hard to replace. Leading by example, he is often a nurturing team member making the tea for the rest of his group.

Ms Allison Mankin joined CNS as a program director, primarily looking after GENI related activities. Allison brings a wealth of Internet experience: working on projects including DNS security and IPv6. She is active in the IETF as a chair of the geolocation privacy working group, and the process and tools team. She was, for ten years the Director of Transport Area in the Internet Engineering Steering Group (IESG), and continues to serve in several directorates. She is a member of Internet2's Abilene technical advisory committee and ICANN's security and stability committee. Allison's vast experience is fueled by her well-grounded and seemingly infinite energy.

The "Social Scene"

After running the Theoretical Foundation Program competition this summer by way of conducting seven panels in five weeks, I'm proud to report our panels, as a rule, run efficiently and smoothly. Each panel meeting, as I described in my previous column, takes place over two days. The evening of the first day we have a pretty good idea of how

late we will have to work the second day. More often than not, we have been able to work till sixes and sevens the first day so that we could adjourn the intense meeting mid-afternoon the second day. Twelve to fifteen experts sharing their reviews of research proposals for two days in a room makes for a delightful social dynamic that gets energized over dinner and starts to unwind only at lunch the second day. It's a unique pleasure to observe the group form and function in a cohesive manner. It's absorbing, stimulating, fast paced, and fun. Over the last round of panels, I have learned more jokes and one-liners that made it to my personal favorites list than ever.

I have resumed my every-other-weekly commute to NJIT. Train trips mean reading time and in this case, guest column writing.

This column has given rise to an informal book club, since I have been reporting on train-ride reading: for those of you who are interested, I'm on the second read in former "NSFer" Kim Stanley Robinson's trilogy [6].

As usual, this column is coming to an end as the train is pulling into the beautiful Washington DC Union Station.

… Till next time, dream big, and keep in touch!

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REFERENCES:

[1] http://www.nsf.gov/pubs/2007/nsf07510/nsf07510.htm

[2] http://www.nsf.gov/pubs/2006/nsf06601/nsf06601.htm

[3] http://www.nsf.gov/pubs/2007/nsf07507/nsf07507.htm

[4] http://www.nsf.gov/pubs/2006/nsf06542/nsf06542.htm

[5] http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=106711&org=CISE

[6] http://www.amazon.com/Fifty-Degrees-Below-Stanley-Robinson/dp/0553803123/ref=pd_sim_b_1/102-6297158-4280944

Job Vacancies

Associate Professors/Assistant Professors (closing date: January 31, 2007)

The Department of Information Engineering at The Chinese University of Hong Kong (CUHK) invites applications of faculty positions at the above levels. Applicants should have (i) a PhD degree in any relevant areas in Information Engineering; and (ii) a strong research record. Apart from teaching, the appointees will actively undertake research projects in Communications Theory, Communications Systems and Networks (including Wireless and Lightwave Communications), Information Theory, Multimedia Systems, and Internetworking. Appointments will be made on a fixed-term contract basis normally for three years from August, 2007, renewable subject to mutual agreement. Visiting appointments of shorter duration will also be considered. Further information about the Department is available at http://www.ie.cuhk.edu.hk.

Salary and Fringe Benefits

Salary will be highly competitive, commensurate with qualifications and experience. The University offers a comprehensive fringe benefit package, including medical care, plus a contract-end gratuity for appointments of two years or longer, and housing benefits for eligible appointees.

Further information about the University and the general terms of service for teaching appointees is available at http://www.cuhk.edu.hk/personnel. The terms mentioned herein are for reference only and are subject to revision by the University.

Application Procedure

Please send full resume, copies of academic credentials, a publication list and/or abstracts of selected published papers, together with names, addresses and fax numbers/e-mail addresses of three referees to whom applicants' consent has been given for their providing references (unless otherwise specified), to recruit@ie.cuhk.edu.hk on or before January 31, 2007.

Call for Papers: Fifth International Workshop on Optimal Codes and Related Topics (OC 2007)

