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 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