

IEEE Information Theory Society Newsletter



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President's Column

David L. Neuhoff



David L. Neuhoff

As I write this in April, spring has finally arrived in the north central US and the academic year is winding down. It is a pleasure to look ahead to a summer of outdoor activities and indoor research, with special attention to my favorite information theory topics. Of course, the highlight of the summer will be the IEEE International Symposium on Information Theory (ISIT 2006) in Seattle in July, being organized by

Jodi O'Sullivan, John Anderson, and a host of others. See www.isit2006.org.

Thinking ahead to ISIT reminds me of the two workshops I have already attended in 2006. The information theory year began in February with the Information Theory and Its Applications (ITA) Workshop, sponsored by the newly formed Information Theory and Applications Center at UC San Diego, organized with exquisite detail and humor by Alon Orlitzky and a number of others. Attendees who received the "ITA without tears" email from Alon before departing for San Diego will know just what I mean. This workshop included the inauguration of the new center. With over 400 attendees, it was a smashing success. We are all wondering if they will continue this fine workshop next year. Whether or not they do, we can expect to hear of many interesting things happening at the ITA Center. See <http://ita.ucsd.edu> for more information.

The second workshop was ITW in Punta del Este, Uruguay, in March. This workshop provided an unprecedented opportunity for many of us to visit Uruguay, as well as to attend an outstanding workshop. With 155 attendees, nearly 40% of whom were from Uruguay, it also offered an

unprecedented opportunity for local engineers to attend an information theory event. We hope to have made a number of converts. Many attendees remarked on how well organized was the workshop and how interesting were the papers. Thanks very much to Gadiel Seroussi, Alfredo Viola and the other organizers for such a great workshop. See also the article in this issue.

Uruguay was also the site of the first IT Society Board of Governors meeting of the year, and also, of the new "tradition" of an Officers Meeting prior to the first BoG meeting. Last year we met in Metz, France, where then president Steve McLaughlin was teaching. At these meetings, the officers (president, vice presidents and past presidents) as well as treasurer and editor-in-chief, spend a day and a half discussing strategies for the future and proposals to make to the Board of Governors. Those who could not physically be present joined via Skype. Highlights of the BoG meeting included actions of the Board to (1) maintain the 2007 IT Society membership and hard copy IT Transactions fees at 2006 levels, (2) form an ad-hoc committee to consider the possibility of a permanent conference committee, (3) propose the inclusion of electronic access to past ISIT and ITW proceedings as an additional benefit of IT Society membership, (4) permit local students to attend ISIT at reduced cost, and (5) to encourage ISIT and ITW attendees who are not members of IEEE and IT to join on site. See the treasurer's corner in this issue for more information about the last two items. We are now in discussion with IEEE headquarters to see if the third item is feasible. At the present moment, it seems likely that we can do this on a trial or promotional basis for 2007. However, it is not clear that we will be able to continue beyond 2007.

I wish you all of you a pleasant and productive summer, and hope to see many at ISIT 2006.

From the Editor

Dear IT society members, welcome to the summer 2006 issue of our newsletter. First of all, I would like to join our President Davis Neuhoﬀ in wishing each and every one of you a pleasant and productive summer. Second, borrowing our historian Anthony Ephremides' culinary comparison, let me unveil the rich menu of this issue:

As an amouse-bouche, I propose a summary of the main society events during the first quarter of 2006 in David Neuhoﬀ's "President's Column", as well as a very fascinating comparison between Information Theory and Communication & Network Theory by analogy with different types of cuisine in Anthony Ephremides' "Historian's Column".

I shall then offer you two appetizers: first, an interesting reflection on the key ideas, impact and potential of the recently discovered duality relationship between Gaussian Multiple Access Channels and Gaussian Broadcast Channels by the winners of the "2005 Joint Information theory/Communications Society Paper Award" Nihar Jindal, Andrea Goldsmith and Sriram Vishwanath. Second, a description of the first "Kailath Lecture and Colloquium" on the occasion of Thomas Kailath's 70th birthday.

As sorbet, please enjoy solving the Classic Mathematical Quickies you will find in "Golomb's Puzzle Column".

For the main course, you can choose between five different conference reports, even though I warmly suggest you taste them all. Four of them took place in the Southern Hemisphere (ITW05 in New Zealand, ISIT05 in Australia, AusCTW05 in Australia and ITW06 in Uruguay) and one in the USA (CISS06). You can accompany the main course with a description of the recent activities and future initiatives of the ITSoc Student Committee and an update of what is going on behind the scene of www.ItSoc.org by newly appointed On-Line Editor Nicholas Laneman.

For cheese platter, I propose to read the latest news about our society's solid finances in Muriel Medard's "Treasurer's corner" and to taste it with two wines, the minutes of the past two Bord of Governors meetings.

For coffee, check out your Mini-Sudoku skills in "Golomb's Puzzle Column Solution" and read our "Guest Column: for the National Science Foundation" by Program Manager Sirin Tekinay.

To conclude, as pousse-café, take a look at the list of incoming conference deadlines and calls for paper.

I hope you will enjoy the menu as much as I did putting it all together!

But before you start your reading, I would like to share with you an update on the arXiv front. As you know, for the past year and a half, the IT Society has been encouraging the use of the arXiv preprint server at <http://arxiv.org>. I am pleased to announce that the posts in the cs.IT area are now running at a level of over 100 posts per quarter, as shown in the accompanying bar chart.

continued on page 3



Daniela Tuninetti

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Table of Contents

President's Column	1
From the Editor	2
The Historian's Column	3
2005 Joint Information Theory/Communications Society Paper Award	4
2005 Kailath Lecture and Colloquia	7
Golomb's Puzzle Column: Classic Mathematical Quickies	9
Workshop Report: The 2006 IEEE Information Theory Workshop, Uruguay	10
Workshop Report: The 2005 IEEE International Symposium on Information Theory	11
Workshop Report: The 2006 IEEE Information Theory Workshop, New Zealand	12
Workshop Report: The 7th Australian Communications Theory Workshop (AusCTW'06)	13
Workshop Report: The 40th Annual Conference on Information Sciences and Systems	14
Updates Behind the Scenes at www.itsoc.org	15
An Update on the Information Theory Society Student Committee Activities	16
Treasurer's Corner	17
Information Theory Society Board of Governors Meeting (March 05)	18
Information Theory Society Board of Governors Meeting (September 05)	20
Guest Column: From the National Science Foundation	22
Golomb's Puzzle Column: Mini-Sudoku Solution	25
2006 IEEE Information Theory Workshop – Call for Papers	27
Conference Calendar	28

continued from page 2

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:

Issue	Deadline
September 2006	July 15, 2006
December 2006	October 15, 2006
March 2007	January 15, 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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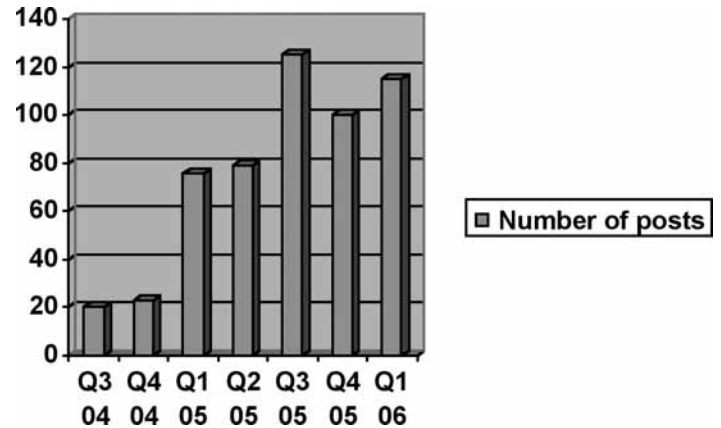
Sincerely,
 Daniela Tuninetti

The Historian's Column

Today I will take "maximal" license and attempt a bold venture into matching some very heterogeneous concepts. Before you conclude that I have slid into flippancy, I hope you will open your mind and wear a different kind of eyeglasses that will enable you to look into the space I try to develop for you. My aim today is to draw a parallel between scientific disciplines and ... cuisine! For those who know me, it will not be surprising that I see analogies between food for the mind and food for the body. After all, my ancestors did state that a healthy mind can exist only in a healthy body (before you take issue with this assertion, let me be the first to admit that there are many and notable exceptions; the British physicist Hawkins and many basketball players, who shall remain unnamed, spring immediately to mind).

I want to, hereby, claim that Information Theory is to Communication and Network Theory what French cuisine and wine is to American and Australian cuisine and wine, respectively. Before I proceed, let me state that there can be additional parallels drawn to Chinese, Indian, and other cuisines. The reasons for which I stick to the "western" style of food are (i) I am more familiar with it, (ii) oriental and "exotic" cuisines lack the wine component (that will be central to my arguments), and (iii) as Hemingway said, there are three orthogonal dimensions of cuisine that span the space of "taste", namely, French, Chinese, and ... Turkish. Thus, I will stock mostly to one dimension, since, in Science, there are probably many more dimensions of thinking than three, and since I am limiting myself to a focus on the "space" of communications.

The epiphany to my mind was a recent weekend in New York City where I had the chance to sample the full spectrum of cui-



Anthony Ephremides



sine nuances from pure French to pure American (and beyond) and where it clearly dawned on me that the differences were so parallel to those between Information Theory and the more applied approaches to Communications that the story had to be told.

Before I go further let me gently remind you that you have to put on your special eyeglasses (just like the ones you must wear to enjoy and appreciate a 3-D movie) in order not to dismiss my arguments.

So, in simple (and simplified) terms, the French style of cooking and wine making has above all, subtlety. Forget about Jacques Chirac and Charles deGaulle. We are talking food and wine here. We are talking Troisgros, Bocuse, Ducasse, Petrus, Lafite, Dom Perignon, etc. The French will never bring you unchilled white wine. They will never give you inadequate utensils for your dishes. They will never serve you coffee before (or with) the dessert. They will never stand on top of you like hawks to remove your plate as soon as you take your last bite. They will never overcook your fish. They will never name a wine "Crazy Horse". They will respect your presumed elevated sense of taste. Never too much salt; never unseasonal ingredients; never pasteurize the milk for your cheese (globalization pressures tend to, unfortunately, corrupt some of these practices; more on this later). By contrast, American (and Australian) cuisine will want to surprise you. Either through "all you can eat", or through

ingredients you never heard of before, it will tend to saturate you and stun you, one way or another. And, the same is true of the wine making. The objective there is “bigness”, obvious shock on the taste buds, and ... standardization. No risks to be taken. Plastic corks (or screw tops), homogenization, and fanciness are the order of the day.

Look now at the disciplines. Information Theory is not interested in stunning the public. It is not interested in standardizing (it did not even attempt to standardize the “bit” over the “nat” as a unit of information). It is interested in subtlety and depth. It is eclectic. It is not interested in attracting the crowds. It is not going with the trends and yet it often (if not always) displays originality.

By contrast, Communication and Network Theory wants to be noticed. It wants to grow. It wants to take over. It pushes standards, it leads to new products. It accommodates the ... uninitiated. It adds intellectual “salt” aplenty. It knows you don’t care about whether your wine is chilled or not. It facilitates your use of intellectual utensils. It comes up with fancy names (Ethernet, TCP, Blackberry, Apple as opposed to side-information, decoding, multiple descriptions).

A French wine maker would choose “Slepian-Wolf” over “ARQ” as a label for his product. An American chef would choose “High Speed” rather than “Asymptotically Capacity Achieving” as a name for his sauce. And an Australian would take “Flow Control” over “Rate Matching” as a description of his products.

