

IEEE Information Theory Society Newsletter



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Editor: Lance C. Pérez

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President's Column

Steven W. McLaughlin



**Steven W.
McLaughlin**

This is my final column as IT Society president and I want to thank all of you for making it a very enjoyable – and challenging – year. It has been a real pleasure meeting and working with so many new people. In the coming years the Society is in good hands – next year our President will be David Neuhoff, Bixio Rimoldi will be First Vice President and Marc Fossorier will join our team as Second Vice President. We have all worked together as a team to get a

number of new things started and we will continue to work closely in the coming years. I want to make a special thank you to Professor Han Vinck who has completed his five-year term as an IT Society Officer. Those of you who have worked with him know that his experience, advice and wisdom have had a very strong and positive effect on the Society.

I believe we have started some new and potentially important projects for the Society and the future of information theory. I have mentioned it in previous columns and I want to once again ask your support and input to the newly formed IT Society Student Committee (being spearheaded by Andrea Goldsmith) and the ArXiv efforts (posting preprints and conference submissions on ArXiv). We are in the process of redefining the IT Society webpage in an effort to draw more people to information theory.

As I write we have all just returned from the ISIT in Adelaide. Everyone I spoke with thought that this year's ISIT was one of the most successful. Alex Grant and Rod

Kennedy and their entire team did an outstanding job. I particularly enjoyed Dick Blahut's Shannon lecture and the outstanding plenaries given by Benjamin Schumacher, David MacKay, P. R. Kumar, and Terry Speed. You can see the Shannon Lecture on line at <http://www.isit2005.org/>. Looking ahead, the ISIT will be held in Seattle in 2006 (co-chaired by Jody O'Sullivan and John Anderson), Nice in 2007 (co-chaired by Guisepppe Caire and Marc Fossorier) and Toronto in 2008 (co-chaired by Frank Kschischang and En-hui Yang). We expect to approve an ISIT in Seoul for 2009 (co-chaired by Jong-Seon No and Vince Poor) in the next few months. As for workshops there will be an IT Workshop in Punta del Este Uruguay in March 13-17 2006 (co-chaired by Gadiel Seroussi and Marcelo Weinberger), and an IT Workshop in Chengdu, Cina, October 22 – October 26, 2006, (co-chaired by Dan Costello, Shu Lin and Pingzhi Fan).

Thanks to the efforts of Muriel Medard, the society has gotten back into a firm financial state, and future looks stable. As you may know, the greatest source of revenue for the Society is the income distribution we receive from the IEEE Electronic Library (IEL) which is the primary product IEEE sells to libraries, companies and institutions. IEEE is in the process of phasing-in a new financial model that rewards high quality content in IEL. Our revenue from IEL is tied directly to the number of papers in IEL and frequency of access of those papers. At the recent IEEE Technical Activities Board (TAB) meeting the projections for 2006 and 2007 were presented and our high quality approach has paid off not only intellectually but financially – our income distribution will increase under the new model. Thanks to all of our editors for their hard work.

Finally, thanks again to everyone for giving me the opportunity to serve as your President in 2005.

From the Editor

Lance C. Pérez



This issue of the Information Theory Society Newsletter is my last as editor. I would like to give my sincere thanks to the Society for the support they have given the Newsletter during my five-year tenure; the Newsletter would not exist without the contributions of the IT Society members.

The new editor for the Newsletter is Daniela Tuninetti. Daniela may be reached at

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

<u>Issue</u>	<u>Deadline</u>
March 2006	January 15, 2006
June 2006	April 15, 2006
September 2006	August 15, 2006
December 2006	October 15, 2006

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

Sincerely,
Lance C. Pérez

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The Historian's Column

A. Ephremides



I recently picked up the “proceedings” of a very unusual meeting that took place in July 1974 at Stanford University and that was sent to me some time ago by Bob Gray, a frequent and valuable contributor to this column. It is actually not a classical “Proceedings” document but, rather, a report that includes the transcribed lecture notes of a research seminar that was actually sponsored by the National Science Foundation and the Industrial Affiliates Program of the famous Stanford Information Systems Laboratory. As I was perusing it, I was overwhelmed by a feeling of nostalgia. Although I was not present at that seminar, it brought to my memory the totally different style of research activities of that era. Unlike today, when the multitude of megaprojects and parallel events obfuscates what is important and what is not, at that time there was a very clear (and some might say elitist) filter of quality that allowed for an easy discrimination between valuable and outstanding events on one hand and the “run-of-the-mill”, forgettable, miscellaneous activities of which, it must be actually be said, there weren't that many.

So this was an eclectic seminar on Source Coding and Ergodic Theory Research. It was actually organized and chaired by Bob Gray who was an Assistant Professor at the time. To appreciate the “feel” of that event it is useful to run down the list of lecturers and participants. First of all, it is a rather short list (again, typical of that era), and secondly, it consists of people most of whom are considered now among the senior “elite”, if not the “gurus”, of our field. Some may not be on the “stage”, so to speak anymore, but their work surely is. And, based on that list, one may recreate in their mind (or imagination) what it must have been like to be present at that gathering.

