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Performance analysis and power allocation of mixed-ADC multi-cell millimeter-wave massive MIMO systems with antenna selection

Key words: Millimeter-wave; Massive multiple-input multiple-output (MIMO); Mixed-ADC; Performance analysis; Antenna selection

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Motivation

1. Millimeter wave and massive multiple-input multiple-output (MIMO) are two key technologies to meet the high data rate requirements of fifth generation mobile communication (5G).

2. Millimeter wave has the defect of high path loss, and massive MIMO has the defect of high power consumption and cost.

Main idea

1. The exact and approximate closed-form expressions of the uplink achievable rate for a mixed-ADC multi-cell mmWave massive MIMO system with antenna selection are derived.

2. A power allocation scheme to improve the sum achievable rate is proposed.

3. Energy efficiency (EE) of the system and gain insights into the changes of energy efficiency from quantization precision and the ratio of high-resolution ADCs are studied.

Method

1. A mixed-precision ADC structure equipped with an antenna selection module is proposed, which is suitable for a millimeter massive MIMO system.

2. For the proposed structure, the spectrum efficiency and energy efficiency of the system are calculated, and a performance optimization algorithm is proposed.

Major results

1. System model

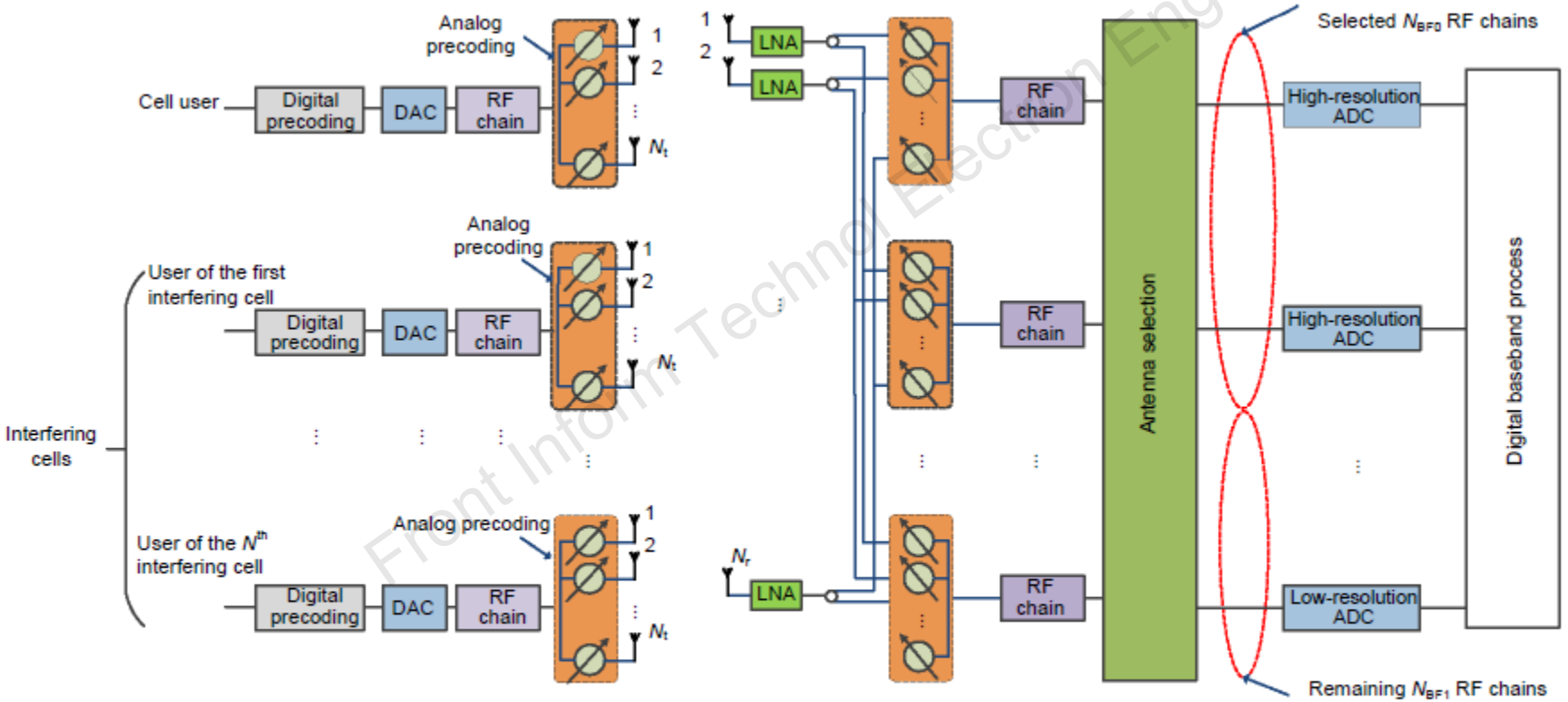

Fig. 1 Hybrid beamforming architecture of the mixed-ADC multi-cell mmWave massive MIMO system with antenna selection

ADC: analog-to-digital converters; mmWave: millimeter-wave; MIMO: multiple-input multiple-output; RF: radio frequency; LNA: low noise amplifier