Dedicated to the 60th Anniversary of the Insitute of Mathematics and Informatics

Programme Committee	Stefan Dodunekov (Sofia), Tor Helleseth (Bergen), Ivan Landjev (Sofia), Juriaan Simonis (Delft), Leo Storme (Gent), Henk van Tilborg (Eindhoven)
Organizing Committee	Silvia Boumova (Sofia), Peter Boyvalenkov (Sofia), Emil Kolev (Sofia), Ivan Landjev (Sofia), Nikolay Manev (Sofia)
Local Organizer	Institute of Mathematics and Informatics, Bulgarian Academy of Sciences
Topics	• Optimal linear codes over finite fields and rings; • Bounds for codes; • Spherical codes and designs; • Covering problems for linear and nonlinear codes; • Optimization problems for nonlinear codes; • Sets of points in finite geometries; • Combinatorial configurations and codes; • Optimality problems in cryptography; • Graph theory and codes; • Related topics
Time	June 16 – 22, 2007
Location	The Workshop will take place at Hotel White Lagoon (http://www.whitelagoon-bg.com), near to Balchik, Bulgaria. The nearest airport (50 km) is in Varna but arrival in Sofia is also possible. White Lagoon offers nice accommodation and conference facilities. More information from the organizers at oc2007@moi.math.bas.bg.
Registration Fee (includes accommodation all inclusive, social events, workshop proceedings and materials)	EURO 470/520 (Double/Single room) prior to May 16, 2007; EURO 520/570 (Double/Single room) after May 16, 2007; EURO 370 for students (Double room); EURO 320 for spouses.
Deadlines	March 31, 2007: to inform the organizers if you intend to come; April 15, 2007: Deadline for submission of papers; May 1, 2007: Notification of acceptance (to be mailed out).
Language	The official language of the Workshop will be English. The organizers intend to prepare a book of proceedings of the Proceedings workshop. Authors are invited to submit at most six page camera-ready papers in English, LaTeX format 132x190 mm, by e-mail to oc2007@moi.math.bas.bg.
More information Visit our web site	http://www.moi.math.bas.bg/oc2007/oc2007.html.

Ninth International Symposium on Communication Theory and Applications
(ISCTA '07)
15th - 20th July, 2007, Ambleside, Lake District, UK

LANCASTER
UNIVERSITY

First Call for Papers

A major objective of the Symposium will be to pursue the progression from communication and information theory through to the implementation, evaluation and performance of practical communication systems of various types. You are invited to submit original papers in the following and related areas:

Digital Transmission and Recording
Source and Channel Coding
Modulation, Detection, Channel Estimation
Channel Modelling, Synchronisation
Optical and Magnetic Recording

Space-Time Techniques
Information-Theoretic Aspects, Channel Capacities
Space-Time-Coding, Signal Constellations
Spatial Spreading, Linear Dispersion Codes
MIMO Detection and Channel Estimation
MIMO Precoding, Writing on Dirty Paper
Time Reversal

Special Topics in Channel Coding, Source Coding, Information Theory
Turbo Codes, Low Density Parity Check Codes
Source Coding and Data Compression
Privacy, Secrecy and Security
Multi-Functional Coding
Sequences and Arrays
Fountain, LT, etc. codes

Systems, Multiple Access, Protocols
Communication System Architectures
3G and Beyond-3G Wireless Communication Systems
Sensor Networks
Ad Hoc Networks
Multiple Access Techniques, Protocols
Multimedia Networking, wireless e-learning, e-commerce and e-health

Detection Techniques
Vector Detection, Multiuser Detection
Combined Equalisation, Decoding and Channel Estimation
Iterative (Turbo) Schemes

Realisation
DSP for Communication Systems
MIMO Demonstrators
Complexity Considerations
Implementation of LDPC decoders

Broadband Techniques
Ultra Wideband
Fixed Wireless Access

Fusion of Communication and Location
GNSS-based
Probabilistic algorithms
Applications

The deadline for the submission of papers for consideration is Friday 2nd March, 2007. Papers should not exceed 6 pages in length, including figures. Please submit your paper to:

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Lancaster LA1 4YR UK
Tel: +44 (0) 1524 510398
Fax: +44 (0) 1524 510493
E-mail: b.honary@lancaster.ac.uk

or

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Tel: + 44 (0)191 222 7332
Fax: +44 (0)191 222 8180
E-mail: r.carrasco@ncl.ac.uk

You will be notified of acceptance by 20th April, 2007. There will then be an opportunity to revise your paper, taking into account any comments by the referees, and to put it into the required format for the Symposium Proceedings. The deadline for receipt of your revised paper is 18th May, 2007.