So here are the lecturers: Toby Berger, Tom Cover, Lee Davisson, Bob Gray, Marty Hellman, Tom Kailath, Martin Morf, Joel Morris, Jim Omura, Mike Pursley, Dave Sakrison, Paul Shields, Harry Tan, Jack Wolf, Aaron Wyner, and Kung Yao. I count five Shannon Lecturers in this list. With the exception of Dave Sakrison and Aaron Wyner, who have passed away, and Harry Tan, whose whereabouts I simply do not know, everyone is active, alive, and “kicking” one way or another. But it is equally instructive to look at the list of the other participants in the room. They were Bob Ash, Dave Espenshade, Brad Dickinson (now at Princeton), Phil Fire, Will Gersh (now at the University of Hawaii), Mark Gold, Jim Kelly, Dave Neuhoff (now at the University of Michigan and President of our Society), Bill Pearlman, Bob Scholtz, Gideon Schwarz, Adrian Segall (now at the Technion), G. Sidhu, Martha Sloan (IEEE President in the nineties), and Terry Wagner.

So this was the setting. Also recall that Blahut's paper in 1972 that effectively solved the problem of fast, numerical evaluation of rate-distortion functions, was a fresh and recent development as were many other papers by Wyner, Slepian and Wolf, Cover, Berger, Jelinek, Davisson, Gray, and others. In this context and “zeitgeist”, also imagine that the seminar lasted from

Monday, July 15 until Thursday, July 25, that is not one but almost two whole weeks. That is how scientific and personal bonds are forged, and not by arriving to a conference of 17 parallel sessions at 11am, giving a talk at 2pm and then catching a flight on the same evening!

In any event, here is what transpired in that seminar. At the start there was an overview of Source Coding by Toby Berger and Bob Gray. Then there were three lectures on Multiuser Communications (yes, already at that time!) by Jack Wolf, Aaron Wyner, and Tom Cover (already we have cited four of the five Shannon Lecturers). These were followed by a talk on “Distance Measures and Approximation” by Bob Gray and one on the Rohlin-Kakutani theorem of Ergodic Theory by Paul Shields.

The following day Hellman talked on Joint Source and Channel Coding (M. Hellman), Trellis coding (J. Omura), Tree Coding (T. Berger), and Nonblock Source Coding and Ergodic theory (B. Gray). The first week was wrapped up by four lectures on the topic of Sources with Unknown Statistics by Bob Gray (fixed rate Universal Coding), Mike Pursley (Variable Rate Coding with a Fidelity Criterion), Joel Morris (Robust Quantization), and Dave Sakrison (Robust Coding with a Fidelity Criterion), and two more talks on Universal Noiseless Coding (Lee Davisson on an Information Theoretic Approach and Tom Cover on a Computational Complexity Approach).

After the weekend, during which we can only image what the participants did (I would have headed north towards Napa), the second part of the seminar started with Toby Berger's lecture on Information Singular Processes. It was followed by four talks on Properties of Rate-Distortion functions by Bob Gray, Kung Yao, Harry Tan, and Mike Pursley. After that came a lecture by Paul Shields on Ergodic Theory Selected Topics, and a talk by Dave Sakrison on Fidelity Measures for Vision. And, on the final day, Tom Kailath (the fifth Shannon Lecturer) talked on Representations of Random Processes, Martin Morf on Speech Compression, and Marty Hellman on Cryptography.

And, then the feast was over. Now you must agree that even if this is not your field and even if you only recognize a handful of these people, the whole thing must have sounded quite appealing to you. It certainly did to me; more than that, actually I would love to have been there. Learning about Source Coding on a sure footing as the field was taking shape and having the chance to talk to Marty Hellman about Cryptography then, and challenging Tom Kailath on Innovation Processes! And, hearing it all from the “horse's mouth”! Oh, how I would have enjoyed it! My whole career might have been different!

IT Society Announces 2005 Paper Award Winners

By David L. Neuhoff



Nihar Jindal, Andrea Goldsmith and Sriram Vishwanath, winners of the 2005 Joint Comsoc/IT Society Paper Award.

2005 Joint ComSoc/IT Society Paper Award:

At ISIT 2005 in Adelaide, the Joint ComSoc/IT Society Paper Award was given to Nihar Jindal, Sriram Vishwanath, and Andrea Goldsmith, for their paper

N. Jindal, S. Vishwanath, and A. Goldsmith, "On the Duality of Gaussian Multiple-Access and Broadcast Channels," *IEEE Trans. Inform. Theory*, vol. 50, pp. 768-783, May 2004.

This award recognizes this paper as an outstanding contribution to both communications and information theory in 2004. The following description is condensed from the original nomination of the paper.

This paper for the first time established clearly and beautifully the dual relation between the capacity regions for Gaussian broadcast channels and multiple access channels. Some type of duality had been suspected in the information theory community (even hinted at in Cover and Thomas), but the actual nature of it had remained elusive. This paper used a fresh approach to establish the duality, considering the problems of Gaussian broadcast channels and multiple access channels jointly from an optimization perspective. The paper has not only established capacity results, but has provided a basis for understanding the relation among coding and decoding schemes for Gaussian broadcast channels and for multiple access channels. The paper elegantly showed the relation, for broadcast channels, between schemes based on interference cancellation at the receiver and dirty paper coding, in effect interference cancellation at the transmitter. The relation between interference cancellation for broadcast and for multiple access channels was also beautifully elucidated. More importantly, perhaps, the paper was able to provide, from the theory of Lagrangian duality, crisp and fundamental engineering results.