Don’t get me wrong. Communication and Network Theory is wonderful. Just like creative American cooking and Australian,

imaginative wine making, it drives innovation, satisfies many of our needs, entertains, and creates a sea change in our Society. But Information Theory, just like the best of the French traditionalists in food and wine, enhances our senses, strives for perfection, often seems difficult and obtuse, but it does not compromise. It worships its giants and its rare and, usually, evolutionary innovators. It does not swing with the wind. As a result it is often declared out of touch or even ... dead. Yet, not only does it survive but it serves as the conscience and source of inspiration for Communication System and Networking design. Just like new chips embody Viterbi decoding or Lempel-Ziv, or turbo codes or just like Charles Trotter and others draw from the principles of Troisgros, and like Mondavi draws from the tradition of the wine masters of Gevrey-Chambertin.

But there is a danger in the horizon. Fine dining and wining has become all too popular. The temptation to mislead the many ignoramuses is intense. Huge profits and glory can be achieved all too easily. Google can become like Starbuck’s, iPod can become McDonald’s. The public will be delighted. And there is real need for this sort of thing. At the same time, there is still need for a few dining sanctuaries and exceptional wines that will never capture the headlines. They will remain as secret as some special fraternity grounds. They will continue to produce sublime products that will be enjoyed by the “cognoscenti”; and that will inspire those who straddle the fences to go out and popularize them. Let us make sure that no disruptive innovation replaces the real thing!

I know that every analogy can only go so far. But for this one, as the Italians say, “se non é vero, é bello”!

2005 Joint Information Theory/Communications Society Paper Award: Reflections on MAC-BC Duality

Nihar Jindal, Andrea Goldsmith and Sriram Vishwanath

The mirror-image relationship between the Multiple Access Channel (MAC) and the Broadcast Channel (BC) begs for a duality relationship between them. This duality has been hinted at in the similarities between the capacity-achieving strategies of the Gaussian MAC and BC, which both employ a form of superposition encoding and successive decoding/interference cancellation at the receiver, with water-filling of power over time or frequency under fading or intersymbol interference. Despite the similarities in the structures and capacity-achieving strategies for these channels, an explicit duality relationship between the BC and MAC had not previously been established, although its existence was expected. Indeed, Cover & Thomas [1] state that, although other forms of duality had emerged in information theory, “one would have expected a duality between the BC and the multiple access channel.” The paper “On the Duality of Gaussian Multiple-Access and Broadcast Channels” uncovers an extremely simple yet powerful duality relationship between Gaussian MACs and BCs, which allows the capacity region and capacity-achieving transmission and reception strategies for a MAC to be obtained from its dual BC, and vice versa. As illustrated in the paper, this duality can be used to solve open capacity problems as well as to greatly simpli-

fy the calculation of known capacity regions. The paper also discusses how the duality relationship extends beyond Gaussian channels to fading, MIMO, and deterministic BCs and MACs.

Let us first describe the basic duality result for MACs and BCs with Gaussian noise. Consider a K -user AWGN BC, where a transmitter sends data simultaneously to K independent receivers with channel gain h_i between the transmitter and the i -th receiver. The i -th received signal y_i is described by:

$$y_i = h_i x + z_i, \quad i = 1, \dots, K,$$

where x is the transmitted signal and z_i is circularly symmetric complex Gaussian noise, iid for the K users. The *dual* MAC is simply the “role-reversed” channel, i.e., the resulting channel if the transmitters and receivers switch roles, so now K transmitters send data to a single receiver with channel gain h_i between the i th transmitter and the receiver. Furthermore, the received Gaussian noise in the dual MAC has the same statistics as in the BC. The received signal in the dual MAC is thus described by:

$$y_{MAC} = \sum_{i=1}^K h_i x_i + z,$$

where z has the same power as any one of the z_i 's in the BC. Note that this MAC-BC dual pair of channels exactly describes a time-division duplexed (TDD) wireless channel with equal noise powers at all receivers.

The capacity region of a K -user BC or MAC is a K -dimensional region describing all rates that can be simultaneously achieved by each user with asymptotically small error probability. This capacity region is known for most memoryless MACs of interest, but is generally unknown for most memoryless BCs. However, the capacity region of the K -user AWGN BC, which we denote as $C_{BC}(h_1, \dots, h_K; P)$, falls into the class of *degraded* BCs, whose capacity region is known. Assuming WLOG that $h_i \geq h_j$ for $i < j$, the capacity region of the K -user AWGN BC is the set of rate vectors satisfying [2]:

$$C_{BC}(h_1, \dots, h_K; P) = \left\{ (R_1, R_2, \dots, R_K) : \begin{array}{l} R_i \leq \log \left(1 + \frac{h_i^2 P_i}{1 + \sum_{j < i} h_j^2 P_j} \right) \\ \exists P_i \geq 0, \sum_i P_i = P \end{array} \right\} \quad (1)$$

where P is the average power constraint that must be met by the input x : $E[|x|^2] \leq P$. The capacity region of the K -user AWGN MAC is well known and typically assumes a separate power constraint on each of the K transmitters. For the purposes of establishing a simple duality relationship, however, consider a joint power constraint across all K transmitters: $\sum_{i=1}^K E[|x_i|^2] \leq P$. The capacity region of the MAC, subject to this sum power constraint, is given by:

$$C_{MAC}(h_1, \dots, h_K; P) = Co \left\{ (R_1, R_2, \dots, R_K) : \begin{array}{l} R_{\pi(i)} \leq \log \left(1 + \frac{h_{\pi(i)}^2 P_{\pi(i)}}{1 + \sum_{j < \pi(i)} h_{\pi(j)}^2 P_{\pi(j)}} \right) \\ \exists P_i \geq 0, \sum_i P_i = P, \text{ permutation } \pi \end{array} \right\} \quad (2)$$

where $Co(\cdot)$ refers to the convex hull operation.

With this background in hand, the fundamental duality result between the MAC and BC capacity regions can now be stated in a single line:

$$C_{BC}(h_1, \dots, h_K; P) = C_{MAC}(h_1, \dots, h_K; P)$$

The interpretation of this result is very simple: the capacity regions of the Gaussian downlink and uplink with sum power constraint are identical. The proof of this statement requires only equating the per-user rate equations in the capacity expressions of the BC and MAC and seeing that simple non-linear transformations relate the BC and MAC power allocations. One transformation finds the downlink power allocation in terms of the uplink power allocation achieving the same rates, while the other finds the uplink power allocation in terms of that of the downlink. In both cases, the exact rate of each user and the sum power of the system are preserved. Moreover, the capacity-achieving transmission and reception strategy of one channel can be obtained from its dual. Specifically, the capacity-achieving strategies for the AWGN MAC and BC are well known, and are parameterized by their power allocation and decoding order. As just described, the



From left to right: Andrea Goldsmith, Sriram Vishwanath and Nihar Jindal.

optimal power allocation for any point on the BC capacity region is obtained from the optimal power allocation for the corresponding point on the MAC capacity region, and vice versa. For decoding, in both channels successive interference cancellation is known to be the optimal strategy. Due to the degraded nature of the Gaussian BC, it is optimal to perform this successive decoding in order of increasing channel gains [2], i.e., the user with the largest channel gain decodes all other codewords first, beginning with the weakest user. In the MAC with a sum power constraint, we find via the duality proof that the decoding order *opposite* to that of the BC is optimal, i.e., the user with the weakest channel gain is decoded last. Thus, optimal power allocation and decoding order, and hence the capacity-achieving transmission and reception strategy, for one channel can be obtained from its dual. While the result is stated here for AWGN channels, it extends in a straightforward manner to fading channels under a number of different notions of capacity (e.g., ergodic as well as outage capacity) assuming perfect channel knowledge at transmitters and receivers.

We came about this result while studying optimal power allocation schemes for the fading MAC and BC. The similarity between the ergodic-capacity achieving schemes for the fading MAC [3] and BC [4] sufficiently piqued our interest to lead us to consider the MAC and BC with equal channel gains and noise power. Once the correct dual channels were considered, the result followed in a very straightforward fashion. So why is it that this result went unnoticed by researchers for so many decades? We guess that notation played a large role in hampering its discovery. In earlier information theoretic treatments of the MAC and BC as in Cover & Thomas [1], no channel gain is considered: all channels are set to unity, and user quality is differentiated based on noise power in the BC and on individual power constraints in the MAC. In this framework, there is no obvious dual channel model. Only after the channel attenuation, as experienced in wireless channels, was explicitly considered in multi-user system models (which seemed to have begun in the 1990's), could the relationship become apparent. Note that earlier research had identified a connection between the uplink and downlink channels in the context of the achievable rates with downlink transmit beamforming and uplink receive beamforming (without interference cancellation on either channel), but this work did not apply to the actual capacity region of these channels [5] [6] [7].

After a few years of hindsight, we are now able to more clearly see the implications of the MAC-BC duality. First, and most obviously, duality provided a unification of research on the capacity of the MAC and BC, particularly in the fading versions of these channels. There is a great body of literature on optimal power/rate control for the fading Gaussian MAC and BC (c.f. [8] [3] [9] [4]), and one can now see that these two bodies share a direct relationship. Perhaps more important, though, has been the use of duality in the study of the multiple antenna BC, which we discuss next.

In light of Caire & Shamai's groundbreaking work on the multiple antenna BC, an obvious question that followed our initial duality work was whether the same duality relationship applied to the multiple antenna versions of the Gaussian BC and MAC? While it was not yet known that dirty paper coding, which can be used to perform interference pre-cancellation at the transmitter in the BC, achieved the full capacity region, we were able to establish the same duality relationship between the dirty paper coding achievable region (which is now known to be the actual capacity region [10]) and the capacity region of the multiple antenna MAC. Using the same idea as for the single antenna channel, the dual MAC was formed by reversing the roles of transmitters and receivers, and thus corresponds mathematically to taking the transpose of each channel matrix. The equivalence of these two regions was shown by establishing a more complicated transformation between BC input covariances and MAC input covariances that preserves user rates and sum power [11].

The dual MAC expression for the dirty paper coding region led to proofs of the sum capacity-optimality of dirty paper coding [11] [12] (reference [13] provides a proof of the same result not requiring duality), as well as bounds to the full capacity region [14] [15]. Efforts in this field culminated with the work of Weingarten, Steinberg, and Shamai showing that the dirty paper coding region is indeed the capacity region of the multiple antenna BC, although ultimately a proof not requiring duality was derived [10]. In addition, duality has continued to play an important role in research on the multiple antenna BC by allowing for efficient computation of the BC capacity region. The dirty paper coding-based rate equations describing the multiple antenna BC capacity region are not concave functions of the input covariances, and thus are extremely difficult to analyze or numerically optimize. The multiple antenna MAC, on the other hand, can be described by concave functions and thus allows for efficient convex optimization techniques to be employed. As a result, a large majority of information theoretic research on the multiple antenna BC studies the equivalent dual multiple antenna MAC.

Although the treatment of the Gaussian MAC and BC has been a relative success, an unanswered and lingering question is whether the MAC-BC duality can be generalized to other channel models? In the discrete memoryless setting, the challenge is to find a meaningful yet simple relationship between BC's and MAC's. We attempted to attack this question by first considering one of the simplest class of channels: deterministic, or noiseless, channels. While we were able to establish a meaningful dual MAC for the well-known ternary-input, binary-output Blackwell BC [16], we also showed that there exist simple deterministic BCs for which no dual MAC (within our specific framework) exists [17]. These initial results lead to a somewhat pessimistic outlook on the possibility of a very general MAC-BC duality.

Another, possibly more promising, avenue for expanding duality is in the realm of multi-user Gaussian networks, by which we mean multi-transmitter/multi-receiver networks subject to additive Gaussian noise at all receivers. The dual BC and MAC's are formed simply by reversing the roles of transmitters and receivers, and the same idea can be applied to an arbitrary multi-user Gaussian network as well. Thus, it is very tempting to conjecture a similar duality result holds in such networks, but of course such a result cannot be verified since capacity results are in general unknown for such networks.

