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Presents

A Variational View of Channel Coding

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Abstract:

In the 60 or so years since Shannon's noisy channel coding theorem a number of papers have been published on its connections with statistical mechanics. A common feature of these is that the phenomenon of channel capacity is viewed as a type of phase transition.
The talk will develop these ideas, but in the framework of Bayesian in-ference. This admits a variational form, in which the posterior distribution minimises an information quantity we call the 'apparent information.' The variational formulation can be extended to infinite systems, where it shares
many of the properties of the Gibbs variational principle.
We shall consider a number of estimation problems associated with the noisy channel coding theorem, and show that connections between the specific apparent information quantities in the different layers of the communication architecture are at its heart. The specific apparent information quantities for these problems exhibit a variety of phase transitions. We give preliminary results on the existence and nature of 'Gibbs' measures in this context. Standard results on their existence and uniqueness, requiring translation invariance, are not applicable here.
The broader conceptual goal of our research is to understand statistical mechanics where observations are explicitly modeled, and to view statistical inference of the 'state' given 'observations' as a problem of interactive statistical mechanics. We believe that there are nontrivial connections between recent work on nonequilibrium statistical mechanics (Gallavotti, Ruelle, Lebowitz) and statistical inference. We have shown that these connections are quite precise in the context of observed diffusion processes. Generalizations of work on decay of correlations and correlation inequalities (for example, GKS inequalities) to the context of statistical inference are challenging problems whose investigation would lead to a deeper connection between statistical physics and statistical inference.

About the Speaker:

Sanjoy K. Mitter received his Ph.D. degree from the Imperial College of Science and Technology, University of London, in 1965. Prior to 1965, Sanjoy K. Mitter worked as a research engineer at Brown Boveri & Co. Ltd., Switzerland (now ASEA Brown Boveri), and Battelle Institute, Geneva, Switzerland. He taught at Case Western Reserve Univerisity from 1965-1969 and joined MIT in 1969 first as a Visiting Professor and then in 1970 as Associate Professor in the Department of Electrical Engineering and Computer Science. He served as Director, then co-Director of the Laboratory for Information and Decision Systems between 1991 and 1999. He is currently Professor of Electrical Engineering.
Professor Mitter has held visiting positions at the Tata Institute of Fundamental Research, Bombay, India; Scuola Normale Superiore, Pisa, Italy; Imperial College of Science and Technology; Institue National de Recherche en Informatique et en Automatique, France; University of Groningen, the Netherlands, and several universities in the United States.
Professor Mitter is currently Associate Editor of Journal of Applied Mathematics and Optimization; SIAM Review; the Ulam Quarterly; and Random and Computational Dynamics. He is a fellow of the IEEE. In 1988 he was elected to the National Academy of Engineering.