Curriculum Vitae

Prof. Amos Lapidoth

Professor of Information Theory
lapidoth@isi.ee.ethz.ch

Degrees/Higher Education

1995	PhD in Electrical Engineering, Stanford University, U.S.A.
1990	MSc in Electrical Engineering, Technion, Israel Institute of Technology, Israel
1986	BSc in Electrical Engineering, Technion, Israel Institute of Technology, Israel
1986	B. A. in Mathematics, Technion, Israel Institute of Technology, Israel

Professional Career

1999–present	Professor of Information Theory, Department of Information Technology and Electrical Engineering, D-ITET, ETH Zurich, Switzerland
1995–1999	Assistant and Associate Professor, Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology (MIT), U.S.A.

Professional Activities

- Associate Editor for Shannon Theory for the IEEE Transactions on Information Theory, 2003–2004
- Member of the Editorial Board of Foundations and Trends in Communications and Information Theory
- Co-chair of the Program Committee for the 2002 International Symposium on Information Theory (ISIT'02), Switzerland

Visiting Positions

Information Systems Laboratory (ISL), Stanford University,
March to June 2006

Honors and Awards

- 2004 IEEE Fellow «for contributions to robust communications under channel uncertainty.»
- 1998 IEEE Transactions on Information Theory Reviewer Award
- 1997 NSF Faculty Early Career Development (CAREER) Award
- 1997 KDD Chair for Research in Communications and Technology
- Erdös Number 3

Membership in Societies & Centers

- Fellow of the Institute of Electrical and Electronics Engineers (IEEE)
- Member of the Institute of Mathematical Statistics (IMS)
- Research Affiliate at the Research Laboratory of Electronics (RLE), MIT
- Member of the Center for Communication and Information Technologies (CCIT), Technion

Achievements

- Universal decoding for channels with memory
- Provably-secure, provably-robust digital watermarking of Gaussian sources
- High SNR analysis of the capacity of stationary Gaussian fading channels

Teaching

- Introduction to Digital Communications
- Introduction to Information Theory
- Multi-Terminal Information Theory

Publications

- For journal publications please see: www.isi.ee.ethz.ch/~lapidoth/publications.html
- For recent conference publications: www.isi.ee.ethz.ch/archive/publications

Plenary Talks

- 2011 IEEE Wireless Advanced (Formerly SPWC)

For more information visit www.isi.ee.ethz.ch

Prof. Amos Lapidoth- Research Highlights

The Information Theory of Remote Sensing Networks

Keywords

- Multi-Terminal Information Theory
- Wireless Communications
- Robust Communications
- Digital Watermarking
- Optical Communication

Future priority areas

- Combined source-channel coding for multi-terminal networks
- Heat-imposed fundamental limits on on-chip communications
- The role of feedback in multi-terminal networks
- Interference networks with local side-information

Focus

The Information Theory Section's research focuses on Shannon Theory with the goal of extending the theory to multi-terminal problems and of studying its implications in the design and analysis of communication systems, signal processing algorithms, data compression, and data security. Our goal is to extend Shannon's theory to more complicated scenarios such as those arising in mobile cellular telephone systems or more general ad-hoc networks.

Some current research projects include:

- The role of feedback in multi-access communications
- The capacity of multi-antenna wireless fading channels
- Combined source and channel coding for multiple-access channels
- Network Coding
- Fundamental limits on communication with the aid of a relay
- Multi-antenna broadcast channels
- Heat-imposed limitations on on-chip communications

Transmitting Correlated Sources over a Wireless Multi-Access Network

This project studies fundamental Shannon-theoretic limits on communicating multiple correlated sources to a single receiver using spatially-separated power-limited transmitters; see Fig. 1. The network is thus a many-to-one network where the data to be sent by the different transmitters are correlated. Such scenarios are typically encountered in sensor networks where a physical phenomenon (e.g. pollution, traffic, seismic activity etc.) is monitored by having a number of measurement devices (sensors) distributed over the area where the phenomenon is taking place. Since all sensors measure the same phenomenon, the results of their measurements are correlated. But since the sensors are distributed, cooperation among them is very limited. In this project we study the fidelity with which the data of the different transmitters can be reconstructed at the receiver as a function of the average power available to the different transmitters.

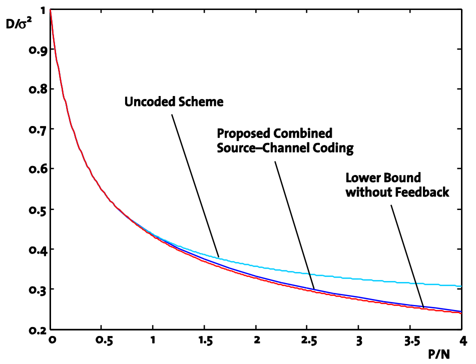

Figure 1: A multi-access channel with feedback links and correlated sources

One of our key results shows that below a certain threshold that depends on the correlation coefficient between the sources, an «uncoded scheme» that simply sends a scaled version of the sources is optimal and outperforms any separate source-channel coding approach; see Fig. 2.
It is remarkable that this result continues to hold in the presence of feedback from the receiver to the transmitters. Such feedback increases the capacity of the multiple-access channel and hence improves the performance of the best separate source-channel coding scheme. Nevertheless, even with feedback, below the above threshold, the separate source-channel coding approach is inferior to the «uncoded scheme», even though the latter does not utilize the available feedback at all. Also in the other extreme, in the asymptotic regime where the allowed average powers are very high, separate source-channel coding is sub-optimal. In fact, we have succeeded in computing the exact asymptotic behavior of the optimal achievable distortion, and it is strictly better than the one achieved by separate source-channel coding. However, in this regime feedback bridges the gap, and the separate source-channel coding approach with feedback is asymptotically optimal as the powers tend to infinity.
Our results show that the structure of efficient communication strategies for transmitters with correlated data is fundamentally different from the one for transmitters with independent data. An efficient strategy must exploit the correlation. The results also show that at low transmission powers, feedback cannot improve the reconstruction fidelity, and the best fidelity is achieved by a very simple and practical transmission scheme which consists of having the transmitters send a scaled version of their data. This is an operation that requires neither memory nor computation power.

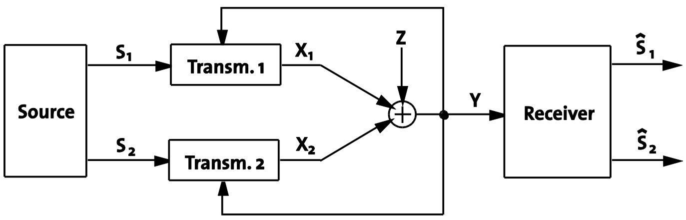

Figure 2: Reconstruction fidelity as a function of the transmission power for the case without feedback; achievable fidelity with the uncoded scheme and a combined source-channel coding scheme in comparison with a lower bound

For more information on our research group and our projects:
www.isi.ee.ethz.ch