While it remains to be seen if any such extensions come to fruition, if nothing else the MAC-BC duality was able to unite two seemingly separate branches of the knowledge tree, which, according to Robert Gallager, is the role of theory.

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2005 Kailath Lecture and Colloquia

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. Following the example of his remarkably wide-ranging career, 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, increasingly, the physical, biological and social sciences.

The first of these events - the Kailath Lecture and Colloquium - was held at Stanford during June 9-10, 2005, with a standing-room crowd of more than 200, including many members of the Information Theory Society. The Colloquium began with a morning session on June 9, with talks by John Cioffi and A. Paulraj of Stanford, and Vwani Roychowdhury of UCLA, who was a principal organizer of the event and of the Kailath Fund. A highlight of the occasion was a "Q&A with TK" session in which Prof. Kailath reminisced about his career and fielded questions from the audience about his philosophies of teaching and research. The final event of the day was Prof. Gallager's Kailath Lecture, entitled "The Golden Years of Information Theory." The basic thesis of this lec-



Kailath with two well-wishers.

ture was that much of the power and simplicity of the field of information theory has been lost in the exigencies of today's research environment. Rather than being a mere lament, however, the lecture was a call to arms for the community to return to its roots by focusing on elegance and fundamentals.

A video of the Gallager and Kailath sessions can be found at <http://isl.stanford.edu/kailathlecture/>. Slides used in the other talks of the day are also included there.

Following the day's events, a reception and dinner were held at Stanford's Arrillaga Alumni Center, during which many of Profs. Gallager's and Kailath's friends, former students and colleagues, paid tribute to these two giants of our field. It was a remarkable evening, as the many and diverse influences of these two men were recounted. At the end of the evening, Prof. Kailath took the podium and, in a very gracious and moving speech, thanked his family, friends, students and colleagues for their contributions to his life and career.

On the following day, a second colloquium was held, organized by Prof. Paulraj. The speakers included S.-Y. Kung and Sergio Verdú of Princeton, Hanoch Lev-Ari of Northeastern, Bernard Levy of



Gallager delivering the first Kailath Lecture.

UC-Davis and Dirk Slock of Eurocom. This event concluded with a panel session entitled, "The Next Big Thing in Signal Processing and Communications." This panel, organized by Stanford's Ozgur Oyman and Erik Stauffer, included panelists Helmut Bolcskei of ETH-Zurich, Vincent Poor of Princeton, and David Tse of Berkeley, who opined on future directions in these fields. Again, slides of the day's talks can be found on the above website.

Overall, these events of June 9 and 10, 2005, comprised a very significant occasion. The speakers provided much food for thought about the directions of information theory and related fields, and the inspiring messages from Profs. Kailath and Gallager are certain to influence all of the generations of researchers present.

The next Kailath Lecture is eagerly awaited, and will be delivered on July 6, 2006 by another of Prof. Kailath's MIT classmates, Prof. Jacob Ziv of the Technion. There will also again be two colloquia (on July 6 and 7); one of these colloquia will celebrate the 40th anniversary of the Schalkwijk-Kailath paper on a simple scheme for exploiting noiseless feedback on the Gaussian channel to communicate at channel capacity with the error probability declining at a double-exponential rate. The results of this paper have been explored and extended in recent years for applications in networks and control. Again, details are forthcoming on the Lecture website.

Thomas Kailath has also been selected for inclusion in the Silicon Valley Engineering Hall of Fame. The introduction ceremony took place at the 2006 Engineers Week Banquet on Friday February 24th 2006 at the Hyatt Santa Clara, Santa Clara, California. More information is available at <http://www.svec.org/banquet/index.html>. Prof. Kailath was further recently awarded the IEEE Jack S. Kilby Signal Processing Award for "seminal contributions to the theory and applications of statistical signal processing". The presentation will be held on Saturday June 24th 2006 at the Hyatt Regency Minneapolis, Minneapolis, Minnesota, during the 2006 IEEE Honors Ceremony. More information is available at <http://www.ieee.org/portal/pages/about/awards/>.

Bibliography

Dr. Thomas Kailath, Hitachi America Professor of Engineering Emeritus at Stanford University Thomas Kailath was educated in Pune, India, and at the Massachusetts Institute of Technology (Sc.D. in EE, 1961). He joined Stanford University in 1963 as an Associate Professor of Electrical Engineering, was promoted to Professor in 1968, and named to the Hitachi America Chair in 1988. He assumed Emeritus status in June 2001.

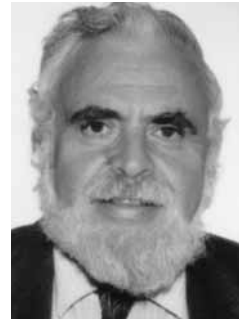
His research has spanned a number of fields, emphasizing information theory and communications in the sixties, linear systems, estimation and control in the seventies, VLSI design and sensor array signal processing in the eighties, and finally, applications for semiconductor manufacturing and digital communications.

He has mentored over a hundred doctoral and postdoctoral students, holds several patents, authored over 300 journal papers and several books and monographs. He also co-founded and served as a director of several private and public high-technology companies — the most recent being semiconductor design-for-manufacturing company, Clear Shape Technologies.

He served as President of the IEEE Information Theory Society in 1975 and received its Shannon Award in 2000. His honors include, among others, outstanding paper prizes from the IEEE Transactions on Information Theory, on Signal Processing, and on Semiconductor Manufacturing; honorary degrees from universities in Sweden, Scotland, Spain and France; Guggenheim, Churchill and Humboldt fellowships; the Ragazzini Award of the American Control Council; the Technical Achievement and Society Awards of the IEEE Signal Processing Society; a Golden Jubilee Medal of the IEEE Circuits and Systems Society, the IEEE Donald G. Fink Prize Award and the IEEE Education and Kilby Medals. He has been elected to the National Academy of Engineering, the National Academy of Sciences, the American Academy of Arts and Sciences, the Indian National Academy of Engineering, and the Royal Spanish Academy of Engineering.

Classic Mathematical Quickies

Solomon W. Golomb








What these problems have in common is that in each case there is a simple way to arrive at the solution, with minimal computation.

- Suppose that 163 people enter a singles tennis elimination tournament. In the first round, 81 matches are played, and one player has a bye. In the next round, the 81 first-round winners and the bye-holder are paired, and 41 matches are played. In each subsequent round, winners advance, losers are eliminated, and bye-holders (if any) also advance to the next round. Eventually a single overall winner emerges. How many actual matches (not counting byes) are played in the entire tournament?
- There are 200 green marbles in a green jar, and 200 red marbles in a red jar. Thirty green marbles are taken from the green jar and inserted into the red jar, which is then thoroughly shaken. Then thirty marbles are taken from the shaken red jar and put into the green jar. Are there now more red marbles in the green jar, or green marbles in the red jar?
- A cubic ice cube, 2 cm on each edge, is floating in a level cylindrical jar of water, filled to the brim, at a temperature of 4°C. The inner dimensions of the jar are that the circular base has an 8 cm diameter, and the height is 6 cm. When the ice cube has melted completely, how much water (in cm³) will have spilled over the rim of the jar?
- You bought 650 shares of ZYX Corp. at \$86.50 per share. Over the next three months, the stock declined in value by exactly 20%. However, over the following three

months, the stock then went up by 25%. Six months after your original purchase, by how much (in dollars) are you now ahead (ignoring any commissions for buying or selling)?

- John and his grandmother both celebrate their birthdays on January 16. Next year, on their common birthday, John's age will be exactly half that of his grandmother's. When will John be as old as his grandmother was on the day that John was born?
- Evaluate the product $(x - a)(x - b)(x - c) \cdots (x - z)$ in the case that $a = 1, b = 2, c = 3, \dots, z = 26$.
- Mr. and Mrs. Jones have invited five other (heterosexual) couples to a dinner party. Their rectangular dinner table has one chair at each narrow end, and five chairs along each of the two long sides. Mr. and Mrs. Jones wish to sit at the two narrow ends of the table, and to seat their guests along the two long sides in such a way that men and women alternate all around the four sides of the table. In how many ways can this seating be accomplished?

- The five *tetrominoes* are the five shapes, , , , , and  each consisting of four unit squares. Can you assemble these shapes to form a 4 × 5 rectangle? (The shapes can be rotated and turned over as you wish.)

Workshop Report: The 2006 IEEE Information Theory Workshop, Punta del Este, Uruguay

Sergio Verdú



From left to right: Ron Roth (Program Committee Co-Chair), Gadiel Seroussi (General Co-Chair), Alfredo Viola (General Co-Chair), Marcelo Weinberger (Program Committee Co-Chair), Jorma Rissanen (Keynote Lecturer), and Dave Neuhoff (IT Society President).

The 2006 IEEE Information Theory Workshop took place in Punta del Este, Uruguay, on March 13-17, 2006. Gadiel Seroussi and Alfredo "Tuba" Viola chaired the Workshop and Ron Roth and Marcelo Weinberger chaired the Program Committee.

Playground of the Argentinean upper crust, Punta de Este is a Summer resort of manicured lawns, manor houses, high-rise apartment buildings, and endless beaches.

With 155 registrants the workshop was a great success technically and otherwise. Uruguay and the United States supplied



Participants to ITW06.

two thirds of the attendees (in roughly equal parts), with the rest hailing from Argentina, Australia, Austria, Brazil, Britain, Canada, Finland, France, Germany, Greece, Hungary, Israel, Italy, Japan, Korea, Mexico, Norway, Portugal, Spain, and Switzerland.

Elwyn Berlekamp and Jorma Rissanen gave the keynote lectures and the invited and contributed sessions covered most major topics within the purview of the IT Society. The full lineup of talks along with a photo gallery can be seen at <http://www.fing.edu.uy/itw06>

In addition to the workshop proceedings (CD-ROM available from IEEE), the registration package included a kaleidoscope, a professionally designed poster, a T-shirt, an ITW cap, and a tube of sunscreen (which, alas, remained unopened).

A visit to the atelier of Carlos Paez Vilaro took place on Wednesday. Not only were we able to chat with the jovial 82 year-old renowned artist, but we witnessed a breathtaking sunset from his cliffside house.

Performing at the end of the banquet, a professional troupe of musicians, singers and dancers, were joined by a number of workshop participants who showcased their tango, milonga and candombe dancing skills. None of us appeared to be quite ready to quit our day job.

Overlapping with ITW2006, the superb facilities of the Conrad Resort hosted the Miss Uruguay beauty contest. Rumor has it that some ITW participants skipped a paper or two to peek in the rehearsals of that event. Which just goes to show the proverbial wide range of interests of our members.

Workshop Report: The 2005 IEEE International Symposium on Information Theory, Adelaide, Australia

Albert Guillén i Fàbregas and Alex Grant

Last year, our Societies Symposium visited the Southern Hemisphere for the first time, and was held at the Adelaide Convention Centre, Adelaide, Australia, 4-9 September.

There were 634 participants, including 191 students, and 500 technical papers were presented. 137 delegates received financial aid in the form of free registration and partial travel support. Most of the financial support went to students presenting papers. For the first time in the history of ISIT, published papers were up to 5 pages in length, and were distributed on CDROM.

Four pre-conference tutorials were held on Sunday, and drew a total of 208 participants. The presenters were M. Medard, R. Koetter and P. Chou, "Network coding"; A. Goldsmith, S. Jafar, N. Jindal, and S. Vishwanath, "Capacity limits of MIMO systems"; R. Urbanke, "EXIT functions: Fundamental properties and practical implications"; S. Bartlett, "Quantum computing". A traditional welcome cocktail on Sunday evening officially opened the symposium, with a few special Australian wildlife guests, including like snakes and koalas. The technical program started on Monday morning. For five days, except on Wednesday afternoon, seven parallel tracks were scheduled with two morning sessions and two afternoon sessions, each consisting of four 20 minutes talks. Talks covered the whole spectrum of Information Theory. One session on recent results was organized on Tuesday morning where 20 posters were presented.