Nominations are currently sought for next year's Joint ComSoc/IT Society. Please see the announcement elsewhere in the Newsletter.



Ning Cai, Robert Li, and Raymond Yeung, winners of the 2005 IT Society Paper Award.

2005 IEEE Information Theory Society Paper Award

The 2005 IEEE Information Theory Society Prize Paper Award was announced at ISIT 2005. This award will be presented at ISIT 2006, Seattle, to Shuo-Yen Robert Li, Raymond W. Yeung, and Ning Cai, for their paper

S.-Y. R. Li, R.W. Yeung, and N. Cai, "Linear network coding," *IEEE Trans. Inform. Theory*, vol. IT-49, pp. 371-381, Feb. 2003.

This award recognizes an exceptional publication in information theory appearing in the period January 1, 2003 through Dec. 31, 2004. The following description of the paper derives from a nomination statement.

The field of network coding began with the paper:

R. Ahlswede, N. Cai, S.-Y. R. Li, and R. W. Yeung, "Network information flow," *IEEE Transactions on Information Theory*, vol. IT-46, pp. 1204-1216, July 2000, which showed how coding is strictly superior to routing for network communications. The networks studied transmit messages which are elements of some alphabet, often taken to have the structure of a finite field. "Coding" means that network nodes may emit arbitrary functions of their inputs, rather than merely routing them in a particular direction. A multicast network has one source and multiple receivers. The source transmits a set of messages and each receiver must obtain all of the source messages. The Li-Yeung-Cai paper proved the elegant result that if a multicast network has any solution then it must have a linear solution over some sufficiently large finite field alphabet. By "linear", we mean that every node performs only linear operations over the finite field to create its outputs from its inputs.

The Li-Yeung-Cai result is not only interesting and nontrivial, but their proof itself is enlightening. They actually describe an explicit algorithm for obtaining a linear solution in a multicast network that has some solution. The entire setup of their proof considers

each network node to have a vector space spanned by its inputs from which to choose an output. This vector space approach is a powerful method of looking at the network coding problem, since it guarantees linearity of functions and very nicely incorporates the concept of "solvability".

A total of 12 papers were nominated for the 2005 IT Society Paper Award. From these, four finalists were selected, the winner plus the following three papers (in alphabetical order):

P. Moulin and J. A. O'Sullivan, "Information Theoretic Analysis of

Information Hiding," IEEE Trans. Inform. Theory, vol. IT-49, pp. 563-593, Mar. 2003, P. Sotiriadis, V. Tarokh, and A. Chandrakasan, "Energy Reduction in VLSI Computation Modules: An Information-Theoretic Approach", IEEE Trans. Inform. Theory, vol. IT-49, pp. 790-808, April 2003, L. Zheng and D. Tse, "Diversity and multiplexing: a fundamental tradeoff in multiple antenna channels," IEEE Trans. Inform. Theory, vol. IT-49, pp. 1073-1096, May 2003.

Nominations are currently sought for next year's IT Society Prize Paper Award. Please see the announcement elsewhere in the Newsletter.

Chapter of the Year Award Announced

The 2005 Chapter of the Year Award went to the Japan Council Chapter. The award recognizes the most active chapter during the

previous year. Japan already received it in 2002. In 2003 and 2004 it went to the German and the Benelux chapters respectively.

Call for Nominations: 2006 IEEE Information Theory Society Paper Award

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

The purpose of this Award is to recognize exceptional publications in the field and to stimulate interest in and encourage contributions to fields of interest of the Society. The Award consists of a certificate and an honorarium of US\$1,000 for a paper with a single author, or

US\$2,000 equally split among multiple authors. The 2006 award will be given for a paper published in 2004 and 2005.

NOMINATION PROCEDURE: By March 1, 2006, please email the name of the paper you wish to nominate, along with a supporting statement explaining its contributions, to the IT Transactions Editor-in-Chief, Vincent Poor, at poor@princeton.edu, with a cc to Lynn Stetson at lstetson@princeton.edu.

Call for Nominations: 2006 Joint Information Theory/Communications Society Paper Award

The Joint Information Theory/Communications Society Paper Award recognizes one or two outstanding papers that address both communications and information theory. Any paper appearing in a ComSoc or IT Society publication during the year 2005 is eligible for the 2006 award. A Joint Award Committee will make the selection.

NOMINATION PROCEDURE: By February 1, 2006, please email the name of the paper you wish to nominate, along with a supporting statement explaining its contributions, to IT Society First VP, Bixio Rimoldi (bixio.rimoldi@epfl.ch).

Call for Nominations: 2006 Information Theory Society Aaron D. Wyner Award

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

Nominations for the Award can be submitted by anyone and are made by sending a letter of nomination to the President of the IT Society by April 15, 2006. The individual or individuals making the nomination have the primary responsibility for justifying why the nominee should receive this award.