Major results

2. The antenna selection algorithm improves the system performance significantly.

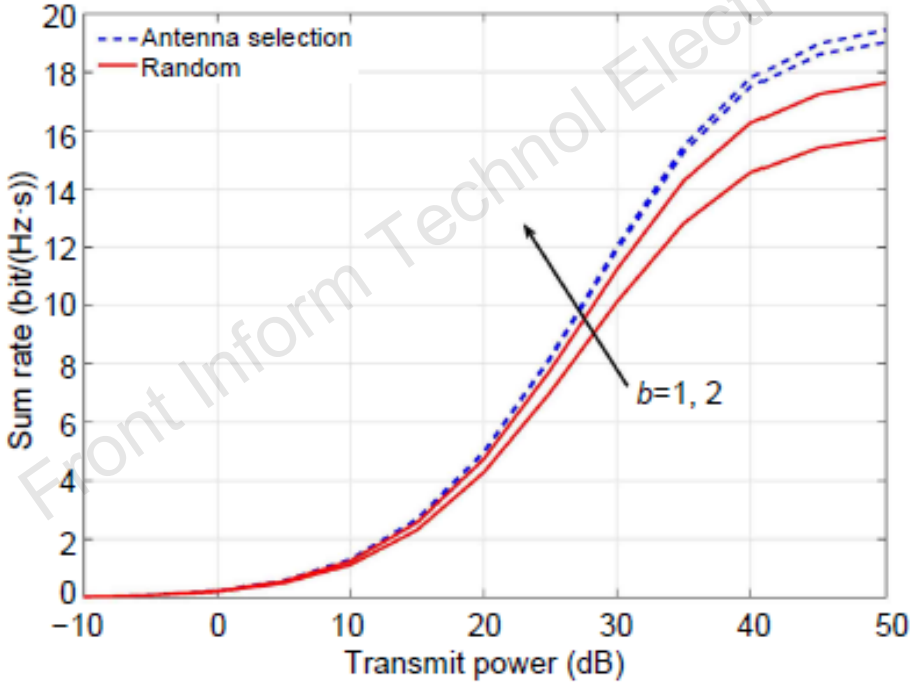

Fig. 3 Uplink sum rate of antenna selection and random connection against the transmit power ρ for N_r=256, γ=0.5, and b=1, 2

Major results

3. Energy efficiency of the system

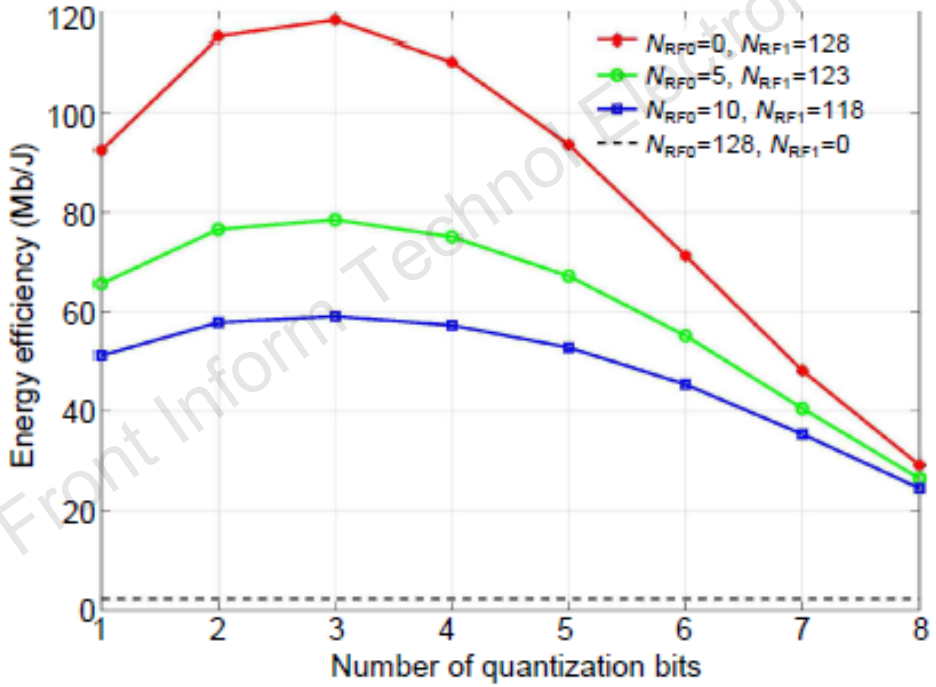

Fig. 8 Energy efficiency of multi-cell mixed-ADC mmWave massive MIMO systems over different numbers of ADC quantization bits with N_r=256 and N_{RF0}=0, 5, 10, 128

Conclusions

1. Antenna selection algorithm is an effective method for improving the performance of the mixed-ADC system.

2. An efficient power allocation scheme which can significantly increase the sum achievable rate is proposed.

3. The system will achieve the highest EE and the best tradeoff between the achievable rate and power consumption when BS configures 3- and 4-bit ADCs, respectively.