Each day commenced with a plenary lecture:

- on Monday, Prof. Benjamin Schumacher from Kenyon College (USA) lectured on "Quantum and Information" giv-

ing a great overview of this emerging area;

- on Tuesday, Prof. David MacKay from Cambridge University (UK) gave an animated lecture on "Hands-free writing", including an impressive demonstration of his Dasher software;
- on Wednesday, Prof. P. R. Kumar from University of Illinois, Urbana-Champaign (USA) gave a very topical lecture "Towards a Theoretical Foundation for Wireless and Sensor Networks";
- and on Friday, Prof. Terry Speed from University of California, Berkeley (USA) & Eliza Hall Institute on Medical Research (Australia) issued a stimulating challenge to our community with his lecture "What has Information Theory ever done for Bioinformatics".

This year's Awards of the Information Theory Society were presented on Tuesday during a lunch ceremony. The Society president, Prof. Steven W. McLaughlin, announced the newly-elected IEEE Fellows from our Society.

Prof. Vincent H. Poor, editor in chief for IEEE Transactions on Information Theory, then handed out appreciation certificates for the outgoing associate editors Khaled Abdel-Ghaffar, Gérard Battail, Claude Carlet.

Babak Hassibi, Thomas Johansson, Aleksandar Kavčić, Emanuel H. Knill, Amos Lapidoth, Tamás Linder, Andrew B. Nobel, Kenneth G. Paterson, Galen H. Sasaki, Serap Savari, İ. Emre



From left to right: Ralf Mueller, Jossy Sayir, koala, Alex Grant, Gerhard Kramer at the welcome reception on Sunday.



Bob Williamson, Steven Pietrobon, Jaimie Evans, Lars Rasmussen, Steven McLaughlin. Down: Alex Grant, Robyn Grant, Christian Schlegel.

Telatar, David N. C. Tse and Raymond W. Yeung.

Prof. Shuo-Yen Robert Li, Prof. Raymond W. Yeung and Ning Cai, were presented the 2005 Information Society Paper Award, Prof. Nihar Jindal, Prof. S. Vishwanath and Prof. Andrea Goldsmith the 2005 Joint Communication Society/Information Theory Society Paper Award. Finally Prof. Ian Blake was awarded the 2005 IEEE Information Theory Society Aaron D. Wyner Service Award and Prof. Richard Blahut was presented the 2005 Claude E. Shannon Award.

On Wednesday afternoon, no technical sessions were held. Instead, a wide range of excursions in the surroundings of Adelaide were organized, including tours of the Adelaide Hills, a visit to the McLaren Vale wine region, and a bush walking excursion in the Adelaide Hills.

This year's Shannon Lecture was given by Prof. Richard Blahut from the University of Illinois at Urbana-Champaign (USA) on Thursday morning, speaking on 'Pyramids, Informids and Beyond'. He introduced the audience to the fascinating historical perspective of communications in parallel to some of his own career achievements. For the first time, the Shannon Lecture was recorded on video, and can be downloaded for free from the Symposium web site, <http://www.isit2005.org>.

The banquet dinner was held at the Adelaide Convention Centre, and delegates were entertained by the Descendance indigenous dance troupe. After dinner, the recipient of the 2006 Shannon Award was announced: Prof. Rudolf Ahlswede. Prof. Ahlswede will give his Shannon Lecture at the 2006 ISIT in Seattle. At the conclusion of the banquet, Prof. Joseph A. O'Sullivan welcomed everyone to participate to the next ISIT that will be held in Seattle, USA, 9-14 July 2006.

Workshop Report: The 2005 IEEE Information Theory Workshop, Rotorua, New Zealand

Ulrich Speidel

It doesn't happen often that one gets to tell in this newsletter about a workshop getting into hot water, with lots of mudslinging going on. Well, all of this happened at ITW2005 in Rotorua, so do read on to find out how!

ITW2005 took place in the week prior to ISIT in Adelaide, which means "late winter" in New Zealand terms, and in our case mythical morning fog and sunshine for the rest of the day, every day. On Sunday night, 28th of August, we were welcomed officially onto the venue at Rotorua's picturesque lakeside by a Maori welcome party from the local tribe. They put down a rather serious challenge to the local chair, Mark Titchener, and yours truly, who forgot all of their little Te Reo Maori when it came to it!

In the morning, Rotorua's Deputy Mayor, Trevor Maxwell, opened the workshop with a brief karakia (prayer) in Maori, again linking

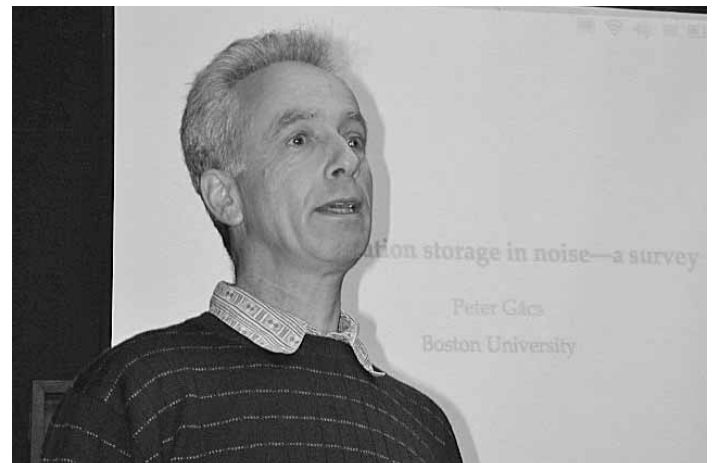


The workshop in hot water!

us and our activities with the venue and its history and culture. This was followed by Péter Gács from Boston, who had returned from his trip to Urewera National Park in time to deliver the opening keynote, which was well received.

The rest of the workshop saw a range of sessions with both invited talks and papers from open call. We received 82 open call submissions, 56 of which were accepted as papers or posters. No authors failed to present and only one needed to hand in an apology. A number of participants comments on the high standard of many presentations. Proceedings were published on CD rather than on paper, in line with ISIT in Adelaide.

I would like to take this opportunity to thank authors and the numerous reviewers for their hard work at an extremely busy time. The fact that all speakers had a very decent audience despite stiff competition from excellent weather and tourist attractions all



Peter Gács, keynote speaker.

around speaks for itself. In total, we had just over 100 attendees, not counting family members. Financially, we are proud to have been able to return a solid profit to the society's coffers.

Monday night saw the second social event in the form of a Maori haka and concert. Trevor Maxwell had encouraged us to "let your hair down" and - as we found out - this didn't have to be particularly encouraged - there was widespread enthusiastic participation in the various performances. I'm sure many of the participants will put their newly-learned haka or poi skills to good use when confronting their local beancounters next time!

Tuesday afternoon was excursion time - in Rotorua that basically means visiting one of the many geothermal areas in the vicinity. Having traipsed around Waimangu Volcanic Valley and cruised around Lake Rotomahana for a few hours, it was time to do the local thing and soak in a natural hot creek in the bush. About half of the participants donned their bathing trunks and

swimsuits and headed straight into Kerosene Creek at dusk. Thanks to the late hour, only fuzzy photographs are available, but we were able to witness some serious mudslinging (literally) among senior academics, with the remaining landside crowds cheering them on!

At the workshop dinner on Wednesday, Masahiro Nakamura received a Best Paper Award for his paper "Ergodic Theorems for Algorithmically Random Sequences".

On behalf of Des and myself, I would once again like to take this opportunity to say thanks to everybody who has helped along the road: You've all been absolutely fabulous and I am looking forward to seeing you soon again, perhaps at ISITA2008, which is planned for New Zealand as you read this. On a personal note, I'd especially like to thank Des for sharing the chair role with me - it's been tremendously reassuring to have such an experienced hand at my side.

Workshop Report: The 7th Australian Communications Theory Workshop (AusCTW'06), Perth, Australia

Albert Guillén i Fàbregas and Steven R. Weller

This year, the Australian Communications Theory Workshop (AusCTW) visited the West Coast of Australia for the first time, and was held at the University of Western Australia, Perth, Australia, 1-3 February. Since its inception in 2000, AusCTW has been immensely successful in bringing together researchers from Australia and New Zealand working in theoretical aspects of the physical layer, in particular communications and information theory. This 2.5-day workshop provides an opportunity for researchers and postgraduate students to gather in a largely informal environment to share ideas, make contacts and foster collaborative research links. This year there were some 101 participants, including 48 postgraduate students, in attendance.

The workshop was generously sponsored by the Western Australian Telecommunications Research Institute (WATRI), National ICT Australia (NICTA), the Australian Telecommunications Cooperative Research Centre (ATCRC), Agere Systems Australia, the University of Western Australia, the Institute for Telecommunications Research (ITR) at the University of South Australia, and the ARC Communications Research Network (ACoRN), with in-kind support from the University of Newcastle, and technical co-sponsorship by the IEEE Information Theory Chapter (SA/ACT/VIC).

Following the pattern of recent workshops, this years AusCTW ran over two and a half days, with a 45-minute Research Overview presentation starting the technical program on each day. This years Research Overviews were given by Prof. Alex Grant (University of South Australia, "Network coding"); Prof. Tony Antoni (University of Western Australia, "The jitter equation and its applications in communications and electronics"); and Dr. Alan Coulson (Industrial Research Ltd. New Zealand, "Narrowband interference in OFDM systems"). Following the Research Overviews on each day were 2-hour poster sessions, with 25

posters in each session. These poster sessions are a key element of the AusCTW program, providing an excellent platform for research interaction and discussion. Following lunch on the first two days, 12 technical presentations, each of 20 minutes duration, were presented, covering a wide spectrum of communications theory and related areas.

On the day immediately preceding the workshop, Prof. Lang White (University of Adelaide) presented a 1-day tutorial titled "Introduction to Internet Engineering - Routing and Reliable Transport in TCP/IP Networks", under the auspices of ACoRN.

Further details on the technical program can be found on the workshop web site, <http://ausctw06.watri.org.au>. The workshop proceedings are available in electronic format on IEEEExplore.



Poster session at AusCTW 2006.

Workshop Report: The 40th Annual Conference on Information Sciences and Systems (CISS2006), Princeton, NY, USA

Mung Chiang

The 40th annual Conference on Information Sciences and Systems (CISS) took place at Princeton University, NJ, USA, on March 22-24, 2006. Robert Calderbank and Hisashi Kobayashi from the Electrical Engineering Department of Princeton University co-chaired the conference.

With 443 registrants from 22 countries, this year's CISS is the largest in its history. Strong leadership from the conference co-chairs, countless number of hours of hard work by the conference coordinators, Kathy Apgar and Lidia Stokman, and continuous support from the faculty, staff, and student volunteers at Princeton EE Department made this CISS both technically stimulating and socially enjoyable.

The topics covered by 330 papers organized in 63 sessions, including 17 invited sessions, spanned the wide and expanding landscape of information and systems, from Shannon theory to signal processing, from systems control to wireless networking, from adaptive learning to distributed optimization. The 3-day technical program, which is still up on the conference website www.ciss.us, also included 3 inspiring plenary talks, given to audiences that completely filled the large auditorium, by Professor Frank Kelly from the University of Cambridge on "Network Control", by Professor P. R. Kumar from the University of Illinois on "Network Embedded Control Systems", and by Professor Andrea Goldsmith

from Stanford University on "Wireless Communications".

This is the first year that CISS was technically sponsored by IEEE Information Theory Society. The conference proceedings CD-ROM, with a cover that showcased the artistic talent of Sergio Verdú, can be obtained from both IEEE and CISS coordinators ciss@ciss.us, and the papers searchable through the IEEE Xplore database.

