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Joint DOA and channel estimation with data detection based on 2D unitary ESPRIT in massive MIMO systems

Key words: Two-dimensional (2D) Direction-of-arrival (DOA) estimation; Channel impulse response estimation; Data detection; Uniform rectangular array (URA); Massive multiple-input multiple-output (MIMO)

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Introduction

- The conventional DOA estimation algorithms usually assume that the channel impulse responses are known exactly.
- To resolve the problem of joint direction-of-arrival (DOA) and channel estimation in massive MIMO systems; a novel method must be proposed.
- A low-complexity method based on ESPRIT algorithm for joint two-dimensional (2D) DOA and channel estimation with data detection for uniform rectangular arrays (URAs) in the massive MIMO systems is presented.

The system model on this work

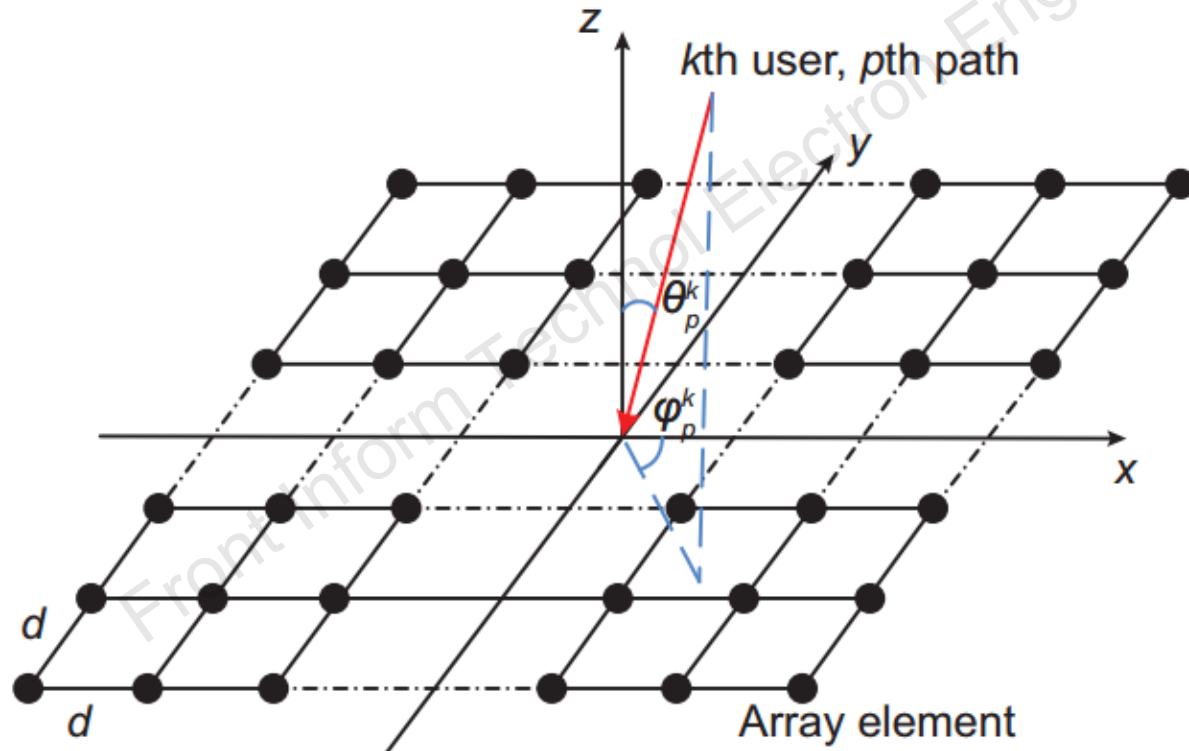


Fig. 1 System model

Measurement results (1)

