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MIMO detection for higher order QAM-Semidefinite programming relaxation approach for multiuser detection of QAM Signals

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Introduction

- A semidefinite programming (SDP) relaxation approach

is proposed to solve multiuser detection problems in systems with *M-ary quadrature amplitude modulation (MQAM).* In the proposed approach, the optimal *M-ary maximum* likelihood (ML) detection is carried out by converting the associated *M-ary integer programming problem into a binary* integer programming problem. Then a relaxation approach is adopted to convert the binary integer programming problem into an SDP problem. This relaxation process leads to a detector of much reduced complexity. A multistage approach is then proposed to improve the performance of the SDP relaxation based detectors. Computer simulations demonstrate that the symbol-error rate (SER) performance offered by the proposed multistage SDP relaxation based detectors outperforms that of several existing suboptimal detectors.

Problem statement

Maximum Likelihood Detection

Minimize $\|\boldsymbol{r} - \boldsymbol{C}\boldsymbol{x}\|^2$

Subject to $\mathrm{x}_k \in \mathcal{A} = \{\mathrm{I}_m + jQ_n\}$ $for\ \mathrm{k} = 1, \dots, \mathrm{K}$;

$\mathrm{m} = 1, \dots, \widehat{M}$; $n = 1, \dots, \widehat{N}$

$\equiv$

Minimize $\boldsymbol{x}^H \boldsymbol{H}\boldsymbol{x} + Re\{\boldsymbol{x}^H \boldsymbol{p}\}$ (3a)

Subject to $\mathrm{x}_k \in \mathcal{A} = \{\mathrm{I}_m + jQ_n\}$ $for\ \mathrm{k} = 1, \dots, \mathrm{K}$; (3b)

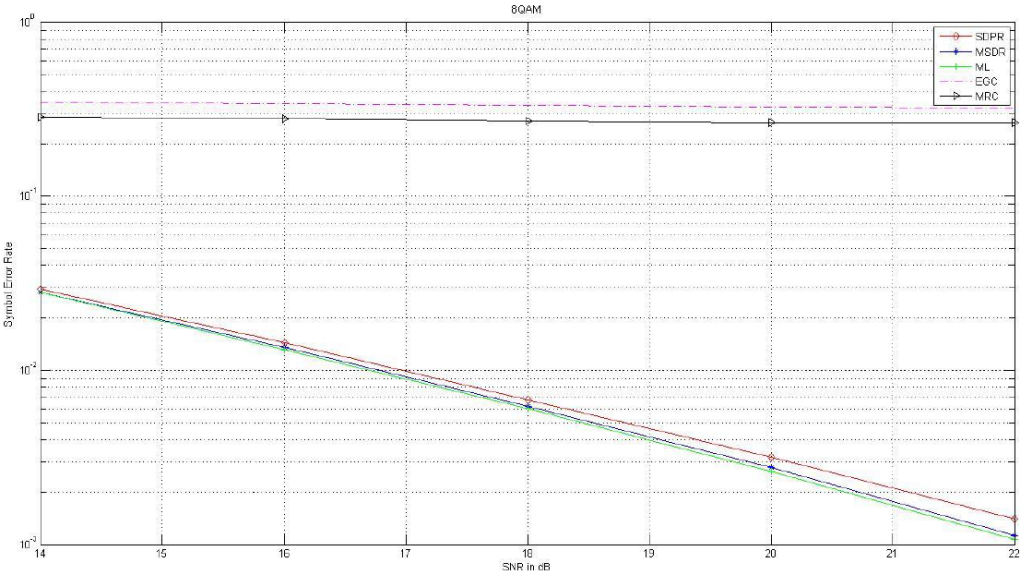
$\mathrm{m} = 1, \dots, \widehat{M}$; $n = 1, \dots, \widehat{N}$

Where $\mathrm{H} = C^H C$, $p = -2C^H r$ and x_k denotes the k^{th} component of x. In general, an exhaustive search is required to obtain the solution to the problem (3), in which the computational complexity involved is $\mathcal{O}(M^K)$.

The method

- SDP relaxation approach
- Multistage SDP Relation Multiuser Detection
- Randomization
- Rank-one Approximation
- Maximal Ratio Combining detection
- Equal Gain Combining detection

Simulation results



We considered a four-user system using 8QAM as modulation scheme. The spreading codes of all users are of length fifteen. The SERs obtained by using the ML, the SDPR, the M-SDPR, the MRC and the EGC are plotted. The simulations show that the methodof multistage SDP is the most closedto the ML detection. The performanceof the SDPR is similar to the M-SDPR. However, the performance of MRC and EGC are not good enough.

compare the performance of rank one and randomization