NOMINATION PROCEDURE: Letters of nomination should

- Identify the nominee's areas of leadership and exceptional service, detailing the activities for which the nominee is believed to

deserve this award;

- Include the nominee's current vita;
- Include two letters of endorsement.

Current officers and members of the IT Society Board of Governors are ineligible.

Please send all nominations by April 15, 2006 to

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A New Committee for Students in Information Theory

By Andrea Goldsmith and Ivana Maric

The Student Committee of the Information Theory Society is a new committee whose goal is to help make the society of more value to students. The society's Board of Governor's established the committee with the recognition that students will become the future members and leaders of the society, and it is therefore crucial that they play an active role. The committee is currently chaired by Andrea Goldsmith, and once established it will be run by students with a small advisory committee of regular society members. The committee will also have a representative attend the society's Board of Governor's meetings.



Students and IT members at a panel discussion at the 2005 Allerton Conference.

The committee has created both a website (itsoc-students.ece.cornell.edu) and a mailing list (itsoc-students@lists.cornell.edu). Anyone (whether an IT student member or not) can join the committee by signing up for the committee mailing list. The website will be developed with a focus on providing resources to students, including discussion groups on various topics in information theory; taped lectures and panels (including the annual ISIT Shannon lecture); 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 like 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 events planned by the committee. A questionnaire is also posted on the website to solicit feedback from students on what events and resources the committee should focus on. A list of current volunteers and volunteer opportunities is also posted on the website.

The inaugural meeting of the Information Theory Student Committee was held Monday, September 5, at ISIT in Adelaide. The purpose of the meeting was to introduce students to the committee, its goals and its actions-to-date; to introduce the students and regular members that had been involved in launching the committee; to solicit feedback for event planning on what would be of most interest to students; to provide a Q&A session for students with members of the society's Board of Governors; and to open the floor to questions and discussion on any topic of interest or concern to students.

The open forum and board question-and-answer session at the ISIT meeting was lively and dynamic (it was not taped, but in the future such events will be taped and posted to the website for

students unable to attend the event). The board members gave their perspective on the society as well as advice to students. The board sent a strong message that the student committee was created to increase the value of the society to students and to help establish a community of students working in information theory, regardless of whether these students are members of the society or not. Many board members expressed how valuable the society was to them, and how they had established lifetime collaborations, connections, and friendships through

the society. We hope that the student committee can establish a similar dynamic for its members.

The committee also held a meeting at the Allerton Conference on Thursday, September 29, after dinner. There was a brief presentation about the student committee, followed by a panel session entitled "Information Theory: What's Hot, What's Not, What's Changed" moderated by Andrea Goldsmith. The goal of the panel was to give students some perspective on the current state of information theory research as well as a historical perspective on how the nature of research in this area has changed over the years. The panelists – Abbas El Gamal, P. R. Kumar, Sanjoy Mitter, Tara Javidi, Massimo Franceschetti, and Jacob Ziv – provided an entertaining and insightful mix of advice, perspective, and wisdom. The panel session was taped and can be downloaded from the committee website.

One initiative that students should be aware of is a website currently being developed by UCSD with tutorial background on key areas of information theory. The website will consist of multiple pages, each describing a particular topic. Topics will be described at a high level, with links to deeper tutorial material on specific subtopics. The target audience is beginning graduate students or researchers from other fields. The goal is to let beginning researchers know what's known, and interest them in learning more. The pages may also include links to books, papers, tutorials, etc. Open problems will also be posted, as well as success stories about the impact of information theory on practical system designs. The website will be linked to the committee website as soon as it comes online.

The success of the student committee will depend very much on student involvement. We welcome input, suggestions, and contributions for the student committee, and also need volunteers to help with the website development, event planning, and committee outreach. More details on these volunteer opportunities and how to volunteer can be found on the committee website.

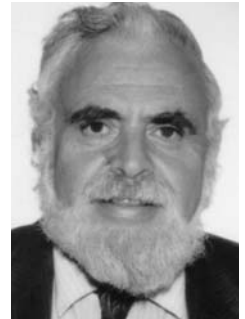
Working in information theory can sometimes be a solitary experience, especially at smaller departments or at departments where information theory is not the main focus. This isolates students at these institutions from the information theory community as a whole. The committee aims to alleviate this isolation by creating an extended, distributed community of students working in information theory along with resources for these students. This will help students getting started in the field, connect students work-

ing on similar problems, and provide faster feedback on results. As pointed out at the Allerton panel session, we need new perspectives, new tools, and interdisciplinary activities to attack some of the challenging problems in information theory and to maintain it as a vibrant and dynamic field. We hope that an active student committee will aid students at all institutions to formulate and solve important problems in information theory, and provide long-term benefits in terms of collaborations and connections.