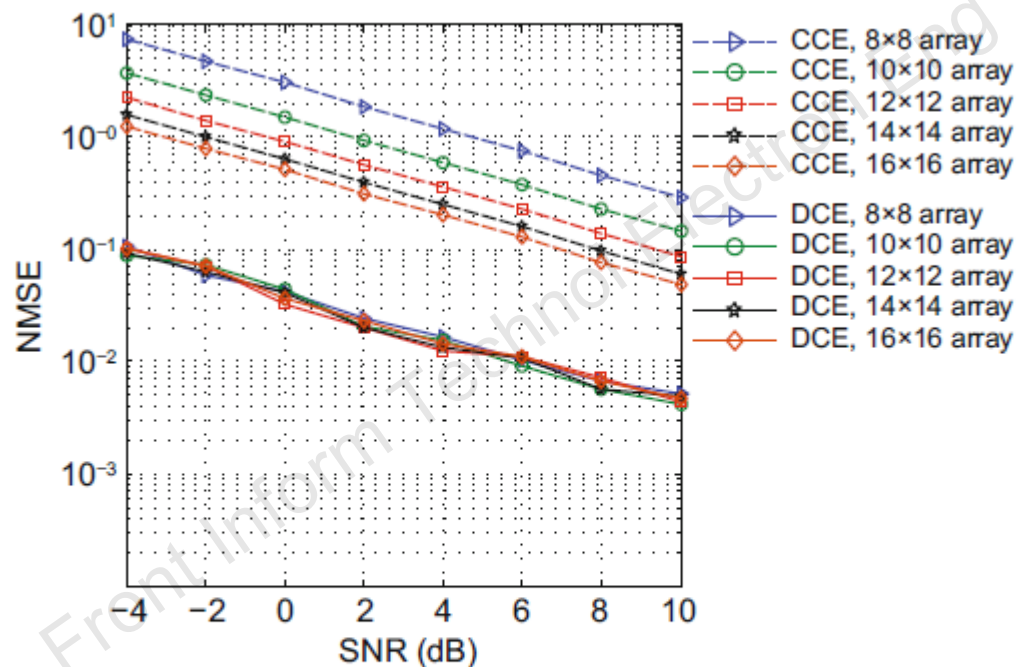


Fig. 2 Normalized mean square errors (NMSEs) of channel estimation versus SNR (CCE: combined channel estimation using Eq. (8); DCE: directional channel estimation using Eq. (29))

Measurement results (2)

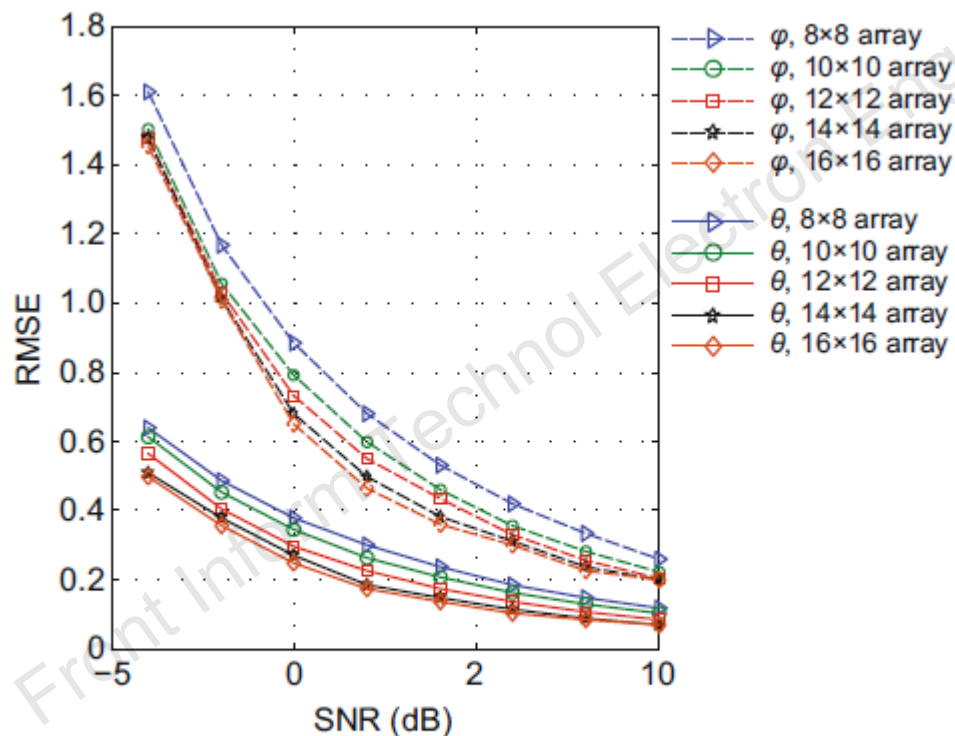


Fig. 3 The root-mean-square errors (RMSEs) of azimuth angle φ and elevation angle θ estimates versus SNR

Measurement results (3)