Organising & Program Committee

Bahram Honary (UK)	Mario Blaum (USA)	Rolando Carrasco, UK (Technical Chair)
Michael Darnell (UK)	Pingzhi Fan (PR China)	Paddy Farrell (UK)
Lina Fagoonee (UK)	Eric Gabidulin (Russia)	Lajos Hanzo (UK)
Peter Hill (UK)	Jurgen Lindner (Germany)	Shu Lin (USA)
Garik Markarian (UK)	Robert McEliece (USA)	Jorge Pereira (Belgium)
Valdemar da Rocha (Brazil)	Ismael Soto (Chile)	Martin Tomlinson (UK)
Javier Garcia-Villalba (Spain)	Han Vinck (Germany)	Tad Wysocki (Australia)
Izzat Darwazeh (UK)	George Kolev (Russia)	Nigel Wall (UK)

The Symposium Venue is St. Martin's College, Ambleside, Cumbria, UK, where all the presentations, most meals, and social events, will take place. Ambleside is in the famous and very beautiful English Lake District, and there will be opportunities for walks and excursions during the Symposium.

For information on registration fees and accommodation, please consult our website: http://www.hwcomms.com/iscta07.htm or http://www.dcs.lancs.ac.uk

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WNC^3 - WiOpt

CALL FOR PAPERS

International Workshop on Wireless Networks: Communication, Cooperation and Competition

Mediterranean Beach Hotel
April 16-20 2007, Limassol, Cyprus

(part of the WiOpt 2007 Conference)

Research in the area of wireless communication networks has recently experienced an unprecedented embrace by both industry and academia. Interest has been fueled by advances that promise exponential gains in the error performance of networks with reduced structure, little central oversight, and limited computational capabilities. The research area's utility and challenging nature is demonstrated both by the contributions from a variety of disciplines, such as information theory, discrete mathematics, game theory and finance, as well as from the effort to unify the above and to bring forth the inherent complexities of multi-terminal communication and interaction.

In pace with the above challenges, the workshop will promote new results which explore the theoretical limitations of network communications, propose novel network coding schemes, present relaying methods and cooperation protocols, and investigate fundamental tradeoffs between cooperation and competition for resource allocation. The aim being to provide the participants with an in-depth and unifying exposition to the complex nature of analyzing, coding, cooperating and competing in wireless networks, the workshop will seek to expose the intricacies of multi-terminal network theory and the advanced mathematical structures that support network communication and interactions. In the spirit of a workshop, exposition will accentuate both the unifying aspects as well as the competing nature of different viewpoints. The workshop will consist both of invited talks on recent landmark results as well as solicited contributions.

In the framework of communication, cooperation and competition over wireless networks, papers are solicited in, but not limited to, the following directions.

Sessions of Interest:

- Cooperative diversity
- Network coding techniques
- Information theoretic bounds
- Stochastic network optimization
- Queueing theoretic aspects
- Application of game theory tools
- Application of sensor networks

Important Dates

- Manuscript Submission Due: December 15, 2006
- Notification of Acceptance: January 31, 2007
- Camera-Ready Manuscripts Due: March 1, 2007

- Registration details: www.wnc3.org   www.wiopt.org
- Awards will be offered to distinguished papers
- **Publication:** Pending

General Workshop Chair
Charalambos Charalambous, University of Cyprus

Workshop Co-Chairs:
Petros Elia,   USC, USA
Christina Fragouli   EPFL, Switzerland

Scientific Committee Chair
Zhen Zhang   USC, USA

Plenary Speaker:
Professor Babak Hassibi from Caltech will be presenting this year's plenary lecture.

Scientific Committee:
Jean-Claude Belfiore, Irad Ben-Gal, Sem Borst, Reuven Cohen, Hesham El Gamal, Anthony Ephremides, Elza Erkip, Piyush Gupta, Yezekael Hayel, Tara Javidi, Christos Komninakis, Ivana Maric, Urbashi Mitra, Mehul Motani, Frederique Oggier, Ariel Orda, Ozgur Oyman, B. Sundar Rajan, Sumeet Sandhu, Devavrat Shah, Emina Soljanin, Daniela Tuninetti, Sriram Vishwanath, Joerg Widmer, Liang-Liang Xie, Feng Xue.

Call for Papers

12th International OFDM-Workshop 2007 (InOWo'07)

August 29th - 30th 2007
Hotel Atlantic, Hamburg, Germany

The 12th International OFDM-Workshop (InOWo'07) provides again an opportunity for international researchers and experts interested in all aspects of the OFDM transmission technique to meet and discuss current activities and results of their research work. The workshop is located in the centre of Hamburg, Germany, and takes place Wednesday through Thursday, August 29th - 30th 2007. In addition to the two-day conference a half-day tutorial on various aspects of the OFDM transmission technique is planned for Tuesday, August 28th 2007.