GOLOMB'S PUZZLE COLUMN™

Simple Probabilities

- Five cards are dealt at random from a standard 52-card bridge deck. The first four are observed to all be hearts. What is the probability that the fifth card will also be a heart?
- Five cards are dealt at random from a standard 52-card bridge deck. If at least four of the cards are hearts, what is the probability that all five are hearts?
- Six "ideal" dice are tossed. What is the probability that a) at least one shows a 5?, b) exactly one shows a 5?
- Six "ideal" dice are tossed. What is the probability that of the six numbers shown, all are a) the same?, b) different?
- In a certain game show, there is a large prize behind one of four doors, but nothing behind the other three. You are told to guess which door conceals the prize. The emcee (as a standard procedure on this show) will then eliminate two of the wrong doors, but not the one you originally guessed (whether right or wrong). You then are given the opportunity to change your original guess to the other remaining door. Your best strategy is a) stick with your original guess, b) switch, or c) it makes no difference. (You win the prize if and only if your final choice is correct.)
- A hat contains five seemingly identical half-dollar coins, but only four are "honest". The fifth coin has *heads* on both sides. You are blindfolded, and instructed to extract one of the five coins at random, and place it flat on a tabletop. The blindfold is removed, and you see that the coin shows *heads*. What is the probability that the other side is also *heads*?
- On average, how many times must a pair of dice be tossed to show, for the first time, a total of k , for each k from 2 to 12?
- A positive real number x , selected at random, is written on a card in one sealed envelope, and the number $2x$ is on a card in a second sealed envelope. You select one of the two envelopes. You will receive the amount, in dollars and cents (rounded to the nearest cent, two places after the decimal point) of the envelope you select. However, *after* you open the envelope and see a number y , you are allowed to change your mind and pick the other envelope. You reason as follows: The original envelope you picked shows an amount y . The other envelope is equally likely to show $\frac{1}{2}y$ or $2y$, for an expected value of $\frac{1}{2}(\frac{1}{2} + 2)y = \frac{5}{4}y$; so your expectation increases by 25% if you switch. Is your reasoning correct?



Solomon W. Golomb

Guest Column: From the National Science Foundation



Sirin Tekinay

Dear reader,

I recently joined the United States National Science Foundation (NSF) as the Program Director for communications research. I am delighted to write this column as a means to fuel interaction on ideas, visions, and issues that impact us all as professionals in the communications community. I would like to provide you with insight to what my new position entails, in addition to relevant NSF news and programs. I am enthusiastically looking forward to hearing from you, too.

I certainly hope this column does not come across as addressed narrowly to the US based readership. My reports will be relevant to the global community, as science and research know no boundaries. NSF organizationally and philosophically is positioned to foster international collaboration, which I will elaborate on.

A Few Words on NSF Organization and Mission

Let me first offer some background. The mission of NSF is to advance science. Specifically, it promotes basic scientific research and research fundamental to the engineering process, and science and engineering education programs at all levels and in all fields of science and engineering. NSF formulates and manages programs to strengthen scientific and engineering research potential. NSF strives to output a knowledge base for science and engineering appropriate for development of national and international policy.

The Office of International Science and Engineering (OISE) serves as a focal point for international science and engineering activities both inside and outside NSF. OISE promotes the development of an integrated, foundation-wide international strategy, and manages international programs that are innovative, catalytic, and responsive to a broad range of NSF interests. Specifically, OISE supports programs to expand and enhance leading-edge international research and education opportunities for U.S. scientists and engineers, especially at the early career stage. It works to build and strengthen effective institutional partnerships throughout the global science and engineering research and education community, and it supports international collaborations in NSF's priority research areas. The Office carries out its functions through close partnership with the NSF Directorates and through its own program activities [1].

The directorate I joined, Computer and Information Science and Engineering (CISE), is one of seven directorates of the foundation.

The goals of CISE are cited as the following: i) to uphold a position of world leadership in computing, communications and information science and engineering, ii) to promote the understanding of the principles and advance uses of computing, communications and information systems in service to society, iii) to contribute to universal, transparent and affordable participation in an information-based society. "Society" here clearly refers to a global society and "world leadership" can only be achieved by incorporating the best of the world via collaborations.

In CISE, we have three divisions, all of which have components relevant to communications research; i.e., Computing and Communications Foundations (CCF), Computer and Network Systems (CNS), and Information and Intelligent Systems (IIS). This is a result of the recent reorganization CISE went through, due to scientific, administrative, and financial motivations. The divisions, along with the clusters they comprise, are now better aligned with the fields they represent. Clusters have sharper focus on the programs they manage. The organization is flexible enough to originate and nurture cross-cutting emphasis areas, such as our Cyber Trust area. I belong to the Theoretical Foundations Cluster in CCF, where the other two clusters are: Foundations of Computing Processes and Artifacts, and Emerging Models for Technology Computation.

News on Communications Research

My job description makes me feel like a kid in a candy store. It expectedly includes the fundamental responsibility of running the ongoing programs in communications research, such as the CAREER program that aims to support junior faculty, and the Theoretical Foundations program, whose solicitation will come out early in 2006. By the time you read this, I hope to have concluded the 2006 CAREER program. Another component of my job description is to help formulate and stimulate research towards GENI, NSF's new initiative to re-build the Internet [2], [3]. (GENI stands for Global Environment for Network Investigations) The GENI initiative has two components: the experimental GENI facility, and the GENI research program. GENI is intended to catalyze a broad community effort that will engage other agencies, other countries, and corporate entities.

