Keynote Speaker

Babak Hassibi

California Institute of Technology

Biography

Prof. Babak Hassibi was born in Tehran, Iran, in 1967. He received the B.S. degree from the University of Tehran in 1989, and the M.S. and Ph.D. degrees from Stanford University in 1993 and 1996, respectively, all in electrical engineering. From October 1996 to October 1998 he was a research associate at the Information Systems Laboratory, Stanford University, and from November 1998 to December 2000 he was a Member of the Technical Staff in the Mathematical Sciences Research Center at Bell Laboratories, Murray Hill, NJ. Since January 2001 he has been with the department of electrical engineering at the California Institute of Technology, Pasadena, CA., where he is currently an associate professor. He has also held short-tem appointments at Ricoh California Research Center, the Indian Institute of Science, and Linkoping University, Sweden. His research interests include wireless communications, robust estimation and control, adaptive signal processing and linear algebra. He is the coauthor of the books {\em Indefinite Quadratic Estimation and Control: A Unified Approach to H^2 and H$^{\infty}$ Theories} (New York: SIAM, 1999) and {\em Linear Estimation} (Englewood Cliffs, NJ: Prentice Hall, 2000). He is a recipient of an Alborz Foundation Fellowship, the 1999 O. Hugo Schuck best paper award of the American Automatic Control Council, the 2002 National Science Foundation Career Award, the 2002 Okawa Foundation Research Grant for Information and Telecommunications, the 2003 David and Lucille Packard Fellowship for Science and Engineering and the 2003 Presidential Early Career Award for Scientists and Engineers (PECASE), and was a participant in the 2004 National Academy of Engineering ``Frontiers in Engineering'' program.
He has been a Guest Editor for the IEEE Transactions on Information Theory special issue on ``space-time transmission, reception, coding and signal processing'' was an Associate Editor for Communications of the IEEE Transactions on Information Theory during 2004-2006, and is currently an Editor for the Journal ``Foundations and Trends in Information and Communication''.

Abstract

Entropic Vectors, Convex Optimization and Wireless Networks

Information theory is well poised to have an impact on the manner in which future networks are designed and maintained, both because wired networks are ripe for applications such as network coding and also because wireless networks cannot be satisfactorily dealt with using conventional networking tools. The challenge is that most network information theory problems are notoriously difficult and so the barriers that must be overcome are often quite high. In particular, there are only a limited number of tools available and so fresh approaches are quite welcome.
We describe an approach based on the definition of the space of "normalized" entropic vectors. In this framework, for a large class of acyclic memoryless networks, the capacity region for an arbitrary set of sources and destinations can be found by maximization of a linear function over the set of channel-

constrained normalized entropic vectors and some linear constraints. The key point is that the closure of this set is convex and compact. While this may not necessarily make the problem simpler, it certainly circumvents the ``infinite-letter characterization'' issue, as well as the nonconvexity of earlier formulations. It also exposes the core of the problem as that of determining the space of normalized entropic vectors.

The approach has several interesting consequences: it allows one to obtain the classical cutset bounds via a duality argument; for wired networks, it shows one need only consider the space of unconstrained normalized entropic vectors, thus separating channel and network coding---a result very recently recognized in the community. Outer bounds to the space of normalized entropic vectors are known to be related to non-Shannon inequalities. We develop inner bounds on this space using lattice-generated distributions and show how they can be used to compute inner bounds on the capacity region of networks using linear programming.