CISS is usually held during the spring break, and this year early signs of spring indeed decorated the historic campus of Princeton. On March 22 and 23, hundreds of participants walked through cool breeze after a full day of program to receptions that offered delightful stimuli to taste buds through buffet dinners completed with a selection of wine and a separate dessert stand.

The feedback from conference participants has been overwhelmingly positive, with some remarking that CISS has become one of the few "must-attend" conferences in their lists. There are indeed many reasons to celebrate the 40th Birthday of CISS, including not the least the absence of mid-life crisis and the abundance of intellectual vigor in the fields of Information Sciences and Systems. Alternating between Princeton University and the Johns Hopkins University, the next CISS will be held March 14-16, 2007 at the Johns Hopkins University.



Hisashi Kobayashi (Program Director), Andrea Goldsmith (plenary speaker) and P. R. Kumar (plenary speaker).



Mung Chiang, Robert Calderbank (Program Director), Frank Kelly (plenary speaker), Hisashi Kobayashi (Program Director).

Updates Behind the Scenes at WWW.ITSOC.ORG

J. Nicholas Laneman

Early this year, the IT Society Board of Governors (BoG) approved the new position of Online Editor, which formalizes and extends the former Webmaster role. Shortly thereafter, I was honored to be appointed as the Society's first Online Editor, and officially took the reigns of the Society website effective April 1, 2006. The purpose of this article is to provide context for these developments, summarize goals, and seek the community's input.

The Society website <http://www.itsoc.org/> can increasingly offer valuable services for individual members as well as Society operations as a whole. The most notable recent example of this is Pareja, the Society's web-based paper submission and reviewing system. Other potential examples include mailing lists, discussion forums, conference websites, arXiv updates, and other services. Such services require more than a single person editing static HTML files; they also include writing scripts, administering database servers, and so forth.

In this context, the approved job description for the Online Editor position includes the following responsibilities:

- Oversee all information gathering and dissemination on the IT Society Website.
- Oversee all website planning, development, and implementation efforts.
- Communicate with society volunteers who are involved in ongoing programs (e.g., Student Committee and ArXiv efforts), and develop new programs and initiatives within the Society.
- Communicate all activities and needs with the BoG.
- Communicate with all other Society partners.
- Report to the Society President and BoG.

With these responsibilities in mind, my short-term goals for serving as Online Editor include:

- Leverage existing content in web-readable forms, e.g., Newsletter articles, Journal archives, arXiv updates,
- Evolve the process and tools for member-contributed content, e.g., news, events, tutorials, discussions,
- Identify and staff larger projects, e.g., Pareja and arXiv inte-



J. Nicholas Laneman

gration, Symposium and Book archives,

Many of our objectives can be met by a suitable content management system (CMS) along with appropriate customizations. To wet the Society's appetite for such tools, I have setup a development website at <http://itsoc.ee.nd.edu/>, with submission instructions at <http://itsoc.ee.nd.edu/submissions/>. Currently anyone wishing to serve as a "beta tester" can setup an account on the site and begin contributing structured content such as News, Events, Files, and Folders. Before being officially "published" on the site, each piece of content must be submitted by the author and approved by a "reviewer". Although I am currently the only reviewer, others are welcome to volunteer to review content, especially as things scale. In the short term, I will be moving approved content manually from the development website to static HTML on the official Society website. This process has already occurred for several news items, and the response has been positive.

At this point, we suffer from having more ideas than time, so there are a number of ways that Society members can contribute to the effort. First, those interested in contributing content can kick the tires on the development website and provide feedback. One major area of effort is the translation of the static content from the official website to the development website. Second, those interested in reviewing content or even managing sections of the development website should contact me. If things scale as we would like, there will be plenty of room for such help. Finally, members can take a fresh look at the official website at <http://www.itsoc.org/>, point out items that may be out of date, and suggest other content or services that could be useful to include.

Before wrapping up, I would like to thank several people for their time and energy in establishing the Online Editor position and helping me transition into the role. Junior Past President Steve McLaughlin initiated discussions about the Society website and listened to many of my initial thoughts. He and BoG member Dave Forney helped crystallize ideas through a number of rounds of email. Secretary and former Webmaster Mehul Motani offered some useful brainstorming and helped make taking the reigns of the Society website seamless. Finally, the new leadership of President Dave Neuhoff and First Vice President Bixio Rimoldi have endorsed these efforts and been very encouraging, which is much appreciated. I look forward to working with these and all Society members to make the website an even more useful and valuable part of our community. Please do not hesitate to email me at the link above.

This article is also available at <http://itsoc.ee.nd.edu/Members/jnl/new-online-editor/>.

An Update on the Information Theory Society Student Committee Activities

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

The Information Theory Student Committee is continuing its efforts to make the society of more value to students. The committee is chaired by Andrea Goldsmith and mostly student-run with active volunteers for event planning, website development, and outreach. There is a small advisory committee of regular society members as well.

Among other activities, we are currently planning student events for the upcoming ISIT to be held on July 9 – July 14 in Seattle, Washington. The IT-Soc student committee meeting and the panel will be held on Thursday, July 13 during the lunch. A round table research lunch discussion will also be organized on Monday July 10 around several hot topics, recent results, and tutorial papers in information theory, where groups of students interested in one of these research topics can get together to discuss them. The IT Student Committee is also sponsoring a T-shirt design contest. Designs can be submitted in jpg or pdf format by May 15, 2006 to Ivana (ivanam@winlab.rutgers.edu), Lalitha (lalitha@winlab.rutgers.edu), and Brooke (bshrader@umd.edu). The design selected by student judges will win \$100 USD. The T-shirts will be free to all students that attend the ISIT student committee meeting. We are currently seeking student volunteers to help in organizing these activities, coordinate the contest and help judge the designs. Anyone interested in being a judge for the contest should send email to Lalitha (lalitha@winlab.rutgers.edu) by May 10, 2006. We are also seeking ideas for the ISIT panel discussion.

Furthermore, we are proposing a student paper award to the Board of Governors, as well as discounted ISIT rates for local students, and discounted student membership rates for students that attend ISIT. These proposals will be made at the Board of Governors meeting in July at ISIT. We welcome your input for other initiatives that we might propose.

On Friday, March 24, at the CISS conference, the committee hosted a panel discussion on the tradeoffs between industry and academic jobs, “Academia versus Research Labs: Tales from the Front Lines”. Approximately 40 students were in attendance to hear the views of panelists – Prof. Vincent Poor (Princeton University), Dr. Emina Soljanin (Bell Labs), Dr. Stefano Galli (Telcordia) and Prof. Christopher Rose (Rutgers University). The panelists offered invaluable insights about the careers that lie ahead for students. They pointed out the rewards of working in academia such as freedom in choosing a research path and working with students; and that of the industry in seeing one’s ideas being turned into products and financial benefits. But, they also talked about the drawbacks – distraction from research in academia, current short term goals of industry. It is apparent that the two paths are significantly different and that the gap may be getting even bigger with industry less interested in fundamental problems. Industry these days is interested in “more breath and less depth” noticed Dr. Galli. But once aware of what each job brings, of their rewards and drawbacks, one message was clear – students cannot predict what the hot research field will be by the time they graduate - they cannot “engineer their careers”. An

encouraging and inspiring message that all panelist agreed with was Prof. Goldsmith’s advice: “Do what you love, then you’ll be creative, do good work and you will have a lot of opportunities open to you”. A part of the panel discussion has been recorded and it is available, along with the panel summary and the panelist’s short biographies, on the committee website: <http://itsoc-students.ece.cornell.edu/>

The website contains other valuable resources, including guidelines for getting started and being successful in research; pointers to information theory books, tutorials, and lecture notes/slides; links to research groups working in information theory and local IEEE information theory chapters; how-to guides on topics such as getting started on information theory research, writing journal papers, and job hunting; job listings and resume postings; dissertation postings; a list of upcoming conferences with information theory sessions; and a list of upcoming committee meetings and related events. The society also plans to start taping all Shannon and plenary lectures at ISIT, and links to these recordings will be available on the student website. Visitors to the website will also find instructions for signing up to our mailing list itsoc-students-l@lists.cornell.edu. The mailing list has been quite successful, with students participating from all over the world including North America, Europe, India, and Iran. The list has not been as active as we would like it to be, and we are working to initiate regular interactions via the list.

We are seeking student volunteers for the roles listed below. All interested volunteers should contact our Volunteer Coordinator, Lalitha Sankar (lalitha@winlab.rutgers.edu).

Please note that our activities are open to all students, whether they are IT Society members or not:

- Event planning - Bring us your ideas for and help in organizing panel discussions or social events at upcoming conferences. Is there a particular panel discussion topic you would like to hear? Should we organize a student soccer match during a conference lunch break?
- Website development - Is there something you think should be added or expanded in our website? You can help us by contributing website content!
- Committee outreach - Do you have ideas for how IT-Soc students can get involved with your university or in your country? Let us know!

While we are pleased with the progress of the committee so far, we would like to have more widespread participation and provide more resources to students. The main challenge in doing this is getting the word out to students about the existence of the committee and its activities, getting more students to participate, and to avoid too much of a demand on the volunteers coordinating the committee efforts.

Treasurer's Corner

Muriel Medard



Dear all,

Welcome to our Treasurer's corner, which seeks to provide you with updates on our Society's finances. First, the good news is that our finances are well on the mend (see figure below). One of the reasons is an excellent crop of income from conferences. This however includes a change of accounting rules at the IEEE level. We now account for conferences as they happen, rather than the year after they happen. Thus, we received in 2005 some of the 2005 conference revenue as well as past revenue. Overall, conference income was of \$ 743.4 K rather than the budgeted \$ 348.5 K (we had also slight higher expenses \$ 266.3 K budgeted versus \$ 363.5 K, because of high attendance). Our fortunes were also buoyed by investment income of \$ 67.4 K. Other elements also came in slightly better than budget. The bottom line is that we have for 2005 an expected surplus of \$ 436.1 K, but because of the one-time factors discussed above, we cannot count on this as a repeatable experiment. However, it does put us in the position to consider some initiatives.

Our initiatives address membership growth and reversing the decline of our student membership. We plan to allot \$ 10 K to this initiative. The desired outcome is to allow non-members to receive the member rate if they join IEEE and the Society onsite at the ISIT conference. The member rate will be provided as a credit online that can be applied to join the society online. Moreover, for students, a credit will be issued for society membership, which can be used for the following year in the case of students who already belong to the society.

A further student initiative, in conjunction with Andrea Goldsmith's committee on student members, seeks to recognize student contributions and to encourage students to participate in ISIT and become active participants in the Society's life. This initiative involves:

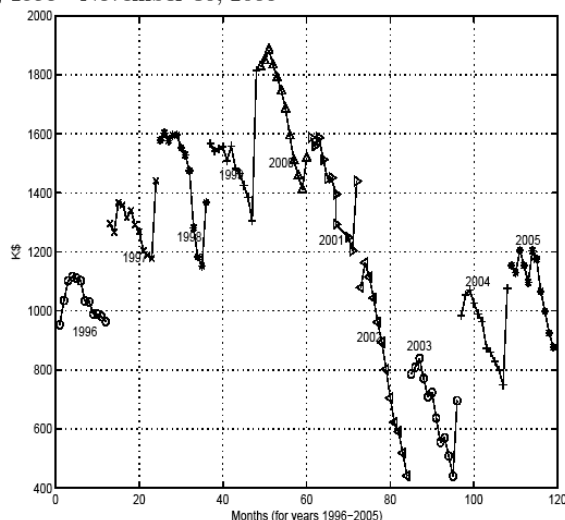
1. allowing inexpensive day passes to the conference, to allow local students to attend ISIT and become interested in the activities of our society
2. recognizing our student contributions by sponsoring a small number of best student paper awards

As a final note, I would like to remind all that conferences are a vital part of our financial health. If you are contemplating putting together a proposal for ISIT or ITW, we now have easy to use Excel files which include the actual numbers from the most recent comparable events to help you check whether your assumptions are borne out by experience. Please contact me if you would like to obtain one of these files for planning purposes.