The GENI research facility will be an interconnection of independent facilities via federated design. It is envisioned to enable shared use through slicing and virtualization in time and space domains (i.e., where "slice" denotes the subset of resources bound to a particular experiment); access to physical facilities through programmable platforms (e.g., via customized protocol stacks); and large-scale user participation by "user opt-in" and IP tunnels. It will offer protection and collaboration among researchers by controlled isolation and connection among slices; and a broad range of investigations using new classes of platforms and networks, a variety of access circuits and technologies, and global control and management software.

The GENI initiative will support research, design, and development of new networking and distributed systems capabilities by creating new core functionality, deploying and validating new architectures, building higher-level service abstractions, and building new services and applications. Beyond the core network focus, we are looking forward to broad research impacts on core theory, fundamental algorithms and applications. Here is a non-exhaustive list of research topics expected to be the foci of research efforts in theoretical foundations:

- Core theory: expanding information theory and formulating a new communication framework, considering the temporal and

spatial distribution of information and power; viewing electromagnetic spectrum as a natural resource, investigating relationships to theoretical foundations of social computing, microeconomics, and biology; developing an evolution theory for computing and learning with mobile information sources; establishing the role of location from spatial behavior of propagation to “place;”

- Fundamental algorithms, such as cooperative communications, scalable security, scalable compression, signal processing techniques to support content analysis; studies on the tradeoff between communication versus computation and storage; models for mobility enhanced information dissemination
- Applications, including multimedia signal processing; wireless communications, mobile and sensor devices, ad hoc networks

In short, GENI is about breakthroughs, new approaches, and brand new theories towards a new Internet. As we all have come to appreciate, the Internet was not designed for what it is handling and providing today, and it shows. Incremental improvements to various layers resemble band aids. Cross layer optimizations are often not scalable and not analytically tractable. I strongly believe that if we don't learn the history, we are doomed to repeat it. The GENI Facility will leverage the best ideas and capabilities from existing network testbeds such as PlanetLab, ORBIT, WHYNET, Emulab, X-Bone, DETER and others. However, the GENI Facility will need to extend beyond these testbeds to create an experimental infrastructure capable of supporting the ambitious research goals of the GENI initiative I noted above.

I hope you're excited about GENI. It's such a thrill to think outside the box, outside existing systems and paradigms, dream up the pervasive, intelligent, sensitive, reliable communication system that can surround you via thin air. (If you were ever a fan of science fiction, we have a thing in common!)

On a Personal Note

Now, if you would indulge me, I would like to share my experiences at NSF so far, in hopes of exciting you about getting involved with the NSF, as a reviewer, visitor, presenter, and program officer.

NSF has “borrowed” me from my home institution, as most program directors are borrowed for, nominally, a two-year period. I was (and still am) with the Electrical and Computer Engineering Department of New Jersey Institute of Technology when my predecessor, Professor Venugopal V. Veeravalli, announced he was leaving NSF to return to his home institution, University of Illinois Urbana-Champaign. I expressed my strong interest in the opportunity to serve our community in this new capacity. (I'm grateful to Venu for all he has done during his two-year sabbatical here, and all the help he provided me with in making sure I hit the ground running.) When I met the folks at CISE, I immediately felt the “hum;” daily life is synched to the heartbeat of advances in science and technology here. I had served as a reviewer before, so I was familiar with the environment. Now I know everyone at the NSF does feel, all the time, how the NSF building buzzes with the enthusiasm of large scope projects, far-reaching futuristic visions, and a vast range of activities and interactions.

NSF People

In every column, I'd like to introduce some of the people I work with; who embody the culture and spirit of NSF. The director of CCF, Dr. Michael Foster, gave me a job description I found irresistible to any researcher with an appetite for making larger impact in his or her lifetime. He did warn me that it was a “three-person job.” I was only relieved and I reassured him that my personal limit is five; as a researcher, supervisor, instructor, editor, and volunteer. I'm sure many of you can relate, with a longer list than mine. I call Dr. Foster an “Infostation [4].” In a thirty-second meeting, he can convey a whole vision that will give rise to a family of research programs.

At 8:00 a.m. on my first day, I ran into Dr. Peter Freeman, the head of CISE. I deeply appreciated his warm welcome. His personal video invitation for participation in the Science of Design program [5] is reflects the foresight, commitment, and excitement of the entire organization.

Since I joined, Dr. John Cozzens, the program director for signal processing in our cluster, has been my infinitely patient mentor. He has been with the foundation for over a decade, and I'm grateful for his vast experience that he generously offers. I wish we could do a core dump so that I could absorb all of the institutional memory and know-how from him, but then I would miss his sharp, witty, humorous articulation of it all.

Since I started to get involved with GENI, everyone recommended that I meet with “Guru.” I have to confess, for the longest time I thought this was a most deserving nickname for Dr. Guru Parulkar, who has been a leader in the origination of GENI. He is a most energetic program director in Computer Networking Systems (CNS).

The “Bootcamp”

A couple of weeks ago, I completed the orientation bootcamp, or, the program management seminar. I was with about twenty other new program directors for three and a half days, learning all about NSF in many contexts, and making new friends. I was the only one from CISE. The atmosphere reminded me of the description of heaven in Michael Frayn's “Sweet Dreams [6],” where everyone does the job they're best at.

