Prediction of Partially Observed Dynamical Processes Over Networks via Dictionary Learning
P. A. Forero, K. Rajawat, G. B. Giannakis
SPAWAR Systems Center Pacific, Indian Institute of Technology, U of Minnesota

Abstract
First, the known network structure and historical data are leveraged to design a dictionary for representing the network process. The novel approach draws from semi-supervised learning to enable learning the dictionary with only partial network observations. Once the dictionary is learned, network-wide prediction becomes possible via a regularized least-squares estimate which exploits the parsimony encapsulated in the design of the dictionary. Second, an online network-wide prediction algorithm is developed to jointly extrapolate the process over the network and update the dictionary accordingly. This algorithm is able to handle large training datasets at a fixed computational cost. More important, the online algorithm takes into account the temporal correlation of the underlying process, and thereby improves prediction accuracy. The performance of the novel algorithms is illustrated for prediction of real Internet traffic.

An Adaptive Approach to Learn Overcomplete Dictionaries With Efficient Numbers of Elements
M. Marsousi, K. Abhari, P. Babyn, J. Alirezaie
U of Toronto, Ryerson University, U of Saskatchewan

Abstract
To avoid the representations suboptimality, a systematic approach to adapt the elements number based on input datasets is essential. Some existing methods try to address this requirement such as enhanced K-SVD, sub-clustering K-SVD, and stage-wise K-SVD. However, it is not specified under which sparsity level and representation error criteria their learned dictionaries are size-optimized. We propose a new dictionary learning approach that automatically learns a dictionary with an efficient number of elements that provides both desired representation error and desired average sparsity level. In our proposed method, for any given representation error and average sparsity level, the number of elements in the learned dictionary varies based on content complexity of training datasets. The performance of the proposed method is demonstrated in image denoising. The proposed method is compared to state-of-the-art, and results confirm the superiority of the proposed approach.

Group-Sparse Signal Denoising: Non-Convex Regularization, Convex Optimization
Po-Yu Chen, Ivan W. Selesnick
New York University

Abstract
Convex optimization with sparsity-promoting convex regularization is a standard approach for estimating sparse signals in noise. In order to promote sparsity more strongly than convex regularization, it is also standard practice to employ non-convex optimization. In this paper, we take a third approach. We utilize a non-convex regularization term chosen such that the total cost function (consisting of data consistency and regularization terms) is convex. Therefore, sparsity is more strongly promoted than in the standard convex formulation, but without sacrificing the attractive aspects of convex optimization.
Reduced-Order Generalized $H_{\infty}$ Filtering for Linear Discrete-Time Systems With Application to Channel Equalization
X. Li, H. Gao
Harbin Institute of Technology, China

Abstract
This paper investigates the problem of reduced-order generalized $H_{\infty}$ filtering for linear discrete-time systems. Generalized $H_{\infty}$ filtering covers standard $H_{\infty}$ filtering as a special case and can make use of the frequency-domain characteristics of practical signals. Moreover, reduced-order filters are more attractive than full-order ones regarding implementability. By virtue of the generalized bounded real lemma, a new necessary and sufficient condition is proposed for analyzing the generalized $H_{\infty}$ performance of the filtering error system. To compute reduced-order generalized $H_{\infty}$ filters, a necessary and sufficient condition is then derived in terms of matrix inequalities, to solve which iterative linear matrix inequality algorithms are further developed. In addition, the proposed filter design method is applied to cope with the channel equalization problem. Examples are finally presented for illustrating the proposed method.

An EM Algorithm for Multipath State Estimation in OTHR Target Tracking
Hua Lan, Yan Liang
Northwestern Polytechnical University, China

Abstract
Different from the traditional multipath data association and estimation methods for OTHR target tracking, a novel scheme for joint multipath data association and state estimation (JMAE) is developed based on the expectation-maximization (EM) framework. The proposed scheme has the iterative optimization of identification (including data association and ionospheric mode identification) and estimation (including path-conditional state estimation and multipath track fusion).
Discrete Signal Processing on Graphs: Frequency Analysis
Aliaksei Sandryhaila, Jos M. F. Moura
Carnegie Mellon University

Abstract
Signals and datasets that arise in physical and engineering applications, as well as social, genetics, biomolecular, and many other domains, are becoming increasingly larger and more complex. In contrast to traditional time and image signals, data in these domains are supported by arbitrary graphs. Signal processing on graphs extends concepts and techniques from traditional signal processing to data indexed by generic graphs. This paper studies the concepts of low and high frequencies on graphs, and low-, high- and band-pass graph signals and graph filters. In traditional signal processing, these concepts are easily defined because of a natural frequency ordering that has a physical interpretation. For signals residing on graphs, in general, there is no obvious frequency ordering. We propose a definition of total variation for graph signals that naturally leads to a frequency ordering on graphs and defines low-, high-, and band-pass graph signals and filters. We study the design of graph filters with specified frequency response, and illustrate our approach with applications to sensor malfunction detection and data classification.

+Plus One

For Most Large Underdetermined Systems of Linear Equations the Minimal $l_1$-norm Solution Is Also the Sparsest Solution
D. L. Donoho
Stanford

Abstract