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Compressed sensing-based structured joint channel estimation in a multi-user massive MIMO system

Key words: Compressed sensing; Multi-user massive multiple input multiple output (MIMO); Frequency-division duplexing; Structured joint channel estimation; Pilot overhead reduction

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Motivation

- Massive multiple input multiple-output (MIMO) has been recognized as a key technique for the next generation wireless systems due to the huge capacity and spectrum efficiency.
- One challenge of channel state information acquisition is that downlink pilots sent from the base station consume many radio resources due to the large number of antennas.
- Channel estimation for frequency-division duplexing (FDD) massive MIMO systems can be difficult due to both the large dimensional channel matrices and multiple users when the pilot resources are limited.

Main idea

- The channel sparisty in the angular domain is analyzed, where the statistical channel information is exploited.
- The users that are geographically neighboring share common sparsity and individual sparsity structures.
- The user equipped with multiple antennas can improve the channel estimation quality.
- Structured compressed sensing (CS) that exploits the statistical channel information is employed for the channel estimation of FDD massive MIMO system.

Method

1. The channel sparsity in angular domain is analyzed, where common sparsity and individual sparsity structures among geographically neighboring users exist.
2. By equipping each user with multiple antennas, the pilot overhead can be alleviated in the framework of CS and the channel estimation quality can be improved.
3. A structured joint matching pursuit algorithm at the BS is proposed to jointly estimate the channel of users with reduced pilot overhead.

Major results

- As the number of user antenna doubled, the MSE performance gain is 2.5 dB in terms of SNR.

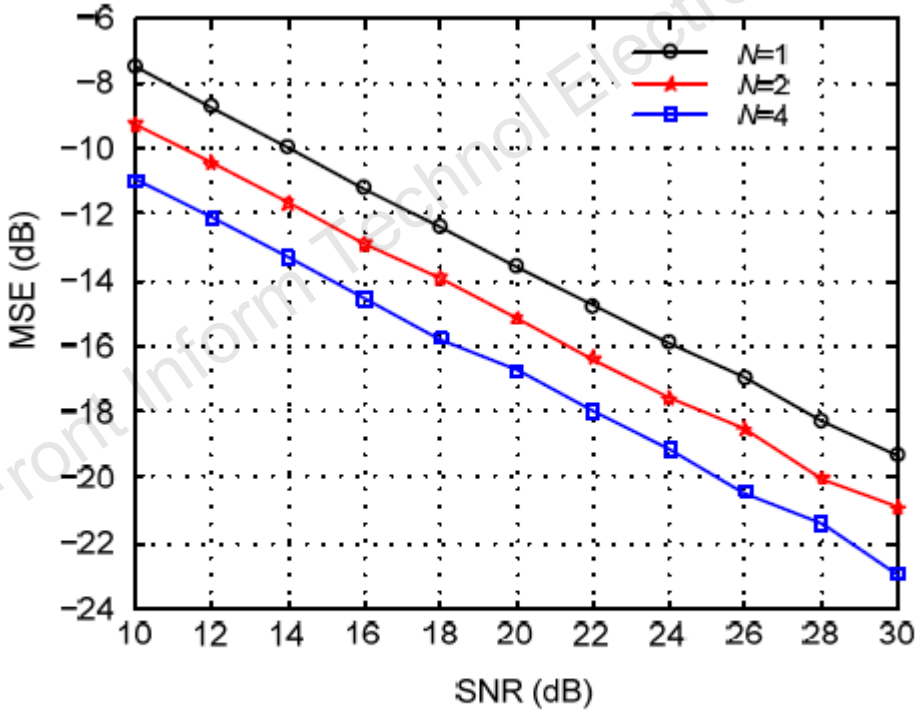

Fig. 3 MSE performance with different numbers of user antennas

Major results

- Our proposed SJMP algorithm achieves better MSE performance than counterpart algorithms and reduces the pilot overhead.

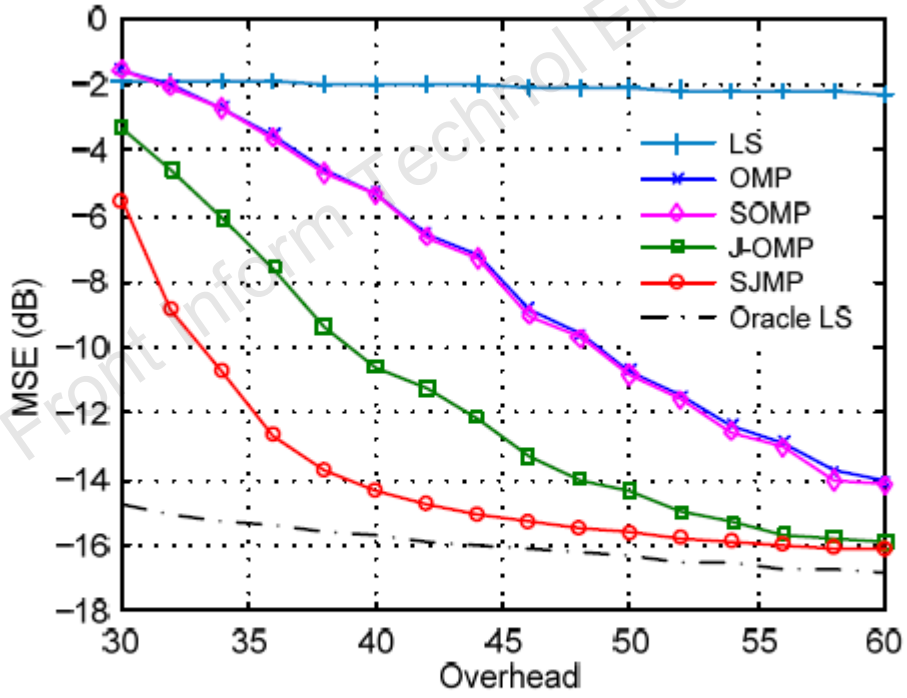

Fig. 4 MSE performance of channel estimation at different overhead T

Conclusions

- The angular domain channel is firstly analyzed in FDD massive MIMO system and there exist the common sparsity and private sparsity structure in channel matrix due to the practical scattering environment.
- Moreover, instead of instantaneous sparsity, the proposed algorithm only requires the statistical sparsity information and need no empirical parameters at the BS side.
- The proposed SJMP algorithm jointly performs channel estimation for all the users, so that pilot overhead in FDD massive MIMO is reduced further and channel estimation performance is boosted.