I spend one day out of each week (typically Mondays) at my office in NJIT, meeting with my graduate students, working on their projects, theses, and dissertations. My obsessive compulsive email habit has already proved to be most helpful in remote-supervising. I'm grateful that NSF allows, in fact, encourages, my research activities. The commute by train gives me the time to catch up on my reading and reviews. I have been writing this on the train.

The train is pulling into the beautiful Washington DC Union Station. I'll get off board soon.

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

Sirin Tekinay

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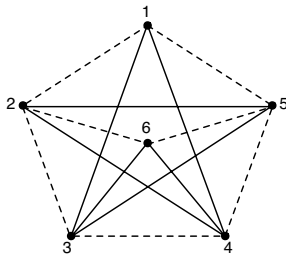
- [1] <http://www.nsf.gov/div/index.jsp?org=OISE>
- [2] <http://www.nsf.gov/cise/geni/>
- [3] Peter Freeman, "The GENI Initiative," to appear in Computing Research News November 2005
- [4] David Goodman, Joan Borrás, Narayan Mandayam, Roy Yates, "Infostations: A New System Model for Data and Messaging Services", 1997 IEEE VTC, vol. 2, pp. 969-973
- [5] http://www.nsf.gov/cise/ccf/sod_pres_video.jsp
- [6] Michael Frayn, Sweet Dreams, Collins, 1973

GOLOMB'S PUZZLE COLUMN™

Some Matrix Questions Solutions

Solomon W. Golomb

1. It is sufficient to remove only one edge from K_6 so that the fourteen remaining edges can be colored using two colors without forming a solid-color triangle:



Only the edge connecting the points 1 and 6 is missing from K_6 . The clever way to view this example is to consider that we started with a triangle-free 2-coloring of K_5 , on the points 1, 2, 3, 4, and 5, and then adjoined 6 as a "clone" of point 1. That is, 6 is connected to each of 2, 3, 4, and 5 with the same colors of edges as those emanating from 1; so if a solid-color triangle involving 6 is formed, there would already have been a solid-color triangle involving 1.

2. In a similar way, we can adjoin clones for *each* of the five original points 1, 2, 3, 4, 5. Call these new points 1', 2', 3', 4', 5'. Then the only lines missing from K_{10} are the five lines connecting each original point to its clone. That is,

40 of the 45 edges of K_{10} can be 2-colored without forming a solid-color triangle. (To convince yourself that no forbidden triangles are formed, adjoin the new "clone points" one at a time.)

3. The question told you that all the edges of K_{16} can be 3-colored without forming a solid-color triangle, but that this is not true for K_{17} . Hence, we can adjoin a clone P' for one of the points P of K_{16} , and connect P' to every original point Q of K_{16} except P , with the same color edge as the edge connecting P to Q , without forming a solid-color triangle. That is, we need remove only one edge from K_{17} so that the remaining 135 edges can be 3-colored without forming a solid-color triangle.
4. The same reasoning shows that if $r = r(c)$ is the *smallest* positive integer such that, if the $\binom{r}{2}$ edges of K_r are colored using c colors a solid-color triangle must be created, then it suffices to remove a single edge from K_r so that the remaining edges can be c -colored without forming a solid-color triangle. Specifically, we start with a c -coloring of K_{r-1} that has no solid-color triangle, and adjoin a new point P' as a clone of P , one of the original $r - 1$ points of K_{r-1} , and proceed as in Solutions 1 and 3 above.

Note. A key idea for this column was supplied by Herbert Taylor.

CALL FOR PAPERS

IEEE Transactions on Information Theory Special Issue on Models, Theory & Codes for Relaying & Cooperation in Communication Networks

A special issue of the *IEEE Transactions on Information Theory* will be devoted to relaying and cooperation in communication networks. The relay channel and models of cooperation in networks have been known in the information theory community for some time. Recently, however, applications in a wide array of wireless communication networks—including cellular networks, wireless local area networks (WLANs), ad hoc networks, and sensor networks—have once again fueled research on relaying and cooperation. The academic and industrial communities have developed new models, problem formulations, and solutions motivated by these particular applications, as well as fresh insights on long-standing approaches.

A special issue that focuses on these activities and gives an overview of related efforts will serve the information theory community as well as the broader communications and networking communities. Papers for this special issue should have an information theoretic component and relate to the developments described above. Expository papers, survey papers, research papers and correspondence items are welcome. Topics include, but are not limited to, the following aspects of relaying and cooperation:

- Physical layer models, e.g., channel models (statistics, fading, MIMO, feedback)
- Device constraints (power, energy, T/FDMA, half-duplex, synchronization)
- Code design, e.g., iteratively decodable codes, strategies, distributed codes
- Cooperation via network coding, wireline and wireless
- Resource allocation, e.g., power, bandwidth, nodes
- Performance metrics, e.g., capacity, cost, outage, delay, energy, scaling laws
- Sensor networks, e.g., distributed compression, rate-distortion theory
- Cross-layer issues, e.g., PHY/MAC/NET interactions, joint source-channel coding, separation theorems
- Multi-terminal information theory
- Historical perspectives

Prospective authors should follow the regular guidelines and submission instructions of the *IEEE Transactions on Information Theory*.

