Low Complexity-Near Optimal Complex Support Vector Detection for Large MIMO Systems

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Abstract

I. Introduction

A. Large MIMO System

Introduce the development and history of Large MIMO systems. The challenges and opportunities.

B. Large MIMO detections

- Local Search (Likelihood Ascend Search and its variances, Reactive Tabu Search and its variances)
- Probabilistic Data Association (PDA and its variances)
- Message Passing Scheme based on Graph Model (Belief Propagation and its variances)
- Monte Carlo Markov Chain detection (Gibbs sampling and its variances)

Evaluate advantages and disadvantages.

C. Support Vector Regression

History and applications.

D. Thesis Contribution

1) Theoretical Analysis of Channel Hardening Phenomenon:

2) Complex Support Vector Detectors for Large MIMO systems:

E. Thesis Outline

II. Theoretical Analysis of Channel Hardening Phenomenon

III. Complex Support Vector Detector for Large MIMO systems

A. The Algorithm

B. Channel Hardening Approximation

Employ channel hardening phenomenon to the detector proposed based on the theoretical analysis in II.

C. Complexity Analysis and Comparisons

Compare proposed detector with candidate detectors in Table.I.

IV. Computer Simulations

A. Candidate Detectors for Comparison

SISO AWGN channel without fading which is a lower bound of ML performance can be used as a benchmark to evaluate the performance of proposed algorithm. Table. I shows the candidate detectors to be compared. Layered Tabu Search (LTS), Random Restart Reactive Tabu Search (R3TS), Belief Propagation based on Markov Random Field (BP-MRF) with damping, Belief Propagation based on Scalar Gaussian Approximation and Factor Graph (FG BP-SGA), Probability Data Association based on Gaussian Approximation (PDA-GA), Multi-Restart Mixed Gibbs Sampling (MR-MGS).

TABLE I
DETECTOR CANDIDATES FOR COMPARISON

Detectors	Complexity	BER Performance		Note
		Low Order Modulation Scheme (BPSK, 4QAM)	High Order Modulation Scheme (16QAM, 64QAM)	
LTS	$O(n_t^3)$	near optimum (at several tens of antennas region)	near optimum (at several tens of antennas region)	complexity gets higher for large system but with out order increasing.
R3TS	$O(n_t^3)$	near optimum (at several tens of antennas region)	near optimum (at several tens of antennas region)	complexity gets higher for high order modulation scheme.
BP-MRF	$O(n_t^2 n_r)$	near optimum (at several tens of antennas region)	far from optimum performance	
FG BP-SGA	$O(n_t^2)$	near optimum (at several tens of antennas region)	far from optimum performance	
PDA-GA	$O(n_t^3)$	near optimum (at over one hundred of antennas region)	Not clear	
MR-MGS	$O(\log_2(M) n_t^3)$	near optimum (at several tens of antennas region)	near optimum (at several tens of antennas region)	complexity is higher than MMSE $O(n_t n_r^2)$, but nominal, without order increasing.

B. BER Results for Spatial Uncorrelated Channel

1) *Performance Analysis and Comparison (Low Order Modulation Scheme):* BPSK, 4QAM.

2) *Performance Analysis and Comparison (High Order Modulation Scheme):* 16QAM, 64QAM.

C. BER Results for Spatial Correlated Channel

1) *Performance Analysis and Comparison (Low Order Modulation Scheme):* BPSK, 4QAM.

2) *Performance Analysis and Comparison (High Order Modulation Scheme):* 16QAM, 64QAM.

D. Influences of Imperfect Channel State Information

1) Performance Analysis and Comparison (Low Order Modulation Scheme): BPSK, 4QAM.

2) Performance Analysis and Comparison (High Order Modulation Scheme): 16QAM, 64QAM.

V. CONCLUSION