Literature Review

# Large MIMO system Introduction

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2. Massive MIMO for next Generation
3. MIMO wireless communication from real world propagation to space time code design

# Large MIMO detector

Linear detectors and their SIC version

Sphere Decoder and its modified versions (FCSD and others)

1. A universal lattice code decoder for fading channels
2. Fixing the complexity of the sphere decoder for MIMO detection

Channel partition

1. Interference cancellation based detection for V-BLAST using diversity maximizing channel partition

Lattice reduction

1. Element based lattice reduction algorithm for large MIMO system

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1. A low-complexity detector for large MIMO systems and multicarrier CDMA systems
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3. Multiple output selection-LAS algorithm in large MIMO systems

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1. Layered tabu search algorithm for large-MIMO detection and a lower bound on ML performance
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1. A novel Monte-Carlo-sampling-based receiver for large-scale uplink multiuser MIMO systems

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# Support Vector Regression

SVM original version

1. Vapnik

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SMO algorithm

1. Platt

Complex support vector machine

1. Complex support vector regression

Training support vector machine without offset

1. Training support vector machine without offset

One of the biggest challenges the researchers and industry practitioners are facing in wireless communication area is how to bridge the sharp gap between increasing demand of high speed communication of rich multimedia information with high level Quality of Service (QoS) and the limited radio frequency spectrum over a complex space-time varying environment. As the most promising technology for solving this problem, Multiple Input Multiple Output (MIMO) technology has been of immense research interest over the last several tens of years and become mature, which is incorporated into the emerging wireless broadband standard like 802.11ac [1] long-term evolution (LTE) [2]. The core idea of MIMO system is to use multiple antennas at both transmitting and receiving end, so that multiplexing gain (multiple parallel spatial data pipelines that can improve bandwidth efficiency) and diversity gain (better reliability of communication link) is obtained by employing spatial domain. Large MIMO (also called Massive MIMO) is an upgrade version of conventional MIMO system, it equips unprecedentedly hundreds of low power low price antennas at base station (BS), serving several tens of terminals simultaneously, It can achieve full potential of conventional MIMO system while providing additional power efficiency as well as system robustness [3][4].

The price paid for large MIMO system is the increasing complexities for signal processing at both transmitting and receiving end. Uplink Detector is one of the key components in large MIMO system. With orders magnitude more antennas equipped at BS, benefit and challenge coexist in designing of detection algorithms for large MIMO uplink, on the one hand, large number of receive antennas provide potential of large diversity gain, on the other hand, complexity of the algorithm becomes extremely crucial to make system practical.

The optimal maximum likelihood detector (MLD) for MIMO system requires the complexity increase exponentially with number of transmitted antennas with a factor of the size of size of constellation, which is prohibitive in practical implementations.

Sphere Decoder (SD)[5] is the most prominent algorithm that utilizes lattice structure of MIMO system.

Its variant fixed complexity sphere decoder (FCSD)[6] make it possible to achieve near optimal performance with a fixed complexity under different signal to noise ratio (SNR). However, all the algorithms that based on lattice structure have the same shortage - their complexities increases exponentially with a factor of the size of symbol constellation. Therefore, they are prohibitive when it comes to a high order modulation scheme, for example in IEEE 802.11ac standard [1], the modulation scheme is 256QAM.

Suboptimal linear detectors (LD) like minimum mean square error (MMSE) and zero forcing (ZF) along with their sequential interference cancellation with optimized ordering (OSIC) counterparts [7][8][9] which have good performance for low loading factor in massive MIMO system (that is the number of receive antennas is much larger than the number of transmit antennas) [10]. In the last several years, a set of detection algorithms are proposed with complexities that is comparable with LD-OSIC and suboptimal performance can be achieved. The local search algorithm, such as likelihood ascend searching (LAS) [11][12], an theoretical analysis of upper bound of bit error rate (BER) and lower bound of on asymptotic multiuser efficiency for the LAS detector was presented [13]. Layered Tabu search algorithm presented in [14] is superior to the LAS algorithms because it can move away to new searching area to avoid local minimal. Message passing detectors based on belief propagation (BF) and Gaussian Approximation (GA) [15][16][17][18]. Markov Chain Monte Carlo algorithm [19] and Lattice Reduction aided detectors [20].

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12. Multiple output selection-LAS algorithm in large MIMO systems
13. A family of likelihood ascend search multiuser detectors
14. Layered tabu search algorithm for large-MIMO detection and a lower bound on ML performance
15. MIMO detection for high-order QAM based on a Gaussian tree approximation
16. Low complexity detection in large-dimension MIMO-ISI channels using graphical Models
17. Channel hardening exploiting message passing for large MIMO
18. Improved large MIMO detection with damped belief propagation
19. A novel Monte-Carlo-sampling-based receiver for large-scale uplink multiuser MIMO systems
20. Element based lattice reduction algorithm for large MIMO system