Paper submissions for the technical sessions may cover all aspects of multi-carrier transmission including any of the following areas (but not limited to):

Signal Processing in OFDM Systems:
- Modulation Techniques
- Equalisation and Synchronisation
- Channel Coding
- Non-Linearities
- Multiple Access Techniques

OFDM System Concepts:
- Crosslayer Optimisation
- 4th Generation Networks
- HiperLAN/2, IEEE 802.11, WiMAX
- DLC-Protocol Issues
- Ad-Hoc Networking, xDSL

MIMO with OFDM:
- Antenna Techniques
- MIMO Coding
- Multi User Systems and MIMO

Experimental Systems and Field Trials:
- Implementation Issues
- VLSI Architectures
- Software Defined Radio for OFDM

Authors are invited to submit a one-page extended abstract, including the authors' full contact information, to the workshop e-mail address: ofdm@tu-harburg.de.

Important Dates

Deadline for Extended Abstracts:	April 13, 2007
Notification of Acceptance:	May 28, 2007
Early Registration:	July 15, 2007
Final Papers Due:	July 15, 2007

For further information about this Workshop, as well as detailed instruction for submitting the final paper, please visit our web page at: http://ofdm.tu-harburg.de

Conference Chair

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http://ofdm.tu-harburg.de

Conference Calendar

Information available at http://www.ieee.org/conferencesearch/

DATE	CONFERENCE	LOCATION	CONTACT/INFORMATION	DUE DATE
January 29, 2007	**The Third Workshop on Network Coding, Theory, and Applications (NetCod 2007)**	San Diego, CA, USA	http://code.ucsd.edu/netcod07/	August 28, 2006
January 29-February 2, 2007	**The 2007 Information Theory and Applications Workshop (ITA 2007)**	San Diego, CA, USA	http://ita.ucsd.edu/workshop.php	TBA
May 6-12, 2007	**2005 IEEE Conference on Computer Communications (INFOCOM 2007)**	Anchorage, AK, USA	http://www.ieee-infocom.org/2007	August 1, 2006
March 14-16, 2007	**Conference on Information Sciences and Systems (CISS 2007)**	The Johns Hopkins University, Baltimore, MD, USA	http://ciss.jhu.edu/	January 31, 2007
April 16, 2007	**Spatial Stochastic Models for Wireless Networks (SPASWIN 2007)**	Limassol, Cyprus	http://www.spaswin.org/spaswin-cfp.htm	December 15, 2006
April 16-20, 2007	**5th Intl. Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt-2007)**	Limassol, Cyprus	http://www.wiopt.org/	October 16, 2006
April 20, 2007	**International Workshop On Wireless Network Measurement (WiNMee/WiTMeMo 2007)**	Limassol, Cyprus	http://www.winmee.org/	December 8, 2006
April 20, 2007	**Resource Allocation in Wireless Networks (RAWNET 2007)**	Limassol, Cyprus	http://www.rawnet.org/	December 15, 2006
April 20, 2007	**Wireless Networks: Communication, Cooperation and Competition (WNC^3 2007)**	Limassol, Cyprus	http://www.wnc3.org/	December 15, 2006
April 20, 2007	**Control Over Communication Channels (CONCOM 2007)**	Limassol, Cyprus	http://www.concom.org/	December 15, 2006
May 6-12, 2007	**2007 IEEE Conference on Computer Communications (INFOCOM 2007)**	Anchorage, AK, USA	http://www.ieee-infocom.org/2007/	August 1, 2006
May 20-23, 2006	**2007 IEEE Communication Theory Workshop (CTW 2007)**	Sedona, AZ, USA	http://www.comsoc.org/~comt/workshops.html	TBA
July 1-6, 2007	**2007 IEEE Information Theory workshop for Wireless Networks (ITW 2007)**	Bergen, Norway	http://www.selmer.uib.no/ITW2007.html	March 16, 2007
June 17-20, 2007	**IEEE International Workshop on Signal Processing Advances for Wireless Communications (SPAWC 2007)**	Helsinki, Finland	http://wooster.hut.fi/spawc07/	September 15, 2006
July 24 -29, 2007	**2007 IEEE International Symposium on Information Theory (ISIT 2007)**	Nice, France	http://www.isit2007.org/	January 8, 2007
June 24 – 28, 2007	**2007 IEEE International Conference on Communications (ICC 2007)**	Glasgow, Scotland, UK	http://www.comsoc.org/confs/icc/2007/index.html	September 25, 2005
July 15-20, 2007	**9th International Symposium on Communication Theory and Applications (ISCTA '07)**	Ambleside, Lake District, UK	http://www.hwcomms.com/iscta07.htm	TBA
August 29-30, 2007	**12th International OFDM-Workshop 2007 (InOWo'07)**	Hamburg, Germany	http://ofdm.tu-harburg.de	April 13, 2007