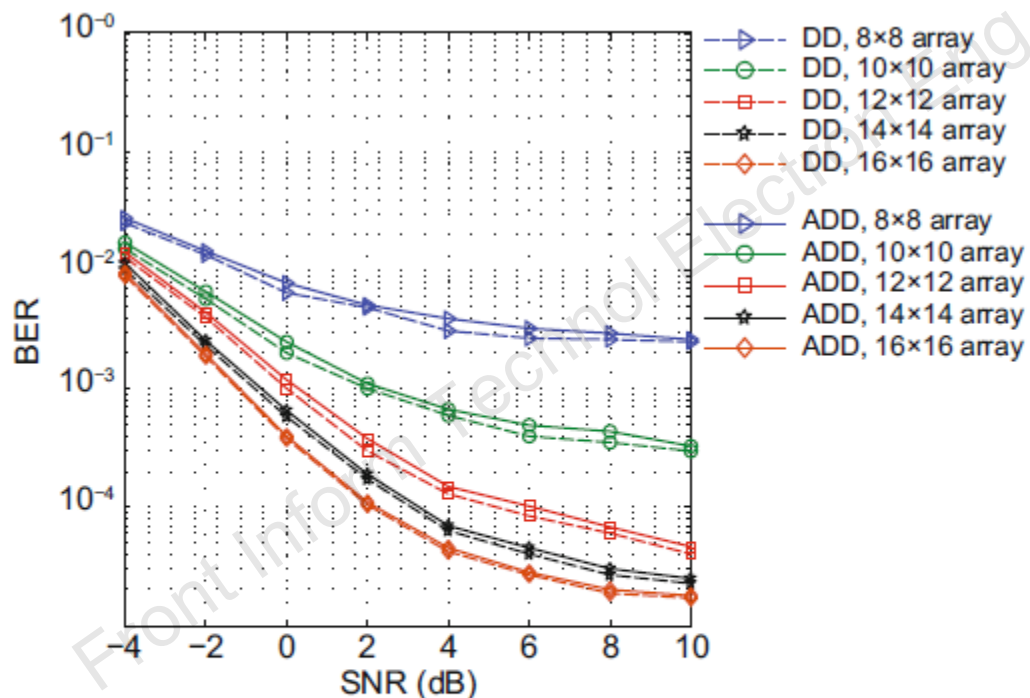


Fig. 4 Bit-error rates of data detection versus SNR (DD: data detection using Eq. (38); ADD: low-complexity approximate data detection using Eq. (44))

Measurement results (4)

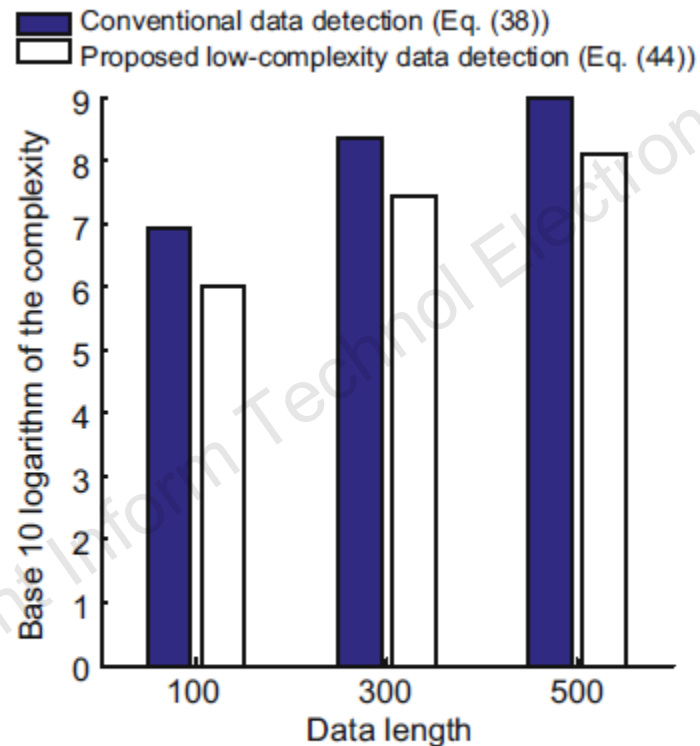


Fig. 5 Computational complexities of data detection algorithms versus the data length

Conclusions

- A novel joint DOA and channel estimation with data detection is proposed for URAs in a massive MIMO system.
- A low-complexity data detection technique is presented.
- Simulation results show that the proposed method can jointly estimate DOA and channel impulse responses and detect data effectively with a good performance