

Chan-fei WANG, Ji-ai HE, Wei-fang WANG, Ya-mei XU, 2018. Semidefinite relaxation aided noncoherent detection in two-way relay transmission. *Frontiers of Information Technology & Electronic Engineering*, 20(9):1259-1265.

<https://doi.org/10.1631/FITEE.1800096>

Semidefinite relaxation aided noncoherent detection in two-way relay transmission

Key words: Multiple-symbol differential detection; Generalized likelihood ratio test; Semidefinite relaxation; Two-way relay transmission

Corresponding author: Chan-fei WANG

E-mail: wangchanfei@bupt.edu.cn

 ORCID: <http://orcid.org/0000-0003-2493-6500>

Motivation

- In two-way relay transmission (TWRT), the coherent detection scheme requires accurate channel state information, where the estimation of channel parameters is a complicated task under some scenarios. Therefore, a noncoherent transmission scheme is considered.
- Recently, a generalized likelihood ratio test (GLRT) based multi-symbol differential detection (MSDD) has been introduced in the TWRT system. This GLRT-MSDD has is nondeterministic polynomial time hard (NP-hard). In this paper, a semidefinite relaxation (SDR) based MSDD (SDR-MSDD) framework is designed in TWRT.

Main idea

- To reduce the complexity of the GLRT-MSDD scheme and make it practical, the Boolean constraint in the GLRT model is relaxed, and correspondingly, the SDR-MSDD scheme is derived in the context of noncoherent UWB TWRT.
- This proposed SDR-MSDD scheme is attractive, because relying on this detector, near-optimal performance can be obtained with polynomial time complexity in TWRT.

Method

- Using an approximate discrete-time model, the relationship of SDR-MSDD and GLRT-MSDD is revealed, and the system performance of SDR-MSDD has been analyzed in TWRT.
- The computational complexity of the proposed schemes has been analyzed to reflect the effectiveness of these MSDDs.

Major results

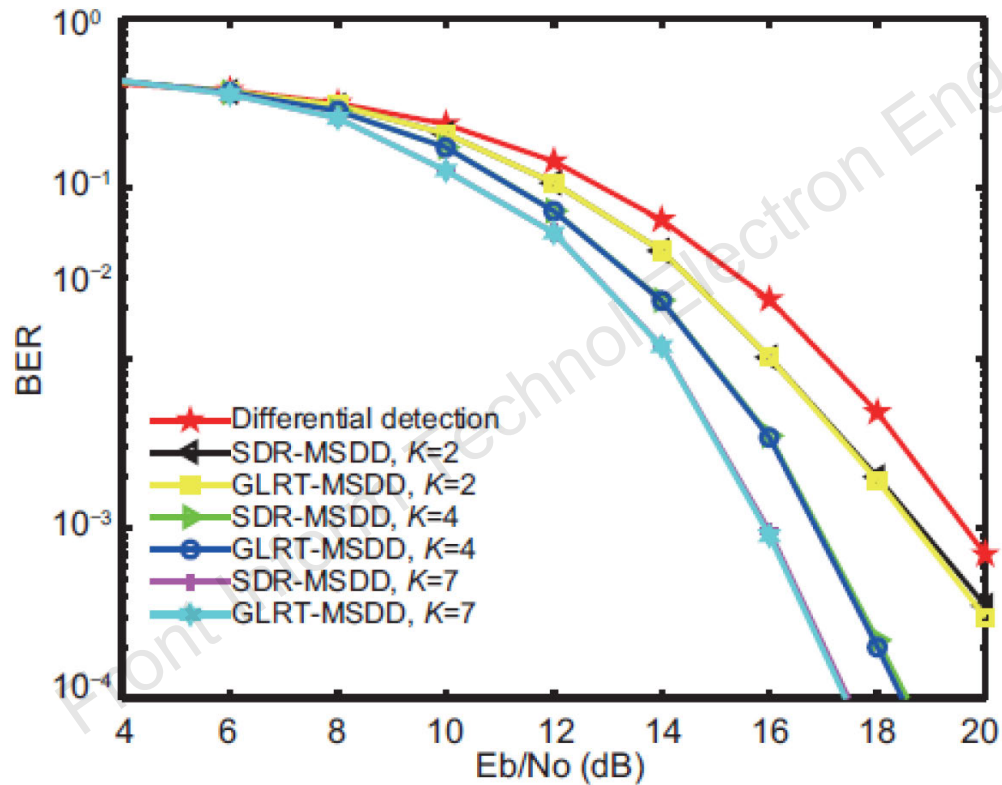


Fig. 2 BER performance comparison between SDR-MSDD and GLRT-MSDD in TWRT with different observation window size K

Major results

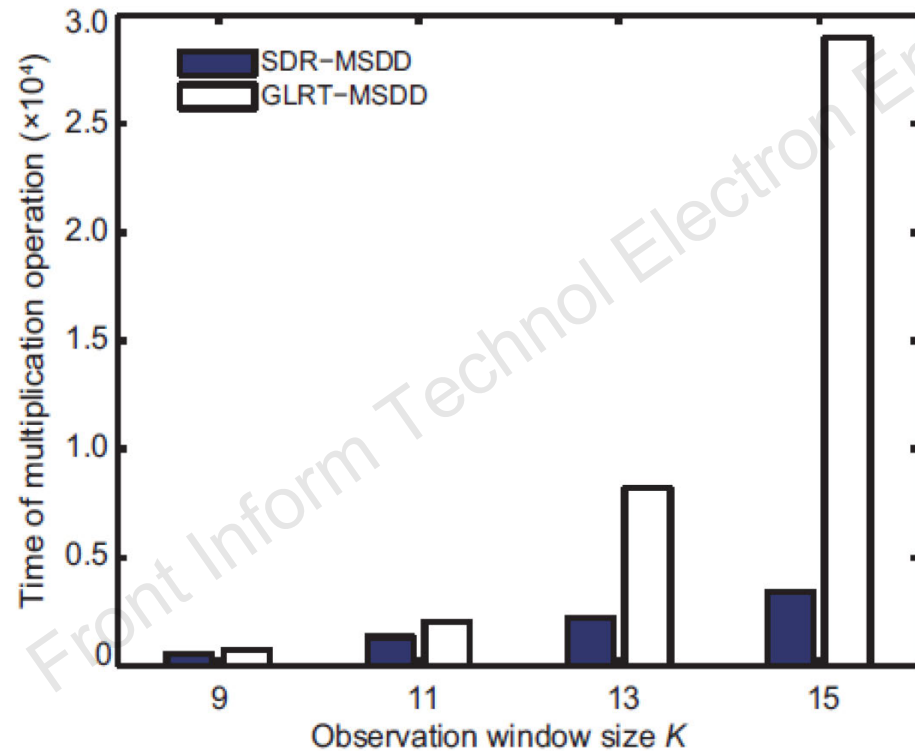


Fig. 3 Complexity comparisons between SDR-MSDD and GLRT-MSDD in TWRT-UWB with different observation window size K

Conclusions

- Two kinds of noncoherent transmission schemes are proposed in TWRT. In particular, the proposed SDR-MSDD detector bypasses exhaustive search decisions and directly calculates the eigenvalue and eigenvector of the matrix. Based on this contribution, an NP-hard problem of GLRT-MSDD is transformed into a convex optimization problem.
- Performance analysis shows that the SDR-MSDD scheme can obtain the solution of rank-one with high probability; in other words, the solution of SDR-MSDD is very close to that of GLRT-MSDD, but with a lower complexity.