Elektrotechnik

Bo Zhao

# Limited Feedback of Channel State Information in Wireless Communication Systems

SHAKER
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# Limited Feedback of Channel State Information in Wireless Communication Systems

Von der Fakultät für Ingenieurwissenschaften
Abteilung Elektrotechnik und Informationstechnik
der Universität Duisburg-Essen

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Berichte aus der Elektrotechnik

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# Abstract

The accuracy of channel state information (CSI) available at the base station (BS) plays a very important role at increasing the overall downlink throughput of the communication systems. To facilitate this, the uplink channel must be consumed to feedback the CSI from the users, in case the channel reciprocity cannot be used. Since the uplink channel data rate is relative low, this CSI feedback should be limited. Moreover, the system throughput can be dramatically increased by BS cooperation, where the limited feedback problem becomes more complex.

This dissertation first proposes for the classic orthogonal frequency division multiplexing (OFDM) system a resource block (RB)-based feedback structure, which utilizes the frequency correlation and temporal correlation of the channel simultaneously. In each RB different feedback reduction algorithms could be implemented for different applications. This RB-based approach could achieve a better bit error rate (BER) performance by spending a few more bits for quantizing the CSI. By exploiting the temporal correlation, the feedback overhead could be reduced by a factor equal to the number of OFDM symbols, which are under similar channel condition.

In a coordinated multi-point (CoMP) coordinated beamforming (CB) system, users need to feedback the serving and interfering channels to enable BS cooperation. This dissertation introduces a bit partitioning algorithm for a two-cell system, which adaptively allocates the bits for quantizing the channel direction information (CDI) of both channels. The proposed algorithm outperforms the equal bit partitioning with the same amount of feedback overhead, especially in the high signal-to-noise ratio (SNR) regime. Also cooperative beamforming strategies are investigated, which profits from both the zero forcing (ZF) and the maximum ratio transmission (MRT) schemes. The adaptive bit allocation algorithm is then extended to a three-cell system as well as a multicell system. And the cooperative beamforming approach is generalized to a low complexity BS-specific approach for the multicell system. Simulation shows that the proposed cooperative approach increases the average user data rate, particularly for the cell-edge users.

In the CoMP joint transmission (JT) system, focus is laid on the dynamic formation of clusters to limit the amount of feedback overhead and backhaul load. By introducing the set partition problem under the assumption of non-overlapping clusters, a modified implicit enumeration algorithm is proposed, based on which the dynamic clustering method is exposed. Simulation reveals the advantage of the proposed method in comparison to the fixed clustering in terms of data rate, fairness and BS power consumption.

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Bo Zhao
Erlangen, July 2021

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