As always, feel free to contact me with any questions regarding our finances.

Your treasurer
Muriel Medard
medard@mit.edu

Net Worth (cash + loans (+ LTI) – deferred incomes): January 1, 1996 - November 30, 2005



Information Theory Society Board of Governors Meeting

Levering Hall, Johns Hopkins University, Baltimore, MD, March 16, 2005

Mehul Motani

Attendees: Daniel Costello, Anthony Ephremides, Dave Forney, Marc Fossorier, Andrea Goldsmith, Ryuji Kohno, Steven W. McLaughlin, Muriel Medard, Mehul Motani, David L. Neuhoff, Vincent Poor, Gadiel Seroussi, Shlomo Shamai, Joseph A. O'Sullivan, Venugopal V. Veeravalli

The meeting was called to order at 18:15 by Society President Steven W. McLaughlin. The members of the Board were welcomed and introduced themselves.

1. The agenda was approved and distributed.
2. The action items from the previous Board meeting at ISITA in Parma, Italy on October 11, 2004 were reviewed.

The Board reviewed the following action item regarding the open meeting on IT Society Publications that was held at ISIT 2004 in Chicago.

Action Item The Board requested John Anderson to call for an open meeting on IT Society Publications at the next ISIT.

The Board unanimously approved the minutes of the previous meeting with minor amendments.

3. The President presented his report and miscellaneous announcements.

The President reported that he had convened a two-day planning meeting of IT Society officers in Metz, France.

It was noted that membership had dropped from approximately 6000 members in 2001 to approximately 3300 in 2005. Membership development will be a priority for the Society.

It was suggested that it was important to get younger members (e.g., students) involved. This is to be addressed by the formation of an ad-hoc student committee to get them involved in Society activities. This was discussed later as part of membership development.

The Board will consider a proposal on membership development at the next Board meeting.

It was reported that the position of Education officer was to be reinstated.

The relation of the Society to IEEE was discussed, specifically the ever changing revenue structure of our parent organization. This implied an evolving model for the Society.

The Society budget was discussed and it was reported that our largest source of income is non-member subscriptions such as libraries and IEL. It was mentioned that paper members (meaning those who elected to receive paper copies of the Transactions) cost the Society \$100 per member.

That the Society should increase its ties to other Societies and conferences was discussed. There was a discussion about how to get IT related conferences (such as Allerton and CISS) to work with us to put their papers online.

Action Item The Board will consider a proposal on the maintenance of the Society's collection of the Transaction on DVD.

4. Marc Fossorier discussed matters related to Symposia and Workshops.
 - (a) ISIT 2004, Chicago: The final report for ISIT 2004 was presented.
 - (b) ITW 2004, San Antonio: Nothing to report.
 - (c) ISIT 2005, Adelaide: It was reported that things are progressing smoothly. There were 775 papers received. The TPC has met and decided on the papers and sessions, with an acceptance rate of 65%.
 - (d) ITW 2005, New Zealand: It was reported that things are progressing smoothly and that the workshop had received over 80 paper submissions.
 - (e) ITW 2005, Japan: Nothing to report.
 - (f) HISC 2005, Hawaii: Nothing to report.
 - (g) ISIT 2006, Seattle: It was reported that things are progressing smoothly. The organizing committee had held a planning meeting. The program committee is finalized and the plenaries are being worked out.
 - (h) ITW 2006, Uruguay: Gadiel Seroussi presented a proposal for an Information Theory Workshop in Punta del Este, Uruguay. He presented a comprehensive proposal.

The Board unanimously approved the proposal for the IT workshop in Uruguay.

- (i) ISIT 2007: It was reported that things are progressing smoothly. The conference services organization has been selected and the hotel selection is in progress.
- (j) ISIT 2008: There was discussion of a preliminary proposal for ISIT 2008 to be held in Toronto.

The Board will discuss the matter and make the decision at the next Board meeting in Adelaide in

September 2005.

5. Muriel Medard presented the Treasurer's report.

The Society's net worth as of November 2004 was reviewed. The financial activities of the Society conferences and workshops was also reported.

The relative costs of paper and electronic members were discussed and the possibility of increasing the charges for paper members was put forth. There was some concern of loss of membership due to the increased charges.

It was noted that the cost of a paper member is \$100 and the current membership charges are \$30. After much discussion, there was a proposal to increase the paper member fees by \$45. The resulting fee structure is as follows: Electronic member - \$30, Paper member - \$75.

The Board unanimously approved this proposal.

6. The IT Transactions Editor-in-Chief gave an update on the Society Transactions.

He noted that the Transactions web submission system called Pareja had been migrated to the new IT Society web server.

The EIC reviewed the mail dates, page counts, and page budgets of the Transactions, noting that the annual volume was increasing with a projected 900 papers for the year 2005. It was noted that 83 papers had been received for the Joint special issue of the IEEE Transactions on Information Theory and the IEEE/ACM Transactions on Networking on the topic of Networking and Information Theory.

The EIC requested more proposal for future special issues.

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

- Eytan Modiano (MIT) for Communication Networks
- Tom Richardson (Flarion) for Coding Theory
- Madhu Sudan (MIT) for Coding Theory

The Board unanimously approved all three AE appointments.

7. Venu Veeravalli announced that the NSF Program Director position was open. He encouraged members of our community to apply so that IT is represented at NSF, which is critical for funding policies and programs.

Action Item The Board requested Venu Veervalli and Steven McLaughlin to make a proposal regarding the NSF position at the next Board meeting.

8. The ArXiv study committee report was discussed. It was suggested that a demonstration of ArXiv should be held at the next ISIT to show users the ease of using ArXiv to upload their papers.

The Board backs the recommendations of the committee and encourages all members to post their pre-prints at the ArXiv server at www.arxiv.org.

9. The Awards committee report was presented.

It was reported that the winners (decided in an email vote in October 2004) of the 2004 IEEE Information Theory Society Paper Award are Ralf Koetter and Alexander Vardy for their paper, "Algebraic Soft-decision Decoding of Reed-Solomon Codes," which appeared in IEEE Transactions on Information Theory, vol. 49, no. 11, pp. 2809-2825, November 2003.

It was noted that the committee had received nominations for the 2005 Information Theory Best Paper award and the Joint ITSOC/COMSOC Paper award. Members of the IT community were encouraged to submit more nominations.

10. Membership development was then discussed.

Action Item The Board requests a concrete proposal regarding membership development and will discuss it further at the next Board meeting.

The declining membership of the Society was noted as a serious concern and ideas were discussed for increasing participation in the Society.

The formation of an ad-hoc student committee was discussed as a way to get younger members involved in the Society. There was a proposal to establish such a committee chaired by Andrea Goldsmith.

The Board unanimously approved the proposal.

Action Item The Board requested the ad-hoc committee to meet at the next ISIT.

11. Cooperation with SITA (Society of Information Theory and its Applications in Japan) was discussed. The Board encouraged and endorsed interaction with SITA and discussed the possibility of a MOU with SITA.

12. There was no new business.

13. It was announced that the second 2005 Board meeting will be held at ISIT on September 4, 2005 in Adelaide, Australia.

14. The meeting was adjourned at 22:20.

Information Theory Society Board of Governors Meeting

Adelaide Convention Center, Adelaide, Australia, September 4, 2005

Mehul Motani

Attendees: John Anderson, Alexei Ashikhmin, Ian Blake, Guiseppe Caire, Daniel Costello, Thomas Cover, Dave Forney, Marc Fossorier, Andrea Goldsmith, Alex Grant, Hideki Imai, Nihar Jindal, Rolf Johannesson, Aman Kansal, Young-Han Kim, Ralf Koetter, Ryuji Kohno, Gerhard Kramer, James Mammen, Steven W. McLaughlin, Muriel Medard, Urbashi Mitra, Mehul Motani, David L. Neuhoff, Ping Li, Vincent Poor, Bixio Rimoldi, Gadiel Seroussi, Shlomo Shamai, Joseph A. O'Sullivan, David Tse, Alexander Vardy, Han Vinck, Sriram Viswanath, Marcelo Weinberger, En-Hui Yang, Raymond Yeung, Oyvind Ytrehus.

The meeting was called to order at 12:30 by Society President Steven W. McLaughlin. The members of the Board were welcomed and introduced themselves.

1. The agenda was approved and distributed.
2. The following action items from the previous Board meeting at CISS in Baltimore, MD on March 16, 2005 were reviewed.

The following matter was discussed and it was decided that there would be no open meeting at this symposium.

Past Action Item The Board requested John Anderson to call for an open meeting on IT Society Publications at the next ISIT.

The following items were discussed at this meeting.

Past Action Item The Board requests a concrete proposal regarding membership development and will discuss it further at the next Board meeting.

Past Action Item The Board requested the ad-hoc committee to meet at the next ISIT.

The following items were not discussed.

Past Action Item The Board requested Venu Veeravalli and Steven McLaughlin to make a proposal regarding the NSF position at the next Board meeting.

Past Action Item The Board will consider a proposal on the maintenance of the Society's collection of the Transaction on DVD.

The Board unanimously approved the minutes of the previous meeting.

3. The President presented his report and miscellaneous announcements.

The President reported on the IEEE Technical Activities Board (TAB) Meeting in June 2005. He discussed the evolving structure at the IEEE and how this affects the Society.

The President noted that there was a new ASPP distribution (from IEEE) and that the Society did well since we produce

a fairly larger share of publications relative to the size of the Society.

Membership development was discussed. The President noted the decline in Society membership over the past few years. The figures indicate a decrease from 6500 to 3000 members. The question of what value we provide to members was discussed. Ideas for maintaining membership were discussed, as were ideas for developing interest in young members, especially students.

The matter of the open access to IEEE publications and ArXiv was discussed. It was noted that authors of papers at this year's symposium were encouraged to upload preliminary version of their papers to ArXiv.

The issue of surplus target for conferences was mentioned briefly.

The President discussed the matter of the Society's ties with other societies and conferences. He mentioned an effort to expand ties with CISS and Allerton.

There was a discussion about building a database of past CISS and Allerton conferences.

Action Item Steve McLaughlin to look into an MOU and technical co-sponsorship with CISS and Allerton.

Action Item Generate estimates of page count for past CISS and Allerton conferences.

The President mentioned the desire to build and or increase ties with other societies, especially SITA (Japan).

Action Item Ryuji Kohno to follow up on building ties with SITA.

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

(a) The Board unanimously approved technical co-sponsorship for CISS 2006 (Princeton, NJ, USA), ISITA 2006 (Seoul, Korea) and HISC 2006 (Nara, Japan).

(b) ITW'05, New Zealand: Nothing to report.

- (c) ISIT'05, Adelaide: 500 papers accepted, 7 parallel sessions.
- (d) ITW'05, Japan: Report was presented. Progress going well.
- (e) ITW'06, Uruguay: Everything on track.
- (f) ISIT'06, Seattle: Report was presented. Minor changes discussed but things are on track.
- (g) ISIT'07, Nice: Everything on track.
- (h) ISIT'08, Toronto: Proposal for ISIT to be held in Toronto made by En-Hui Yang.

The Board voted unanimously in favor of the Toronto proposal.

- (i) ITW'06, China: Proposal by Dan Costello.

The Board voted unanimously in favor of the China workshop proposal.

- (j) ITW'07, Norway: Proposal by Øyvind Ytrehus.

The Board voted unanimously in favor of the Norway workshop proposal.

- (k) ISIT'09, Korea: Proposal for symposium to be held in Seoul or Jeju Island.

The Board voted unanimously in favor of Seoul, given that it is a large city with excellent infrastructure.

Action Item The Board requested a detailed budget proposal at the next meeting.

