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Non-ideal space division multiple access and its application

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Motivations

As Shannon limit and noise limit have been closely approached, space division multiplex access (SDMA) becomes the most effective way to further multiply the spectral efficiency.

The real situation in wireless communication is always non-ideal, measurement is affected by quantization and the distortion of the clock. In some cases, the channel cannot even be directly measured.

Beside, channel conditions are not ideal, which introduce inter-layer interference, which will significantly impact the performance for low signal to interference/noise ratio (SINR) cases.

Then how to optimize the wireless SDMA performance in non-ideal situation is important.

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Main ideas

1. Study SDMA under a non-ideal engineering situation. When the SDMA channel is of high inter-layer correlation and the condition number is large, the multiple user multiple input and multiple output user equipment grouping should be optimized, and in some cases some further dimension-reductions should be applied as well.

2. As the channel measuring is always non-ideal, we studied two methods: feedback mode and non-feedback mode in terms of performance and overhead. It is proposed that the non-feed-back mode is preferable even for some non-reciprocal channels.

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Methods

1. In SDMA, the transmitters need to be pre-coded correctly according to the channel situation. However, channels continue to change, therefore, it is necessary to measure the instantaneous values of channels from time to time.

2. There are two methods: non-feedback mode method and feedback mode method. The following example describes only the downlink channels (from the eNodeB to a terminal), while the uplink channels are similar. The two methods are descript in detail in the paper.

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Major results

1. When the number of antenna is very large, the non-feedback mode is always prefer, because the feedback mode will result in very large overhead in both downlink and uplink. And some information will be loss during the feedback. In addition, the feedback takes time, and will makes the measured chennal mismatch with the real one.

2. When the grouped user is in a non-ideal channel situation, the condition number (CN) will play important part in the performance, when the CN is high, the high-order rank performance is even worse than low-order rank.

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Conclusions

1. The paper come to a conclusion that the non-feed back mode is always prefered due to the more accurate and less overhead. Even when the channel situation cannot be directly measured, there still exist some method to estimate the channel in rough.

2. Another conlusion is that the performance is not only determined by the number of layer, but also the CN. Whe the channel situation is not that good and the CN is high, in some case it is necessary to reduce the number of layer (rank) artificially, in this way the performance would be better.

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