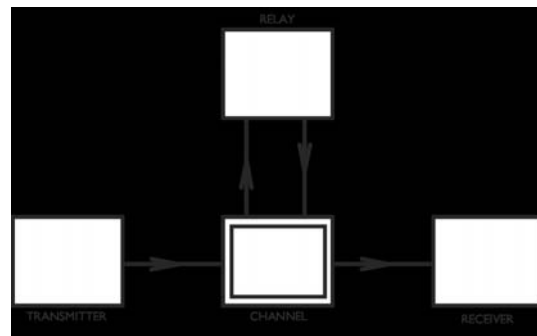
Schedule

- Submission Deadline: August 15, 2006
- Acceptance Notification: May 15, 2007
- Publication: December 2007

Guest Editorial Board

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Mathematics of Relaying and Cooperation in Communication Networks

April 10–12, 2006 • Berkeley, California

*Organized by: Michael Gastpar,
Gerhard Kramer, J. Nicholas Laneman*

Information theory bridges mathematics and communication systems analysis. The point-to-point communication problem is fairly well understood today: researchers have developed a refined set of tools for designing and optimizing codes and protocols. In stark contrast, the analysis of communication networks is still a wide open problem because of the complex nature of the interactions permitted by multi-terminal systems. Our lack of understanding is reflected by the fact that most state-of-the-art communication networks are planned using point-to-point principles, and network considerations enter only at a later stage of design.

Designing resource-efficient wireless networks requires a fundamental understanding of the mathematics underlying multi-terminal communication systems. One of the simplest such systems is a “three-body problem,” with a source, a destination, and a relay whose purpose is to assist the communication from the source to the destination. This seemingly simple communication problem has long resisted solution, but new insight has been gained recently.

This workshop aims at bringing together researchers from engineering, computer science, and mathematics to discuss recent advances and promising directions for future research. In particular, the workshop will emphasize:

- physical-layer models
- performance metrics
- sensor networks
- code design
- resource allocation
- converse bounds
- historical perspectives
- multi-terminal information theory
- relaying via network coding

While leading researchers in each of these areas are being invited to participate in the workshop, submissions of contributed posters of original work in each of these areas are also being solicited. Posters will be reviewed on the basis of an extended abstract (not exceeding 3 pages), submitted in PDF format to gastpar@eecs.berkeley.edu. The deadline for submission is February 1, 2006, with notification of decisions by March 1, 2006.

Registration: is free and remains open until one week before the workshop. On the MSRI home web page, select the link to Workshops, select this particular workshop, then link to Register Online. Limited funding is available; students, recent Ph.D.s, women and minorities are particularly encouraged to apply. To do so, complete the second part of the registration form.

Further information and links to the workshop web page are available at:

<http://www.msri.org>

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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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Call for Papers

NETCOD 2006

Second Workshop on Network Coding, Theory, and Applications

April 3-7, Boston, Massachusetts
(in conjunction with WiOpt 2006)

Multuser information theory has been an important research area since the 1970's. In the past few years, there has been a surge in research activities in the area due to its potential applications to communication networks. In particular, the recent theory of network coding reveals the surprising fact that unlike what was believed in the past, information should not be regarded as a commodity in a network. Since its inception, network coding has emerged as a new paradigm that has influenced information and coding theory, networking, wireless communications, computer science, graph theory, and matrix theory. NETCOD 2006 will be organized as a one day workshop within WiOpt 2006 (www.wiopt.org) focusing on practical and theoretical aspects of network coding.

Submissions and final versions appearing in the workshop proceedings shall be 6 pages long in IEEE double-column format. Submissions should be sent to either medard@mit.edu or to koetter@uiuc.edu by **December 12, 2006**. For further information about the workshop and organizational details see the url:

<http://www.netcod.org>

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Conference Calendar

DATE	CONFERENCE	LOCATION	CONTACT/INFORMATION	DUE DATE
April 3-7, 2006	4th International Symposium on Turbo Codes and Related Topics	Munich, Germany	http://www-turbo-coding-2006.org	Oct. 17, 2005
April 3-7, 2006	4th International Symposium on Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks (WiOpt '06)	Boston, Massachusetts, USA	http://www.wiopt.org	Oct. 5, 2005
May 30-31, 2006	Signal Processing for Wireless Communications	King's College, London, ENGLAND	http://www.spwc2006.org	January 6, 2006
May 30-June 1, 2006	23rd Biennial Symposium on Communications	Kingston, Ontario, CANADA	http://www.ece.queensu.ca/symposium qbsc@post.queensu.ca	January 25, 2005
March 13-17 2006	2006 Information Theory Workshop (ITW 2006)	Punta del Este, URUGUAY	http://www.fing.edu.uy/itw06	October 31, 2005
July 2-7, 2006	The 11th Information Processing and Management of Uncertainty International Conference (IPMU 2006)	Paris, FRANCE	http://ipmu2006.lip6.fr ipmu2006.secretariat@poleia.lip6.fr	December 10, 2005
October 22-26, 2006	2006 IEEE Information Theory Workshop (ITW)	Chengdu, CHINA	http://sist.swjtu.edu.cn/imc/itw06 http://www.ee.cityu.edu.hk/~itw06/	June 1, 2006
TBA	2006 IEEE International Symposium on Information Theory (ISIT)	Seattle, Washington, USA	TBA	TBA