5. Muriel Medard presented the Treasurer's report.

The Society's finances were reviewed. The financial activities of the Society conferences and workshops was also reported.

The Treasures noted that as of May 2005, IEEE TAB requires a 20% surplus on conferences. This is not retroactive but does hold for future conferences.

This matter was discussed and there was a motion to build in a 10% surplus for Society conferences.

The Board voted unanimously in favor of the motion.

6. 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, noting that the annual page budgets for the Transactions were increasing.

There was a discussion on the growth of the Transactions and page counts. There was a proposal to form an ad-hoc committee to look at these publications issues.

The Board unanimously approved the formation of an ad-hoc committee consisting of Alex Vardy (Chair), Vince Poor, Muriel Medard, Ralf Koetter, and Steve McLaughlin.

Action Item The ad-hoc committee is to study the Transactions growth and report back to the Board.

It was noted that 83 papers had been received for the Joint special issue of the IEEE Transactions on Information Theory and the IEEE/ACM Transactions on Networking on the topic of Networking and Information Theory. The guest editors expected to accept about 40 papers and things were on track for a June 2006 publication date.

The EIC announced a new special issue on Relaying and Cooperation.

The EIC noted that Adriaan van Wijngaarden (Lucent Bell Labs) has replaced Kevin Quirk as Publications Editor.

The EIC noted that Wojciech Szpankowski has assumed one of the two AE positions in the area of Source Coding as of September 2005.

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

- Anne Canteaut (INRIA) for Complexity & Cryptography
- Andreas Winter (Bristol) for Quantum Information Theory
- Guang Gong (Waterloo) for Sequences

The Board unanimously approved all three AE appointments.

7. Andrea Goldsmith (Chair) reported on the activities of the Society Student Committee.

She discussed the formation of the committee and its aim to make the Society more valuable to its student members.

She noted that the student registration packets contained a questionnaire to get students' feedback on what the Society can do to be of more value to them.

She noted that a website had been set up to facilitate information dissemination and collaboration. The URL is: <http://itsoc-students.ece.cornell.edu>

She also noted that the inaugural meeting of the student committee would be held on Monday September 5 at this year's symposium and invited all Board member to attend.

8. The ArXiv study committee discussed the use of ArXiv.org. It was noted that ArXiv is being used but it has not yet

crossed the tipping point. This is necessary for it to be an effective information resource for information theorists.

The Board encourages all members to post their pre-prints at the ArXiv server at www.arxiv.org.

9. It was reported that the Institute for Information Transmission Problems (IITP) of the Russian Academy of Sciences (RAS) may be absorbed into a larger institute within RAS and this may have an adverse impact on the field of information theory.

It was suggested that the Board send a letter to the RAS President in support of IITP.

The Board unanimously approved this motion.

10. The Society website was then discussed. It was reported that a redesign is being planned and more details will be made available in the coming months.

It was noted that the Society might provide some funding to support the development of the website.

Action Item Steve McLaughlin, Nick Laneman and Mehul Motani to come up with a proposal and budget.

11. The Awards committee report was presented.

The 2005 IT Society Best Paper award nominees were discussed. The committee reported that of the 12 nominated papers, 4 were shortlisted for the final round. After deliberation and ranking, there was a clear winner.

The committee recommended that the 2005 IT Society Best Paper Award be given to Shuo-Yen Robert Li, Raymond W. Yeung, and Ning Cai for their paper, "Linear network coding", which appeared in the IEEE Transactions on Information Theory, vol. 49, no. 2, pp. 371-381, February 2003.

The Board voted unanimously to accept the Awards committee recommendation.

It was reported that Vladimir Levenshtein has been nominated for the Richard W. Hamming Medal.

It was reported that the winners of the 2005 Joint ComSoc/IT Society Paper Award are Nihar Jindal, Sriram Vishwanath, and Andrea Goldsmith, for their paper "On the Duality of Gaussian Multiple-Access and Broadcast Channels," which appeared in the IEEE Transactions on Information Theory, vol. 50, pp. 768-783, May 2004.

It was announced that Ian Blake has been awarded the Society Distinguished Service Award.

12. The Nominations committee presented its report.

It was reported that 13 nominations had been received for the Board.

The Board unanimously approved the list of 13 nominations.

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

- Dave Neuhoff for President
- Bixio Rimoldi for 1st Vice President
- Marc Fossorier for 2nd Vice President
- Venu Veeravalli for 2nd Vice President

The Board unanimously approved all the nominations.

13. There was no new business.

14. The location of the next Board meeting was discussed.

There was discussion of the meeting to be held in Princeton at CISS or in Punta del este, Uruguay at the ITW. The Board voted in favor of Punta del este.

15. The meeting was adjourned at 18:30.

Guest Column: From the National Science Foundation

News from the Communications Program at NSF

Sirin Tekinay



Dear reader,

I am delighted to write the third column in this series, eight months since joining the NSF. As usual, in this space, I hope to fuel our interaction on ideas, visions, and issues that impact us all as professionals in the communications community as I pro-

vide you with insight to relevant NSF programs and news.

I am thrilled that our "communications" is ever increasing: I continue to enjoy receiving your questions, opinions, comments, and requests for participation in NSF reviews. Recently I received a couple of inquiries on how to apply for

a job at the NSF, which made me feel great: I must be doing something right!

A Few Words on Process Flows at the NSF: Programs and Solicitations

In the last two issues, I offered some background on the general NSF organization and mission, with emphasis on the directorate, division, and cluster that the Communications Research Program belongs to: Directorate of Computer and Information Science and Engineering (CISE), Division of Computing and Communications Foundations (CCF), and the Theoretical Foundations (TF) Cluster, respectively. In this issue I would like to shed some light on how “program solicitations;” i.e., calls for proposals, are made, now that I have some experience in formulating new programs.

In terms of how they are funded and managed, NSF programs vary from foundation-wide to any group of program directors. Indeed, the quick description of the process that governs program formulation is that it is unstructured. Program directors update existing cyclic programs and formulate new programs. I’m proud to have had the opportunity to do both:

The Theoretical Foundations Program Solicitation is an annual program. This year’s TF [1] solicitation has been completely updated: I have re-worded the communications area and formulated a new area, Science for Internet’s Next Generation (SING). I will talk more about the scientific contents of the solicitation in the next section. The mechanism through which the write up made it to public domain; i.e., publication on NSF’s web site, was fascinating. The internal Program Information Management System (PIMS) weaves the document together out of the responses of the program director to its many prompts. PIMS also manages the authorship rights and review sequence for the document. After I uploaded our solicitation by responding to PIMS prompts, and signaled completion, PIMS started to route the document to administrative and financial reviewers, some in sequence, and some in parallel. Whenever a reviewer asked for changes, PIMS returned the document to me. In the end, what appeared on the web site is part human, part machine generated: leaving me feeling like I have taken a part multiple choice, part essay test and passed!

Recently, an internal solicitation for ideas on new foundation-wide programs was broadcast. I’m delighted that my input was well received. I can’t wait to see it in public domain, if and when it makes it through many iterations, and most importantly, funding decisions. It was not too hard to formulate a new science based on the role of information and communication theories in earth sciences, natural sciences, social sciences, education engineering, but I deem it a privilege to happen to be the program director on hand to do it. After all, is communication not intrinsic to all sciences and the catalyst for the function of the best-engineered system there is: Mother Nature? It must be embedded in all of us, the curiosity to explore how we can predict the hurricane from the wing flaps of that proverbial butterfly.

NSF continuously strives to strike a balance between leading and following the research community. We do not formulate problems in detail, nor scope out research areas to the exclusion of others. On the other hand, we do invite, encourage, and prioritize research in certain areas. As researchers ourselves, we understand that research topics, scope, and approach cannot be dictated. We

merely channel the evolution of research by introducing points of focus along its way.

News on Communications Research

Our TF Program Solicitation cleared the internal review process and got posted on NSF website in late February. It comprises three research areas: Scientific Foundations of i) Communications, ii) Computing, and iii) Internet’s Next Generation. The third area, endearingly abbreviated as SING, prompts the merging of the theoretical foundations of computing, communications, and signal processing towards the GENI vision of the new Internet that NSF/CISE has announced [2], concentrating research efforts around a “clean slate” theme. The common wish list for Internet’s Next Generation includes security, mobility, location cognition, power efficiency, to name a few. Reliable communications, which generally have generated algorithmic studies, need more rigorous mathematical specifications, and methods for formal verification of system behavior. Wireless technology is expected to play a much bigger and much more fundamental role in the new Internet than it has to date. Looking forward to the next few years, with optical and wireless communications dominating the Internet, signal processing “at the interface” to the glass wire will become crucial in addressing the potential bottleneck. Speech and vision will become widely available thanks to new sensors. SING is expected to challenge the well-established theories (are bits the universal currency of information?) and break barriers between research communities, by changing the input-output orders in traditional reference framework of computing and communications systems.

I continue to serve as a member of the CISE GENI team. We held a Town Hall Meeting on GENI in March, a joint meeting with the Department of Defense in April, and we will have another Town Hall Meeting in Chicago in May. I have participated in the wireless and sensor communication related panels at these events. The calendar of GENI events is posted on [3]. The management of GENI, the Computing Community Consortium (CCC) has been opened as a solicitation [4]. Please get and stay involved with GENI!

One metro stop up the street from NSF is another funding agency, DARPA. Continuously striving to make the best use of taxpayers’ money, I’m proud to report on the synergies between NSF and DARPA, especially on mobile ad hoc networks (MANETs), which are not networks with links but nodes in a soup of interfering electromagnetic fields. It was a pleasure to meet pioneers and leaders in Information Theory at the ITMANET workshop on March 7 [5]. While information theory for mobile ad hoc networking is one of the areas of top interest to both agencies, another is knowledge based wireless networks, which was the topic of the NSF-DARPA co-sponsored workshop on March 29 [6]. I look forward to reporting on such joint endeavors in more detail in future installments.

On a Personal Note

One of my recent personal victories has been to maximize the number of CAREER proposals I could fund by applying for and obtaining funding from the EPSCoR program. The EPSCoR program is directed at those jurisdictions that have historically received lesser amounts of NSF Research and Development funding. Twenty-five states, the Commonwealth of Puerto Rico and the U. S. Virgin Islands currently participate.

I was happy to support our foundation-wide research infrastructure program again in March, this time through the MRI (Major Research Instrumentation) panels I helped with. It is my selfish wish to increase funding for infrastructure in our area through the best of proposed research.

I cheerfully continue serve as the CISE representative for the foundation-wide IGERT (Interdisciplinary Graduate Education Research Traineeship) Program [7], I described in the last issue. At the end of March, we received well over four hundred preliminary proposals. Other than the daunting task of setting up panels of boundary spanning researchers to review these brilliant interdisciplinary program proposals, I am dedicated to increasing the participation of our community in this program. We also held a one-day principal investigators' workshop for the 2005 IGERT awardees. It was one of the most gratifying days of my life: I met twenty-five scientists from all disciplines heading up twenty-five programs in new science, each contributed by an average of seven academic departments. The abstracts of these awards make for a most exciting read [8].

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 several new directors, who joined NSF after I did, to lead programs relevant to communications.

Dr. Eun K. Park joined our Theoretical Foundations cluster on February 28 as the program director for numerical analysis and computational optimization. However, he brings a greater breadth of expertise: his background spans modeling and analysis, large scale parallel and distributed computing and applications, algorithms, communications and networks. As most of you may, I knew EK as the author of his book on "Mobile and Wireless Internet." EK comes to us from University of Missouri at Kansas City, where he is a professor of Computer Science. He often jokes about my "seniority" as he has started to support our involvement in GENI. He is ambitious yet easygoing, serious yet humorous: a pleasure and privilege to work with.

Dr. William Steiger joined our Theoretical Foundations cluster right after New Year's as the program director for theory of computing. Bill is a professor of Computer Science at Rutgers University. He responded to the request for Venn diagrams representing overlapping disciplines by drawing a heart, labeled "algorithms," inside the circle of computer science. Bill indeed puts his heart in everything he does; and he does a lot, including revamping the Scientific Foundations in Computing section of our solicitation.

Dr. Timothy Pinkston joined our division as the program director for computer system architecture. His home institution is University of Southern California. With his stellar professional experience at USC and previously at Bell Labs, Hughes, and IBM, Tim's an established expert in the interconnection networks area, with particular emphasis on high-performance communication architectures for multicore and multiprocessor systems. Tim's approach to life is evident in the competitive athlete he is, and in the whirlwind manner he started his position at NSF. In this highly transient and high paced culture, Tim stands out among the outstanding, with his energy, commitment, ambition, and competence, but above all, solid friendship.

Dr. Karl Levitt of UC Davis is the program director for the Cyber Trust program in CNS and he supports other programs, such as GENI, NeTS and CSR in the CNS Division. His youthful attitude makes it hard to believe he has been with SRI International for twenty years (where he served as the Director of Computer Science Laboratory) and he has been with UC Davis for twenty years (where he has helped start the Computer Security and Formal Methods Laboratories). It is sheer pleasure to listen to Karl's laser-precise views he communicates with his unmistakable soft tone; whenever I chat with him our conversations are punctuated by giggles.

Last but not least, it is my professional and personal pleasure to say Professor David J. Goodman has joined NSF to lead up wireless networking research in addition to supporting GENI, NeTS and Cyber Trust programs in the CNS Division. A week after joining NSF, David became a member of the prestigious National Academy of Engineering. The rest of his resume is too intense, and my partiality too evident, to state here. I will instead cite his biography as a reference [9]: I refer to it whenever I need a goal-reinforcement.

The "Social Scene"

It is hard to differentiate between working and socializing when your colleagues are your friends. I can't count the number of times I had lunch or coffee with EK, Bill, Tim, and other colleagues, some of whom I introduced in previous columns. As a result, we have plans for workshops, decisions on how to spend cluster reserves, and policies to enforce in upcoming programs. At least six other CISE program directors live in the apartment building I live in, next door to NSF. It's safe to say I happily, busily, excitedly, conveniently, and productively live at work.

Before I get judged for not having a life outside of work, let me negate that potential observation by citing a very interesting book I've been reading lately: "Forty Signs of Rain," by Kim Stanley Robinson [10]. It takes place, well, at NSF...

It is easy to be enveloped by this ethos!

My alternating Friday and Monday schedule at my office in NJIT is working so well, I even found time to participate in departmental service activities in addition to meeting with my graduate students, working on their projects, theses, and dissertations. My obsessive-compulsive email habit is virtually keeping me at both places at one time.

My commute on the train once again gave me the opportunity to write this. Thanks to Spring, it's still light outside as the train is pulling into the beautiful Washington DC Union Station this evening.

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

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REFERENCES:

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GOLOMB'S PUZZLE COLUMN™

Mini-Sudoku Solution

Solomon W. Golomb



1. There are $288 = 12 \times 4!$ distinct Mini-Sudoku solutions. The factor $4! = 24$ corresponds to all permutations of the four symbols. Here are the 12 cases that differ by more than permutation of the symbols.

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2. Here is a Mini-Sudoku solution in which the four elements on each of the two diagonals are also distinct: (It is the seventh of the twelve cases shown above. The fourth case also has this property.)

1	2	3	4
4	3	2	1
2	1	4	3
3	4	1	2

3. At least four cells must be filled in to guarantee a unique Mini-Sudoku solution. Three distinct symbols must appear, since otherwise two unused symbols could be interchanged in the filled-in solution, destroying uniqueness. I tried all inequivalent ways of placing one each of 1, 2, and 3 in the 4×4 grid, and none of these led to a unique Mini-Sudoku solution. There are many ways to place four symbols that will guarantee a unique solution. Here is one of them:

1			
			2
	3		
		3	

, which forces

1	2	3	4
3	4	1	2
4	3	2	1
2	1	3	4

4. The partial array

1			
			2
	3		

 gives

1	2		
3	4	1	2
	1		
	3		

 very quickly. The lower right corner cannot be 2 or 3.

A 4 in that corner forces a 3 in the upper right corner, filled in consistently.

1	2		3
3	4	1	2
	1		X
	3		4

and then the X indicates a cell that cannot be

Instead, we need a 1 in the lower right corner:

1	2		
3	4	1	2
	1		
	3		1

, which still allows further choices. Specifically, cases 1 and 3 in the solutions to Problem 1 are possible ways to complete this Mini-Sudoku.

5. Twelve of the sixteen cells can be filled in without leading to a unique solution. There are many examples, such as

1	2	3	4
3	4	1	2
2		4	
4		2	

, which can become either the first or the second cases in Problem 1.

6. Some, but not all, of the cases shown in the solution to Problem 1 have "orthogonal mates". Thus, cases 1 and 10 in the solution to Problem 1 are orthogonal, but case 8 in the solution to Problem 1 has no orthogonal mate. (If the Latin square can be obtained by permuting the

rows of

1	2	3	4
2	1	4	3
3	4	1	2
4	3	2	1

,

the Cayley table of Klein's group V_4 , there will be orthogonal mates. If the Latin square can be

obtained by permuting the rows of

1	2	3	4
2	3	4	1
3	4	1	2
4	1	2	3

, the Cayley table of the cyclic group C_4 , no orthogonal mate is

possible.) In anticipation of Problem 7, we observe that cases 4 and 7 in the solution to Problem 1 mentioned in the solution to Problem 2, are orthogonal.

7. Subtract 1 from each entry in cases 4 and 7 in the solution to Problem 1 to obtain the still-orthogonal Mini-Sudoku solutions

0	1	2	3
2	3	0	1
3	2	1	0
1	0	3	2

and

0	1	2	3
3	2	1	0
1	0	3	2
2	3	0	1

, and put them together to obtain

00	11	22	33
23	32	01	10
31	20	13	02
12	03	30	21

and read each entry as a two-

digit integer in base 4.

Rewritten in decimal notation, we obtain:

0	5	10	15
11	14	1	4
13	8	7	2
6	3	12	9

. The remarkable Magic Square shown in Problem 7.



2006 IEEE Information Theory Workshop

Call for Papers

October 22 –26, 2006, Chengdu, China, <http://sist.swjtu.edu.cn/imc/itw06/>
In cooperation with SWJTU, UESTC, NSFC and IEEE VT BC

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The 2006 IEEE Information Theory Workshop will be held at the Chengdu International Exhibition and Convention Center, Chengdu China, October 22 (Sunday) through October 26 (Thursday) 2006. Detailed information including submission guidelines, contact links, technical program, registration, travel, accommodation, getting around, and social events will be available at the workshop website: <http://sist.swjtu.edu.cn/imc/itw06/> and its mirror site <http://www.ee.cityu.edu.hk/~itw06/>.

Topics

The workshop aims to explore current topics in the areas of coding and information theory. The workshop has a three and half-day technical program featuring plenary talks, as well as invited and contributed paper presentations. Possible topics include, but are not necessarily limited to:

- error control codes
- iterative decoding and detection techniques
- data compression
- joint source and channel coding
- quantum-theoretical aspects of coding
- network coding
- space-time codes, multi-user and MIMO systems

Paper Submission

Papers presenting new results in the above areas are hereby solicited. Only electronic submissions via above websites in PDF or PS formats are accepted. Each submission must be at most 5 pages in length and conform to the double-column IEEE conference proceedings format (style file and templates can be downloaded from above website). Submissions that cannot be accommodated in contributed paper sessions may be considered for poster sessions.

Conference Proceedings

All papers accepted for oral and poster presentation will be published in the Workshop Proceedings by IEEE Press (in both printing and CDROM forms). All the accepted papers will be included in the IEEEExplore online database and be indexed by Engineering Index (Ei).

Important Dates

Submission deadline:	June 1, 2006
Notification of acceptance:	August 1, 2006
Camera-ready deadline:	September 1, 2006

About Chengdu:

Chengdu, a city with longstanding history and civilization, is the capital of Sichuan Province. The province is the home of giant pandas and is well known for its historical and natural attractions. It has four places on the World Cultural and Natural Heritage: Jiuzhaigou Scenic Area, Huang Long Valley, Mount Emeishan and ancient Dujiang Yan irrigation systems. Chengdu is also well known for its spicy Cuisine. October is in the middle of autumn in Chengdu with average temperatures ranging from 15°C (night) to 21°C (day). There are direct flights to Chengdu from Hong Kong, Tokyo, Osaka, Fukuoka, Seoul, Singapore, Bangkok, Beijing, Shanghai and other major cities.

Further Inquiries

Inquiries on general matters related to the workshop should be addressed to:

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Tel: +86 28 88823966, Fax: +86 28 87600743

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Conference Calendar

DATE	CONFERENCE	LOCATION	CONTACT/INFORMATION	DUE DATE
May 21-24, 2006	2006 IEEE Communication Theory Workshop (CTW 2006)	Dorado, Puerto Rico	http://www.ece.rice.edu/ctw2006/	March 15, 2006
May 22-25, 2006	7th ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc 2006)	Florence, Italy	http://www.sigmobile.org/mobihoc/2006/	April 3, 2006
May 30-31, 2006	Signal Processing for Wireless Communications conference (SPWC 2006)	King's College, London, United Kingdom	http://www.spwc2006.org	January 31, 2006
May 30-June 1, 2006	23rd Biennial Symposium on Communications	Kingston, Ontario, Canada	http://www.ece.queensu.ca/symposium/	February 1, 2005
June 11-15, 2006	2006 IEEE International Conference on Communications (ICC 2006)	Istanbul, Turkey	http://www.icc2006.org/index/welcome.html	September 25, 2005
July 2-5, 2006	IEEE International Workshop on Signal Processing Advances for Wireless Communications (SPAWC 2006)	Cannes, France	http://spawc2006.eurecom.fr/	February 1, 2006
July 2-7, 2006	The 11th Information Processing and Management of Uncertainty International Conference (IPMU 2006)	Paris, France	http://ipmu2006.lip6.fr	December 10, 2005
July 9-14, 2006	2006 IEEE International Symposium on Information Theory (ISIT 2006)	Seattle, WA, USA	http://www.isit2006.org/	January 16, 2006
August 29-September 5, 2006	NATO ASI on Coding and Analysis of Multiple Access Channels 2006	Budapest, Hungary	http://www.szit.bme.hu/natoasi/	March 26, 2006
September 11-14, 2006	17th Annual IEEE International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC 2006)	Helsinki, Finland	http://www.pimrc2006.org/	June 23, 2006
September 23-29, 2006	12th Annual International Conference on Mobile Computing and Networking (MobiCom 2006)	Los Angeles, CA, USA	http://www.sigmobile.org/mobicom/2006/index.html	March 10, 2006
September 25-28, 2006	IEEE 63rd Vehicular Technology Conference (VTC 06 Fall)	Montreal, Canada	http://vtc06f.trackchair.com/	March 31, 2006
September 2006	The Annual Allerton Conference on Communication, Control and Computing (Allerton 2006)	Monticello, IL, USA	http://www.csl.uiuc.edu/allerton/	TBA
October 22-26, 2006	2006 IEEE Information Theory Workshop (ITW 2006)	Chengdu, CHINA	http://www.ee.cityu.edu.hk/~itw06/	June 1, 2006
October 29 – November 1, 2006	The 2006 International Symposium on Information Theory and Applications (ISITA 2006)	Seoul, Korea	http://www.isita2006.org/	April 3, 2006
November 27 – December 1, 2006	2006 IEEE Global Telecommunications Conference	San Francisco, CA, USA	http://www.ieee-globecom.org/2006/	March 5, 2006